Tutor support

Edexcel Diplomas

To support the Edexcel Level 1, Level 2 and Level 3 Principal Learning in Engineering to be taught from September 2008

August 2008

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Contents

Introduction

This publication supports delivery of the Edexcel Level 1, Level 2 and Level 3 Principal Learning in Engineering. It must be read in conjunction with relevant sections of the published guidance and units (Publications code DP019723).

All Edexcel Level 1, Level 2 and Level 3 Principal Learning units contain sections relating to guidance for delivering and assessing each unit.

Each unit identifies the guided learning hours (GLH) required for delivery and assessment. Centres should allocate this amount of time within the timetable for its delivery and assessment. Edexcel has identified within each internally assessed unit the GLH that will probably be required to meet the assessment requirements of the unit. This may, for example, include time spent in experiential learning, practising skills, research activities and undertaking summative assessment activities. (See sections relating to *Internal assessment* and *Programme design and delivery* in the generic introductory part of the *Guidance and units* document.)

The tutor support materials in this publication are designed to supplement the guidance given in the units. For each unit there will be an exemplar assignment that covers the whole unit and relevant centre guidance for the adaptation of exemplar assignments.

These tutor support materials are not prescriptive, however Edexcel recommends that centres use these, either in their current form or adapted within the scope of the guidelines given.

Tutors may feel that the unit can be delivered and assessed more effectively in a different way. This may be because of the way the qualification is organised within their centre or after taking into consideration their learners and their learning styles and prior learning.

For centres wishing to devise their own assignments for internally assessed units *Annexe A: Internal Assessment of Principal Learning Units: Controls for Task Setting and Task Taking* contains the procedures centres must follow to ensure that these are developed and managed correctly.

Structure and aims of Principal Learning in Engineering

The Edexcel Diplomas in Engineering: Principal Learning

The Edexcel Diplomas in Engineering aim to:

- Develop a broad understanding and knowledge about engineering and related sectors.
- Develop the knowledge, skills and attributes required to work in the engineering sector.
- Encourage learners to learn through experience of applying knowledge and skills to tasks or contexts including those that have many of the characteristics of real work.
- Support equality and diversity by considering the needs of all potential learners, to minimise any later need to make reasonable adjustments for learners who have particular requirements.
- Encourage learners to develop and apply functional skills in mathematics, English and ICT at the appropriate level (Level 1 in Level 1 Diplomas, Level 2 in Level 2 Diplomas and Level 2 in Level 3 Diplomas).
- Encourage learners to develop and apply transferable personal, learning and thinking skills (in independent enquiry, creative thinking, reflective learning, team working, self-managing and effective participation).
- Encourage learners to draw out and articulate lessons learnt (both generalised and specific).
- Encourage learners to plan, review and reflect on their experience.
- Develop learners’ understanding of spiritual, moral, ethical, social, legislative, economic and cultural issues, where appropriate to the engineering sector.
- Develop understanding of sustainable development, health and safety considerations and European developments, consistent with international agreements.

The structure of the Principal Learning in Engineering

Edexcel Level 1 Principal Learning in Engineering

All units are compulsory.

Unit number	Title	GLH	Assessment
1	Introducing the Engineering World	30	External
2	Practical Engineering and Communication Skills	60	Internal
3	Introduction to Computer Aided Engineering	30	Internal
4	Developing Routine Maintenance Skills	30	Internal
5	Introduction to Engineering Materials	30	Internal
6	Electronic Circuit Construction and Testing	30	Internal
7	Engineering the Future	30	Internal

Edexcel Level 2 Principal Learning in Engineering

All units are compulsory.

Unit number	Title	GLH	Assessment
1	Exploring the Engineering World	60	Internal
2	Investigating Engineering Design	60	Internal
3	Engineering Applications of Computers	60	Internal
4	Producing Engineering Solutions	60	Internal
5	Electrical and Electronic Circuits and Systems	30	Internal
6	Application of Manufacturing Techniques in Engineering	60	Internal
7	Applications of Maintenance Techniques in Engineering	30	Internal
8	Exploring Engineering Innovation, Enterprise and Technological Advancements	60	External

Edexcel Level 3 Principal Learning in Engineering

All units are compulsory.

Unit number	Title	GLH	Assessment
1	Investigating Engineering Business and the Environment	60	External
2	Applications of Computer Aided Designing	60	Internal
3	Selection and Application of Engineering Materials	60	Internal
4	Instrumentation and Control Engineering	60	Internal
5	Maintaining Engineering Plant, Equipment and Systems	30	Internal
6	Investigating Modern Manufacturing Techniques Used in Engineering	60	Internal
7	Innovative Design and Enterprise	60	Internal
8	Mathematical Techniques and Applications for Engineers	60	External
9	Principles and Application of Engineering Science	90	Internal

Further information

For further information please call Customer Services on 0844 576 0028 (calls may be recorded for training purposes) or visit our website at www.edexcel.com.

Useful publications

Related information and publications:

- *Accreditation of Prior Learning* available on our website: www.edexcel.com
- *Guidance for Centres Offering Edexcel/BTEC NQF Accredited Programmes* (Edexcel, distributed to centres annually)
- *Operating Rules for Component and Diploma Awarding Bodies* (QCA, 2007)
- *The Diploma Structure and Standards, Version 2* (QCA, 2007)
- *The Statutory Regulation of External Qualifications in England, Wales and Northern Ireland* (QCA, 2004)
- *What is a Diploma?* (DfES and QCA, 2007)
- the ASL catalogue on the National Database of Accredited Qualifications (NDAQ) website: www.ndaq.org.uk
- the current Edexcel publications catalogue and update catalogue
- the latest news on the Diploma from QCA available on their website: www.qca.org.uk/diploma
- the latest news on Edexcel Diplomas available on our website: http://developments.edexcel.com/diplomas/

Professional development and training

Edexcel supports UK and international customers with training related to our qualifications. This support is available through a choice of training options offered in our published training directory or through customised training at your centre.

The support we offer focuses on a range of issues including:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing student-centred learning and teaching approaches
- building key skills into your programme
- building in effective and efficient quality assurance systems.

The national programme of training we offer can be viewed on our website (www.edexcel.com/training). You can request customised training through the website or by contacting one of our advisers in the Training from Edexcel team via Customer Services to discuss your training needs.

Our customer service numbers are:

The Diploma	0844 576 0028
BTEC and NVQ	0844 576 0026
GCSE	0844 576 0027
GCE	0844 576 0025
DIDA and other qualifications	0844 576 0031

Calls may be recorded for training purposes.

The training we provide:

- is active – ideas are developed and applied
- is designed to be supportive and thought provoking
- builds on best practice.

Level 1

Unit 1 Introducing the Engineering World

The following represents a typical externally-set assessment that will give learners an opportunity to generate evidence for all of learning outcomes for Unit 1 of the Engineering Diploma at Level 1.

The assessment consists of 30 multiple choice questions and candidates will be given 1 hour to complete the paper.

SECTION 1 — 30 MINUTES

Answer ALL **questions in the spaces provided.**

1. Apprenticeship schemes are funded by:

(i)	trade unions	[x]
(ii)	the government	[x]
(iii)	accountants	[x]
(iv)	engineering council	[x]

(1 mark)

2. A method of energy conservation used in engineering is:

(i)	re-cycling	[x]
(ii)	transporting goods by road	[x]
(iii)	increased productivity	[x]
(iv)	using fossil fuels	[x]

(1 mark)

3. An engineering company that needs a workforce to have both practical skills and knowledge requires.

(i)	skilled workers	[x]
(ii)	semi-skilled workers	[x]
(iii)	un-skilled workers	[x]
(iv)	operatives	[x]

(1 mark)

4. An advantage of effective teamwork is:

(i)	ensuring everyone gets to do their preferred job	[x]
(ii)	achieving more than individuals working alone	[x]
(iii)	having fun	[x]
(iv)	making sure everyone works hard all the time	[x]

(1 mark)

5. An operative role would usually involve:

(i)	routine tasks	[x]
(ii)	managing budgets	[x]
(iii)	designing products	[x]
(iv)	leading a team	[x]

(1 marks)

6. The purpose of the Kyoto Agreement is to:

(i)	prevent industrial accidents	[x]
(ii)	dispose of industrial waste properly	[x]
(iii)	reduce car usage	[x]
(iv)	reduce emission of greenhouse gases	[x]

(1 mark)

7. A renewable energy source is:

(i)	natural gas	[x]
(ii)	hydroelectric	[x]
(iii)	petroleum (oil)	[x]
(iv)	nuclear fuel	[x]

(1 mark)

8. One of the best ways of disposing of radioactive waste is currently considered to be:

(i)	sinking it in the ocean	[x]
(ii)	firing it into space	[x]
(iii)	burying it deep under ground	[x]
(iv)	burning it	[x]

(1 mark)

9. A floating barrier that can be put around an oil spill to contain it is called a:

(i)	boom	[x]
(ii)	dam	[x]
(iii)	hull	[x]
(iv)	footing	[x]

(1 mark)

10. Rechargeable batteries are an example of an engineered product that is:

(i)	modern	[x]
(ii)	reusable	[x]
(iii)	obsolete	[x]
(iv)	recyclable	[x]

(1 mark)

11. Engineered products are bought and sold all over the world. This is called:

(i)	industrialisation	[x]
(ii)	global warming	[x]
(iii)	a business trend	[x]
(iv)	the global marketplace	[x]

(1 mark)

12. The companies that supply water, gas and electricity to our homes are called the:

(i)	national grid	[x]
(ii)	network	[x]
(iii)	utility companies	[x]
(iv)	essential companies	[x]

(1 mark)

13. The pharmaceutical industry develops medicines and medical products. The sector they belong to is the:

(i)	control sector	[x]
(ii)	electronic sector	[x]
(iii)	engineering sector	[x]
(iv)	chemical sector	[x]

(1 mark)

14. To ensure engineering products are effective in use and perform as expected, all sectors must carry out:

(i)	marketing	[x]
(ii)	testing	[x]
(iii)	manufacturing	[x]
(iv)	training	[x]

(1 mark)

15. Plumbing and electrical work in buildings is controlled by the:

(i)	building services sector	[x]
(ii)	construction sector	[x]
(iii)	engineering sector	[x]
(iv)	communications sector	[x]

(1 mark)

16. One example of current environmental legislation is the:

(i)	Control of Substances Hazardous to Health regulations	[x]
(ii)	Greenhouse Effect Act	[x]
(iii)	Provision and Use of Work Equipment Regulations	[x]
(iv)	Clean Air Act	[x]

(1 mark)

17. A reduction in energy use can be achieved by organisations through:

(i)	quality control procedures	[x]
(ii)	a risk assessment	[x]
(iii)	reactive maintenance	[x]
(iv)	lean manufacturing systems	[x]

(1 mark)

18. The automotive sector is mainly concerned with:

(i)	the manufacture of robotic systems	[x]
(ii)	support services	[x]
(iii)	the manufacture of cars	[x]
(iv)	passenger transport	[x]

(1 mark)

19. Train and bus manufacture are the responsibility of the:

(i)	passenger transport sector	[x]
(ii)	road and rail sector	[x]
(iii)	department of the roads	[x]
(iv)	department of the rails	[x]

(1 mark)

20. The sector that includes shipping is the:

(i)	transport sector	[x]
(ii)	marine sector	[x]
(iii)	automotive sector	[x]
(iv)	ocean sector	[x]

(1 mark)

21. The fact that people live longer today is mainly due to:

(i)	more foreign holidays	[x]
(ii)	developments in housing	[x]
(iii)	better cars	[x]
(iv)	developments in healthcare	[x]

(1 mark)

22. The term 'people are more mobile' is often used to describe:

(i)	improved transport	[x]
(ii)	improved movement	[x]
(iii)	improved health	[x]
(iv)	improved housing	[x]

(1 mark)

23. The acronym GPS stands for:

(i)	ground positioning satellite	[x]
(ii)	general polarity system	[x]
(iii)	global positioning system	[x]
(iv)	general programmable satellite	[x]

(1 mark)

24. The internet connection system that provides the fastest connection and downloads is:

(i)	ADSL	[x]
(ii)	Broadband	[x]
(iii)	ISDN	[x]
(iv)	Dial-up	[x]

(1 mark)

25. The software most commonly used to produce presentations is:

(i)	PowerPoint	[x]
(ii)	Word	[x]
(iii)	Excel	[x]
(iv)	Dreamweaver	[x]

(1 marks)

26. A plastic material that can be recycled many times must be:

(i)	soft	[x]
(ii)	thermoset	[x]
(iii)	light	[x]
(iv)	thermoplastic	[x]

(1 mark)

27. Recent developments in internet banking have allowed people to:

(i)	feel safe about banking	[x]
(ii)	save more money	[x]
(iii)	access their accounts from home	[x]
(iv)	borrow more money	[x]

(1 mark)

28. Wooden products should be made from wood that has come from forests that are:

(i)	sustainable	[x]
(ii)	tropical	[x]
(iii)	endangered	[x]
(iv)	large	[x]

(1 mark)

29. The fact that people now live longer has a direct effect on:

(i)	the effectiveness of public transport	[x]
(ii)	what houses are made from	[x]
(iii)	exhaust fumes	[x]
(iv)	the cost of pensions	[x]

(1 mark)

30. Recent developments in mobile phone technology have meant that:

(i)	phones are now waterproof	[x]
(ii)	phones are harder to get	[x]
(iii)	phones are now multi-functional	[x]
(iv)	phones are now bigger	[x]

(1 mark)

TOTAL FOR PAPER 30 MARKS

END

EXAM ANSWER SHEET

Unit 1: Introducing the Engineering World

QUESTION NUMBER	KEY (ANSWER)
1	(ii)
2	(i)
3	(i)
4	(ii)
5	(i)
6	(iv)
7	(ii)
8	(iii)
9	(i)
10	(ii)
11	(iv)
12	(iii)
13	(iv)
14	(ii)
15	(i)
16	(iv)
17	(iv)
18	(iii)
19	(i)
20	(ii)
21	(iv)
22	(i)
23	(iii)
24	(ii)
25	(i)
26	(iv)
27	(iii)
28	(i)
29	(iv)
30	(iii)

Unit 2 Practical Engineering and Communication Skills

Tutor brief

Subject: Engineering		Level: 1
Unit 2: Practical Engineering and Communication Skills		Assessment time: 20 hours
LO. 1	Understand own responsibilities and those of their colleagues under health and safety legislation	
LO. 2	Know about the cutting, forming and joining processes used when producing engineered products	
LO. 3	Be able to disassemble and assemble engineered products	
LO. 4	Be able to produce sketches of an engineered product or assembly	
LO. 5	Be able to plan and produce and engineering product	
PLTS	Independent enquiries (IE4), creative thinkers, reflective learners (RL3, 5) team workers, self-managers (SM2, 3), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner’s work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate’s number/candidate’s name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc. which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1.1	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 1.2	• Annotated photographic evidence.	Classroom	Supervised
Task 2.1	• Drawings or sketches, no larger than A3, printed only. • Annotated photographic evidence.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 4	• Annotated sketches no larger than A3.	Classroom	Supervised

Candidate brief

This is assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

Investigating safe working practices in an engineering workshop environment, putting them into practice when using tools, equipment and drawings, planning and producing an engineering product.

The following is a sample assessment activity. In this case the suggestion covers the whole of learning outcomes 1 to 5 but this need not always be the case. In this unit, four tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 2: Practical Engineering and Communication Skills.

Task 1 — Safely use hand tools to disassemble and assemble engineered products

Assessment focus 1

Understand own responsibilities and those of their colleagues under health and safety legislation

Mark B

Band 1	Band 2	Band 3
Identifies the requirements of working safely with colleagues in a familiar context, complying with responsibilities stated in relevant health and safety legislation. (0–4)	Identifies the requirements of working safely with colleagues in a familiar context, explaining why key aspects of relevant health and safety legislation are necessary. (5–7)	Identifies and applies the requirements of working safely with colleagues in a familiar and unfamiliar context, explaining why key aspects of relevant health and safety legislation are necessary. (8–10)

Assessment focus 3

Be able to disassemble and assemble engineered products.

Mark B

Band 1	Band 2	Band 3
Uses documentation and equipment provided to dismantle a product, clean and lay out component parts. Reassembles with replacement parts provided and compiles a report. (0–5)	Uses documentation provided to select appropriate equipment to dismantle a product, clean and lay out component parts. Identifies some parts needing replacement and reassembles; provides a report including parts for replacement. (6–9)	Uses documentation provided to select equipment to dismantle a product, clean and lay out component parts. Identifies parts needing replacement and reassembles. Compiles a report including parts for replacement and reasons for replacing them. (10–13)

The following activities are about working safely in a workshop environment so that you do not endanger yourself or others. All workshop processes carried out by engineers have some form of risk attached to them and it is impossible to totally eliminate it. Health and safety legislation is there to control the way that people work and behave in workshops.

Task 1.1	
Focus 1	a) Before starting work on a manufacturing project in your school/college workshop it is important that you understand how to work safely so that you do not endanger yourself or anyone else who happens to be there. Put together a checklist which identifies the reasons why you should know about the following: • The Health and Safety at Work Act • Personal Protective Equipment • Control of Substances Hazardous to Health • Risk Assessment • Safety signs and signals • Provision and Use of Work Equipment Regulations b) You and a colleague are working on a task that involves turning down and screw cutting a piece of aluminium bar using a centre lathe. • Before starting work identify the risks involved and write a short risk assessment. • Produce a written explanation of the reasons why health and safety legislation is necessary to control the way that you will be working and behaving when using the lathe. c) Before being allowed on site to carry out work experience the safety manager of the company asks you to investigate certain aspects of health and safety legislation. They want you to focus on the following: • how the safety of workers is managed if a fire breaks out in an injection moulding machine • how the safety of workers is managed in the workshop where sheet steel is guillotined and bent • the use of colour coded wall signs which workers and visitors must take notice of • how the electro plating shop manager keeps up to date with health and safety information relating to the operation of their department. Put together a short report which you will present to the safety manager. When investigating the first 3 bullet points you must identify specific legislation which applies to each and explain why it is necessary.

<table>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 3</td><td>For this next activity your tutor will give you a product to dismantle and then re-assemble.

Gather together the following items which you will use when you carry out the task:
• a service manual/guide and drawing/s relating to the product
• hand tools and equipment
• cleaning fluids and release agents.
d) Dismantle the product, clean the various parts and lay them out for inspection.
e) Identify parts which are worn and need to be replaced.
f) Re-assemble, fitting replacement parts given to you by your teacher/tutor or ones which you have sourced yourself.
g) Put together a checklist of the parts identified as being worn/faulty and state the reasons why they were replaced.
h) Write a report describing how you tackled the tasks.</td></tr>
</table>

Task 2 — Planning and producing an engineered product

Assessment focus 5

Be able to plan and produce an engineered product.

Mark A

Band 1	Band 2	Band 3
Compiles a plan of operation to produce an engineered product; manufactures the product and reviews the success of the plan. (0–5)	Compiles a plan of operation to produce an engineered product; manufactures the product and reviews the success of the plan, suggesting improvements. (6–9)	Compiles a plan of operation to produce an engineered product; manufactures the product and reviews the success of the plan, explaining how changes to the plan would lead to improvements in planning or manufacture. (10–12)

For this task you are going to plan and carry out the manufacture of an engineering component using machine and hand tools. Planning and reviewing are very important aspects of manufacturing engineering because if you get them right you will not waste time making mistakes which can be costly and annoying.

Task 2.1	
Focus 5	Your tutor will give you a drawing of a simple engineered component which you are going to manufacture. You should plan what you are going to do so that best use is made of tools, materials and available workshop time. a) Put together a plan which includes information about: • the manufacturing operations that you will be carrying out • the materials that you will be using • the tools that you will be using. b) Manufacture the product. c) Now think about how well your plan worked and produce a short report in which you answer these questions: • Does the finished product look like the drawings? • Did I correctly estimate how long it would take to complete the manufacturing? • Were the materials I chose correct? • Did I select the correct tools? • Was my plan successful? • Could I have improved the way that I worked? d) Explain how changes to the plan could lead to improvements in planning or carrying out the manufacture of the product if you decided to make another component.

Task 3 — Cutting, forming and joining processes

Assessment focus 2

Know about the cutting, forming and joining processes used when producing engineered products.

Mark A

Band 1	Band 2	Band 3
Identifies two cutting and two forming processes used in industry, and a joining process. (0–5)	Describes two cutting and two forming processes used in industry, and a joining process. (6–9)	Compares two cutting and two forming processes and describes a joining process, relating each to specified industrial applications. (10–13)

There are many ways to cut, form and join materials, for example laser cutting, bending, welding, and fixing with a screw. To choose the correct process for a particular application an engineer needs to know the type of material they are working with and what equipment will be available for carrying out the process.

<table>
<tr><th colspan="4">Task 3.1</th></tr>
<tr><td rowspan="5">Focus 2</td><td colspan="3">Apply knowledge gained when you were on work experience or carrying out practical activities in the school/college workshop:
a) Identify two cutting, two forming and one joining process. Then complete the table below:</td></tr>
<tr><td>Cutting</td><td></td><td></td></tr>
<tr><td>Forming</td><td></td><td></td></tr>
<tr><td>Joining</td><td></td><td>–</td></tr>
<tr><td colspan="3">b) For each process write a short report which:
• describes how it is carried out
• gives a reason for using it
• describes the equipment needed to carry it out
• gives an example of where the process is used in industry
• includes an image of each process.
c) Compare the effectiveness of:
• the cutting processes identified in activity (a) when they are used for a specific industrial application
• the joining processes identified in activity (a) when they are used for a specific industrial application.</td></tr>
</table>

Task 4 — Sketching an engineered product or assembly

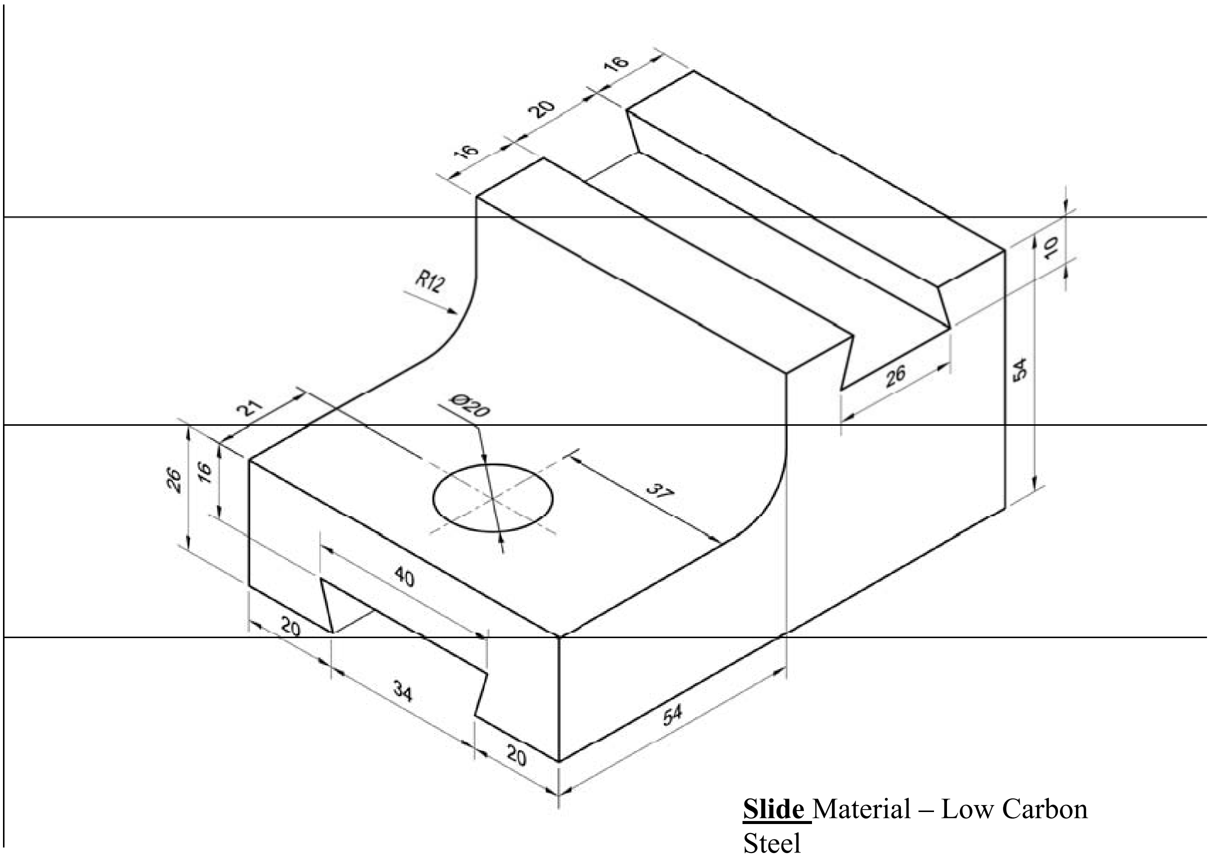
Assessment focus 4

Be able to produce sketches of an engineered product or assembly.

Mark A

Band 1	Band 2	Band 3
Produces sketches of an engineered product or assembly in both orthographic 1st and 3rd angle projection and dimensions the sketches correctly. (0–5)	Produces sketches of an engineered product or assembly in both orthographic 1st and 3rd angle projection and isometric and oblique views. Hatches sections and all sketches dimensioned correctly. (6–9)	Produces sketches of an engineered product or assembly in both orthographic 1st and 3rd angle projection and isometric and oblique views. Identifies on the sketches the correct lines to denote centre lines of views and shows detailed and common drawing conventions and layouts. Hatches sections and all sketches dimensioned correctly. (10–12)

Engineers use graphical techniques to present information to other people. Shown below is a detail drawing of a dovetail block which you are going to sketch, but any similar product or simple assembly can be used. Make sure that you are given enough information by your tutor to enable you to produce accurate, dimensioned sketches of the component (or simple assembly). The aim is to produce sketches which are of sufficient quality for someone in a workshop to be able to correctly interpret them.



Slide Material – Low Carbon Steel

Figure 1 ‘Dovetail Block’

Dimensions in mm

Note: Hole penetrates the full depth of the slide

Task 4.1	
Focus 4	a) Using orthographic first angle projection prepare sketches showing the following views of the component: • Front elevation • End elevation • Plan. Add dimensions to your sketches so that someone in the workshop can manufacture the component. b) Using orthographic third angle projection prepare sketches showing the following views of the component: • Front elevation • End elevation • Plan. Add dimensions to your sketches so that someone in the workshop can manufacture the component. c) Sketch the component using isometric and oblique projection. d) Choose either first or third angle projection and re-sketch the component, adding two cutting planes so that you can include correctly hatched section views in your drawing. e) It is important that your sketches conform to BS8888 so that when other engineers look at them there is no ambiguity and they understand fully what you have drawn. Select one of the drawings which you produced for activities (a), (b) or (d) and identify on it centre lines, hidden detail and other conventions which you have used.

Unit 3 Introduction to Computer Aided Engineering

Tutor brief

Subject: Engineering		**Level: 1**
Unit 3: Introduction to Computer Aided Engineering		**Assessment time: 10 hours**
LO. 1	Be able to use a CAD system to produce a working drawing of a 2D component and an electrical circuit	
LO. 2	Be able to use a CAM system to convert the drawing data into a computer numerically controlled(CNC) operating program	
LO. 3	Be able to set and safely operate a CNC machine tool to produce an accurately machined component and check their production	
PLTS	Independent enquiries (IE4), creative thinkers, reflective learners (RL3), team workers, self-managers (SM2), effective participators (EP3)	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc. which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1	• Printed 2D CAD drawings with dimensions and annotations where necessary, printed no larger than A3. Electronic versions not required.	Classroom	Supervised
Task 2.1	• CAD drawing no larger than A3. Report/checklist of CNC programme. A4 word processed report. Annotated drawings/photographs where suitable.	Classroom	Supervised
Task 2.2	• Annotated photographs of final product	Classroom/ specialist	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following is a sample assessment activity. In this case the suggestion covers all three learning outcomes, although this need not always be the case. In this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

The assessment takes up 50% of the time allocation for the unit and can be carried out over an extended period. The three linked tasks take the learner though the complete computer aided engineering process, ie from designing a product to manufacturing it on a CNC machine tool.

Learners will be cutting material – the tasks relate to a product manufactured from thin sheet steel but any other suitable material can be used, eg aluminium, polymer.

Learners will need access to a suitable CAD/CAM software package and also a machine tool – ideally a small vertical mill or a router.

Cutter path geometry is in two dimensions (2D) when edge profiling the component. The small array of holes will require cutter movement in a third axis (z) when they are being drilled.

If felt appropriate, a sketch of the component to be manufactured can be given to learners prior to starting task 1.

Learner evidence must include witness statements/observation records which are supported by annotated photographs showing learners using CAM software and operating a CNC machine.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 3: Introduction to Computer Aided Engineering.

Task 1 — Using a CAD system to produce engineering drawings

Assessment focus 1

Be able to use a CAD system to produce a working drawing of a 2D component and an electrical circuit

Band 1	Band 2	Band 3
Produces a dimensioned drawing of a simple engineered component in line with BS 8888 and a simple circuit diagram in line with BS 3939. (0–8)	Using separate layers produces a fully dimensioned drawing of a simple engineered component in line with BS 8888 and a simple circuit diagram in line with BS 3939 complete with annotation. (9–14)	Prepare a simple template and using separate layers produces a fully dimensioned drawing of a simple engineered component in line with BS 8888 and a simple circuit diagram in line with BS 3939 complete with annotation. (15–20)

For this task you will be producing drawings using a 2D CAD system. It is important that your drawings conform to standards BS 8888 and BS 3939 so that when someone else looks at them there will be no ambiguity. Ask your tutor for a copy of a 'student' version of the standards or use these links:

BS 8888: www.roymech.co.uk/Useful_Tables/Drawing/Drawing.html

BS 3939: www.roymech.co.uk/Useful_Tables/Drawing/Electical_Control_symbols.html

For more information about producing drawings try this link:

http://ider.herts.ac.uk/school/courseware/graphics/engineering_drawing

Task 1.1	
Focus 1	A rectangular cover plate is to be manufactured from a piece of 2 mm thick mild steel plate and measures 160 x 100 mm with each corner radiused off. The mid points of the two longer sides and the corners are drilled with 5 mm diameter holes so that it can be fixed down with 6 set screws. The centres for the holes should be no more than 10 mm from the edge of the plate. The centre of the plate is drilled with a 15 mm diameter through hole. Produce **one** of the following three drawings: a) Produce a 2D drawing of the cover, add enough dimensions for it to be manufactured and print off your work. b) Produce a fully dimensioned drawing of the cover, but before starting work set up three layers so that centre lines, component outline and dimensions are presented in different colours. Print off your drawing. c) Prepare a simple template with a title and information block, set up three coloured layers and then produce a fully dimensioned drawing of the cover. Print off your drawing, making sure that it is properly positioned on the paper. A lighting circuit consists of a 12 volt battery, lamp, single pole on/off switch and a fuse (for protection). Produce **one** of the following two circuit diagrams: d) Produce a simple circuit diagram showing how the components are connected. e) Prepare a template, set up two layers and draw the circuit diagram which should be annotated with relevant information. Print off the circuit diagram.

If you choose to do tasks (1a) and (1d) your mark will be limited to band 1. To get into mark band 3 you would need to complete tasks (1c) and (1e) to a high standard.

Task 2 — Creating a CNC programme and operating a CNC machine

Assessment focus 2

Be able to use a CAM system to convert the drawing data into a computer numerically controlled (CNC) operating program

Band 1	Band 2	Band 3
Uses CAM software and cutting information to convert a CAD drawing geometry into a machine tool cutter path, processes the cutter path data into a coded CNC operating program.	Uses CAM software and cutting information to convert CAD drawing geometry into a machine tool cutter path, processes the cutter path data into a coded CNC operating program. Identifies and describes errors in program operation by using cutter path graphic simulation.	Uses CAM software and cutting information to convert CAD drawing geometry into a machine tool cutter path, processes the cutter path data into a coded CNC operating program. Identifies and amends errors in program operation and reruns cutter path graphic simulation.
(0–10)	(11–16)	(17–20)

Assessment focus 3

Be able to set and safely operate a CNC machine tool to produce an accurately machined component and check their own production.

Band 1	Band 2	Band 3
Loads a CNC program into the controller, sets work datums and tool offset values. Safely executes the program to produce a first-off component and checks the component for dimensional accuracy and compliance.	Loads a CNC program into the controller, sets work datums and tool offset values. Safely executes the program to produce a first-off component. Records the results of the dimensional checks in a structured format and makes comments about the checks.	Loads a CNC program into the controller, sets work datums and tool offset values. Safely executes the program to produce a first-off component. Uses feed and speed override controls to gain optimum performance. Edits the program to incorporate override values. Compiles an inspection report including reasons for non compliance and actions.
(0–10)	(11–15)	(16–20)

Using a CNC vertical milling machine (or similar machine tool) you are going to manufacture the cover plate designed and drawn in task 1. Before cutting metal the machine has to be programmed and to do this you must convert your drawing into CNC code using CAM software.

The 15 mm diameter hole in the centre of the plate will be pre-drilled so that you can use it as a fixing point when the plate is mounted in the milling machine.

Making mistakes when cutting metal is wasteful and expensive. You should consider carrying out a cutter path simulation so that errors in your programming can be identified and corrected.

Task 2.1	
Focus 2	The 2 mm steel plate measures 10 mm oversize. Before starting work ask your tutor which diameter of cutter to use and what feed rates and spindle speed to set up. a) In task 1 you produced a CAD drawing of a cover plate. Import the CAD drawing geometry into a CAM system and convert into a machine tool cutter path. Add the tool and cutting speed data provided by your tutor and post-process into a coded CNC operating programme. b) Test your CNC programme by running a cutter path graphic simulation and identify any errors. Prepare a short written report which descries any errors in your programme or in one which your tutor may give you to work on. c) Correct any errors in your programme (or one that your tutor has given you). Rerun the cutter path graphic simulation and make additional corrections to the programme until everything works perfectly.

Notes

To achieve marks in band 2 and 3 you must identify, describe and correct programming errors picked up when a cutter path simulation is carried out. If your programme turns out to be perfect, ask your tutor to introduce deliberate errors into it so that you can spot them and make corrections. As an alternative, your tutor may decide to give you a different programme to correct.

You are now going to cut metal by running the CNC programme. If all goes to plan the finished product will be a cover plate which looks like the one you drew in task 1.

If you have not carried out a cutter path graphic simulation then be prepared for things to go wrong!

Task 2.2	
Focus 3	Using the 15 mm diameter hole for location and holding down, fix the steel plate into the machine. Check with your tutor that you have done this correctly, that the cutter is located properly and that you are using relevant PPE. Before running the machine you must confirm with your tutor that you have considered the health and safety issues related to operating it. a) Load the CNC programme into the machine's control unit and set up work datums and tool offset values. Execute the programme, produce a first-off component and remove from the machine, making sure that you work safely at all times. Using appropriate measuring equipment carry out dimensional checks on the component and compare values with those on the drawing. b) When you have completed the dimensional checks, tabulate the results so that they can be used for quality assurance purposes. Present the data in a way that will enable a decision to be made on whether the component is to specification and whether further components can be produced without having to modify the programme. c) Think about ways to improve the performance of your programme by using the speed and feed override controls on the machine. Manufacture a second component to test your use of the override controls and having confirmed an improvement in performance, build these new override values into the programme. Manufacture a third component, carry out a full dimensional check on it and put together a detailed inspection report.

Unit 4 Developing routine maintenance skills

Tutor brief

Subject: Engineering		Level: 1
Unit 4: Developing Routine Maintenance Skills		**Assessment time: 10 hours**
LO. 1	Know about different types of maintenance procedures and supporting documentation used in industry	
LO. 2	Be able to use tools safely and effectively to carry out a routine maintenance task	
LO. 3	Be able to assess a product, piece of equipment or system against cause of failure	
PLTS	Independent enquiries, creative thinkers, reflective learners (RL3), team workers, self-managers (SM2), effective participators (EP2)	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc. which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1.1	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 1.2	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 2.1	• Schedule that was used to complete task. Checklist/report of maintenance task including Health and safety measures.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following is a sample assessment activity. In this case the suggestion covers all of the learning outcomes, although this would not always be the case. For this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

The tasks can be amended to accommodate the local needs of centres, for example in tasks 2 and 3 centres may wish to use an alternative piece of equipment or product for learners to work on.

Purpose

The purpose of this assignment is to provide a framework within which learners can achieve all of the assessment foci for Unit 4: Developing routine maintenance skills.

Task 1 — Maintenance procedures and supporting documentation used in industry

Assessment focus 1.1

Know and understand the different types of maintenance procedures and supporting documentation used in industry.

Band 1	Band 2	Band 3
Gives examples of three different types of maintenance procedures that are carried out in industry and states where each could be used. (0–6)	Describes three different types of maintenance procedures, stating where each could be used and how they are carried out. (7–10)	Describes three different types of maintenance procedures, stating where each could be used, how they are carried out and why each is needed. (11–14)

Assessment focus 1.2

Types of maintenance documentation.

Band 1	Band 2	Band 3
Gives examples of two sorts of documentation used when planning and/or carrying out maintenance tasks and gives an example of a maintenance task where each would be used. (0–4)	Describes two different sorts of documentation used when planning and/or carrying out maintenance tasks, stating what the documentation covers and giving examples of maintenance tasks where each would be used. (5–6)	Explains how to use two different sorts of documentation when planning and carrying out identified maintenance tasks. (7–8)

<table>
<tr><th colspan="2">Task 1 — Maintenance procedures and supporting documentation used in industry</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
Demonstrate knowledge of different types of maintenance procedure
Demonstrate knowledge of different types of maintenance documentation.</td></tr>
<tr><th colspan="2">Task 1.1</th></tr>
<tr><td>Focus 1.1</td><td>1) Explain why three of the following forms of maintenance is needed:
planned
unplanned
routine
preventative
repair to fix.
2) Describe how each of the maintenance procedures you identified in (1) are carried out.
3) Describe three different types of maintenance procedures and give examples of where each procedure would be used in an engineering situation.</td></tr>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 1.2</td><td>1) Give two examples of the documentation needed when planning or carrying out maintenance. Give an example of the kind of task when these documents might be used.
2) Describe what should be covered by two different types of maintenance documentation.
3) With reference to a machine that you are familiar with, explain how to use two different types of maintenance documentation when planning and carrying out maintenance.</td></tr>
</table>

Task 2 — Carrying out a routine maintenance task

Assessment focus 2

Use tools safely and effectively to carry out a routine maintenance task

Band 1	Band 2	Band 3
Carries out, with guidance, a routine maintenance task following a given schedule and uses given documentation, tools and equipment in a safe manner. (0–12)	Carries out, with limited guidance, a routine maintenance task following a given schedule and uses given documentation to select and use tools and equipment in a safe manner. (13–20)	Carries out, independently, a routine maintenance task following a given schedule. Selects and uses documentation and selects and uses tools and equipment in an effective and safe manner. (21–28)

It should be noted that this activity is seen as a practical activity and as such carries the most marks allocated within this unit.

The following task has two options – the first option is for learners who are likely to only achieve marks at band 1. The second is for learners who have the ability to achieve marks across all three mark bands.

<table>
<tr><th colspan="2">Task 2 — Carrying out a routine maintenance task</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate that they can use tools safely and effectively to carry out a routine maintenance task.</td></tr>
<tr><th colspan="2">Task 2.1</th></tr>
<tr><td rowspan="2">Focus 2</td><td>This part of the activity should be attempted by learners who require guidance and are therefore likely to only achieve marks from mark band 1.
Following the schedule that you have been given, use the documentation, tools and equipment provided to carry out a routine maintenance task on the workshop lathe.
You must ensure that you work safely and that you ensure the correct use of personal protective equipment. You will also need to consider general duties and any potential hazards and warning signs.</td></tr>
<tr><td>This part of the activity should be attempted by learners who only require limited guidance or can work independently and have the ability to achieve marks from all mark bands.
Following the schedule that you have been given, carry out a routine maintenance task on the workshop lathe. You can either select appropriate documentation yourself, or use that provided. You must select and safely use suitable tools and equipment.
You must ensure that you work safely and that you ensure the correct use of personal protective equipment. You will also need to consider general duties and any potential hazards and warning signs.</td></tr>
</table>

Task 3 — Assessing a product, piece of equipment or system against causes of failure

Assessment focus 3

Be able to assess a product, piece of equipment or system against causes of failure.

Band 1	Band 2	Band 3
Devises a plan and uses appropriate tools and equipment to see if a product, piece of equipment or system might fail in service. (0–4)	Devises a plan and uses appropriate tools and equipment to see if a product, piece of equipment or system might fail in service. Records key measurements. (5–7)	Devises a plan and uses appropriate tools and equipment to see if a product, piece of equipment or system might fail in service. Records key measurements. Reviews the effectiveness of the plan to make improvements to it. (8–10)

Task 3 — Assessing a product, piece of equipment or system against causes of failure	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate that they can assess a product, piece of equipment or system against causes of failure.	
Task 3	
Focus 3	With reference to a workshop lathe, plan how you might judge the likelihood of that machine failing. Follow your plan and use appropriate tools and equipment to assess whether the lathe will fail in use, recording key measurements. Once you have carried out your assessment, review your plan to see if it was successful or if you could make any improvements.

Unit 5 Introduction to engineering materials

Tutor brief

Subject: Engineering		**Level: 1**
Unit 5: Introduction to engineering materials		**Assessment time: 10 hours**
LO. 1	Know about the properties that are used to describe the performance of engineering materials	
LO. 2	Know about the materials that engineers use and their forming processes	
LO. 3	Be able to identify engineering materials and carry out tests to evaluate their properties	
PLTS	Independent enquiries (IE3), creative thinkers, reflective learners, team workers, self-managers (SM2), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

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The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Drawings or sketches, no larger than A3, printed only.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Drawings or sketches, no larger than A3, printed only.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Drawings or sketches, no larger than A3, printed only.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 5 of the Level 1 Engineering Diploma. In this case the assignment covers all four learning outcomes, although this would not always be the case. For this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 5: Introduction to engineering materials.

Task 1 — Properties, forming processes and applications of Engineering Materials

Assessment focus 1

Know about the properties that are used to describe the performance of engineering materials

Band 1	Band 2	Band 3
States four different material properties that describe the performance of engineering materials (0–4)	States four different material properties that describe the performance of engineering materials and defines three of them (5–7)	States four different material properties that describe the performance of engineering materials, defines three of them and explains how the application of two materials (each with a different property), would be affected (8–9)

Assessment focus 2.1

Know about ferrous metals and their forming processes

Band 1	Band 2	Band 3
Gives an appropriate forming process and an engineering application for each of three ferrous metals (0–3)	Gives an appropriate forming process and an engineering application for each of three ferrous metals and describes the properties of two of them (4–5)	Gives an appropriate forming process and an engineering application for each of three ferrous metals, describes the properties and justifies the use of the forming process of two of them (6–7)

Assessment focus 2.2

Know about non-ferrous metals and their forming processes

Band 1	Band 2	Band 3
Gives an appropriate forming process and an engineering application for each of three non-ferrous metals (1–3)	Gives an appropriate forming process and an engineering application for each of three non-ferrous metals and describes the properties of two of them (4–5)	Gives an appropriate forming process and an engineering application for each of three non-ferrous metals, describes the properties and justifies the use of the forming process of two of them (6–7)

Task 1 — Properties, forming processes and applications of engineering materials	
Purpose: The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of the properties that are used to describe the performance of engineering materials. • Demonstrate knowledge of ferrous and non-ferrous metals, their forming processes and applications.	
Task 1.1	
Focus 1	1) State four different properties that are used to describe the performance of engineering materials. 2) Clearly define three of the properties that you listed in (1). Your definitions should identify the key factors associated with each property, but do not necessarily have to be 'text-book' definitions. 3) Explain how two of the properties that you have defined in (2) would affect the application of materials that have these properties.
Task 1.2	
Focus 2.1	1) Choose three different ferrous metals and give an appropriate forming process and application for each one. 2) Clearly describe the properties of two of the ferrous metals that you have chosen. 3) For two of the ferrous metals you have chosen explain why this process is used.
Task 1.3	
Focus 2.2	1) Choose three different non-ferrous metals and give an appropriate forming process and application for each one. 2) Clearly describe the properties of two of the non-ferrous metals that you have chosen. 3) For two of the non-ferrous metals you have chosen explain why this process is used. For example, aluminium could be cast because it has a relatively low melting point which means it requires less energy than many other metals with a similar strength/weight ratio.

Task 2 — Forming processes and applications of plastics and rubbers

Assessment focus 2.3

Know about thermoplastics and elastomers and their forming processes

Band 1	Band 2	Band 3
Gives an appropriate forming process and an engineering application for each of two different thermoplastic materials and one elastomer material (0–3)	Gives an appropriate forming process and an engineering application for each of two different thermoplastic materials and one elastomer material and describes the properties of one thermoplastic and one elastomer (4–5)	Gives an appropriate forming process and an engineering application for each of two different thermoplastic materials and one elastomer material, describes the properties and justifies the use of the forming process of one thermoplastic and one elastomer (6–7)

Assessment focus 2.4

Know about thermosetting plastics and their forming processes

Band 1	Band 2	Band 3
Gives an appropriate forming process and an engineering application for each of three different thermosetting plastic materials (0–3)	Gives an appropriate forming process and an engineering application for each of three different thermosetting plastic materials and describes the properties of two of them (4–5)	Gives an appropriate forming process and an engineering application for each of three different thermosetting plastic materials, describes the properties and justifies the use of the forming process of two of them (6–7)

<table>
<tr><th colspan="2">Task 2 — Forming processes and applications of plastics and rubbers</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• demonstrate knowledge of thermoplastics, thermosetting plastics and elastomers, their forming processes and applications.</td></tr>
<tr><th colspan="2">Task 2.1</th></tr>
<tr><td>Focus 2.3</td><td>1) Choose two different thermoplastic materials and one elastomer material and give an appropriate forming process and application for each one.
2) Clearly describe the properties of one of the thermoplastic materials and the elastomer that you have chosen.
3) For one of the thermoplastic materials and the elastomer you have chosen explain the forming process.</td></tr>
<tr><th colspan="2">Task 2.2</th></tr>
<tr><td>Focus 2.4</td><td>1) Choose three different thermosetting plastic materials and give an appropriate forming process and application for each one.
2) Clearly describe the properties of two of the thermosetting plastic materials that you have chosen.
3) For two of the thermosetting plastic materials you have chosen explain the forming process.</td></tr>
</table>

Task 3 — Identifying and testing engineering materials

Assessment focus 3.1

Identify materials specified on an engineering drawing or service schedule

Band 1	Band 2	Band 3
Describes how three given engineering materials are shown in abbreviated form on an engineering document (0–3)	Describes how three given engineering materials are shown in abbreviated form on an engineering document and identifies two other materials that are specified on a given engineering document (4–5)	Describes how three given engineering materials are shown in abbreviated form on an engineering document and identifies two other materials that are specified on a given engineering document together with the forms of raw material and their dimensional requirements (6–7)

Assessment focus 3.2

Identify engineering materials

Band 1	Band 2	Band 3
Identifies the materials from which three given engineering components are made by carrying out a visual and tactile inspection (0–3)	Identifies the materials from which three given engineering components are made by carrying out a visual and tactile inspection and describes the properties of two of them (4–5)	Identifies the materials from which three given engineering components are made by carrying out a visual and tactile inspection, describes the properties of two of them and justifies their selection for the components (6–7)

Assessment focus 3.3

Carry out tests on engineering materials

Band 1	Band 2	Band 3
Carries out two given tests on two given engineering materials to evaluate given mechanical properties (0–4)	Carries out two given tests on two given engineering materials to evaluate and compare given mechanical properties (5–6)	Select and carry out two appropriate tests on two given engineering materials to evaluate and compare given mechanical properties (7–9)

Task 3 — Identifying engineering materials

Purpose

The purpose of this task is to provide a framework within which the learner can:

- Identify materials specified on an engineering drawing or service schedule and identify the materials from which given components are made
- Demonstrate an ability to carry out simple tests to evaluate the properties of engineering materials.

Task 3 — activity 3.1

Focus 3.1

1) Describe how the following three materials are shown in abbreviated form on engineering drawings and documents:
   - spheroidal graphite cast iron
   - bright drawn mild steel
   - high speed steel.
2) The following is an extract from the title block of an engineering drawing.

   Identify the materials given in abbreviated form in the title block.

Part no.	**Description**	**Material**	**Stock size**
1	Pin	SS	ϕ 50
2	Cover	Dural	SWG 16

3) Identify the form of supply required and the dimensional requirements for each material listed in the above title block.

Task 3 — activity 3.2

Focus 3.2

1) Carefully examine the three engineering components that you have been given and identify the materials from which they are made.
2) Describe the properties of two of the materials that you have identified.
3) Explain your selection of the two materials whose properties you have described.

The following activity has two options — the first is for learners who have the ability to achieve marks across all three mark bands. The second option is for learners who are likely to only achieve marks at bands 1 and 2.

<table>
<tr><th colspan="2">Task 3 — activity 3.3</th></tr>
<tr><td rowspan="2">Focus 3.3</td><td>This part of the activity should be attempted by learners who require minimal guidance and have the ability to achieve marks from all mark bands.

You have been given two lengths of rod which are the same diameter but made from different materials. Select and carry out two appropriate tests to assess the hardness and toughness of the materials. Evaluate and compare their relative hardness and toughness.</td></tr>
<tr><td>This part of the activity should be attempted by learners who require guidance and are able to achieve marks only from mark bands 1 and 2.

You have been given two lengths of rod which are the same diameter but made from different materials.

1) Secure them in a bench vice and test them for hardness with a file. Whilst held securely in the vice, strike each one with a hammer as if to bend it. State whether you think they are hard to file or easy to file. State also whether you think they are easy to bend or hard to bend.

2) Compare the relative hardness and toughness of the two materials.</td></tr>
</table>

Unit 6 Electronic Circuit Construction and Testing

Tutor brief

Subject: Engineering		**Level: 1**
Unit 6: Electronic Circuit Construction and Testing		**Assessment time: 10 hours**
LO. 1	Know how electronic components are identified	
LO. 2	Be able to use symbols to produce an electronic circuit diagram	
LO. 3	Be able to work in a team to plan the construction of an electronic circuit from a circuit diagram and then individually build the circuit	
LO. 4	Be able to test an electronic circuit	
PLTS	Independent enquiries, creative thinkers, reflective learners, team workers (TW1, 2), self-managers (SM2, 3), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1	• Annotated drawings or sketches, no larger than A3, printed only.	Classroom	Supervised
Task 2	• Sketches and print outs of circuit diagrams. Labelled and no larger then A3.	Classroom	Supervised
Task 3	• Annotated photos of circuit throughout each stage of the process. Outcomes of computer based simulation. Screen dumps required. • Tables of measurements recorded while testing. • A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section ‘What you need to cover’ in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment to give learners the opportunity to generate evidence for the assessment foci within unit 6 of the Engineering Diploma at Level 1.

Where circuits need to be given to the learner the tutor should ensure they will allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. The circuit for task 1.1 must have at least six different components. The circuit for task 2.1 again must have at least six different components and should be different to that given for task 1.1 – however it could include some common components. The circuit for task 3.1 again should have approximately six different components, although learners should be familiar with these components from the other tasks. The circuit required however should be different to any used in tasks 1 or 2.

The tasks as set will give learners this opportunity but some of the tasks can be amended to accommodate the local needs of centres. The following indicates where this flexibility exists:

Tasks 1.1, 2.1 and 3.1

The circuit diagram given could have different components.

Tasks 1.2 and 1.3

The actual components given for each learner could be varied.

Also

Task 3.5

If the learner has not produced any circuit of a suitable standard for this task, a simple circuit of similar nature should be given.

Task 1 — Identify electronic components

Assessment focus 1

Know how electronic components are identified

Band 1	Band 2	Band 3
Identifies six different electronic components on a given circuit diagram from the standard symbols that have been used to represent them. (0–6)	Identifies six different electronic components on a given circuit diagram from the standard symbols that have been used to represent them and identifies the symbol that would be used to represent a further four physical components. (7–10)	Identifies six different electronic components on a given circuit diagram from the standard symbols that have been used to represent them and identifies the symbol that would be used to represent a further four physical components and uses either a physical or web-based catalogue to identify the order code, key features and cost of five given electronic components. (11–15)

<table>
<tr><th colspan="2">Task 1 — Identify electronic components</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate how electronic components are identified.</td></tr>
<tr><th colspan="2">Task 1.1</th></tr>
<tr><td>Focus 1</td><td>You have been given a circuit diagram which includes the symbols for six different electronic components labelled 1–6.
Identify the six components.</td></tr>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 1</td><td>Your tutor has given you four electronic components, labelled 1–4.
Identify the four components and draw their BS circuit symbols.</td></tr>
<tr><th colspan="2">Task 1.3</th></tr>
<tr><td>Focus 1</td><td>Your tutor has given you a further five electronic components labelled 1–5.
For each component use a physical or web-based catalogue to find the following information:
• Component
• Order code
• Cost
• Key features.</td></tr>
</table>

Task 2 — Produce an electronic circuit diagram using standard circuit symbols

Assessment focus 2

Be able to use standard circuit symbols to produce an electronic circuit diagram

Band 1	Band 2	Band 3
Sketches an electronic circuit diagram, which includes at least six components, using standard symbols. (0–6)	Sketches an electronic circuit diagram, which includes at least six components, using standard symbols, reproduces the circuit diagram using a computer-based electronic circuit simulation package and saves the completed drawing. (7–11)	Sketches an electronic circuit diagram, which includes at least six components, using standard symbols, reproduces the circuit diagram using a computer-based electronic circuit simulation package, saves the completed drawing and then retrieves, modifies the circuit diagram and resaves the revised version. (12–15)

Task 2 — Produce an electronic circuit diagram using standard circuit symbols	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate how to produce an electronic circuit diagram using standard circuit symbols.	
Task 2.1	
Focus 2	You have been given an electronic circuit. Use the circuit to sketch an actual circuit diagram. You must represent the components in the circuit by sketches of standard symbols.
Task 2.2	
Focus 2	Use a computer-based simulation package to reproduce the circuit diagram sketch you prepared in task 2.1 and save the diagram to disc. Do not forget you will be expected to include a title block etc. You will need to show your tutor how you used the computer and saved the circuit. Your tutor will need to complete an observation record to record what you did.
Task 2.3	
Focus 2	You have been given a sketch of an electronic circuit which is a modified version of the circuit you were given for task 2.1. Retrieve your circuit, modify and save it so that it represents the modified circuit given. Save the new circuit with a new file name so you can again show you tutor what you did. Again your tutor will need to complete an observation record to record what you did.

Task 3 — Plan, construct and test an electronic circuit

Assessment focus 3

Be able to work in a team to plan the construction of an electronic circuit from a circuit diagram and then individually build the circuit

Band 1	Band 2	Band 3
Works in a team to plan the construction of a given electronic circuit and individually, prototypes the circuit using a breadboard. (0-6)	Works in a team to plan the construction of a given electronic circuit and individually, prototypes the circuit using a breadboard and safely builds the circuit using stripboard. (7-11)	Works in a team to plan the construction of a given electronic circuit and individually, prototypes the circuit using a breadboard and safely builds the circuit using stripboard and constructs the circuit on a given printed circuit board. (12-15)

Assessment focus 4

Be able to test an electronic circuit

Band 1	Band 2	Band 3
Uses an electronic circuit simulation package to test the operation of a given electronic circuit by measuring six different circuit input and output signals. (0-6)	Uses an electronic circuit simulation package and sets-up and uses physical test equipment to test the operation of the given electronic circuit by measuring six different circuit input and output signals for each. (7-11)	Uses an electronic circuit simulation package and sets-up and uses physical test equipment to test the operation of the given electronic circuit by measuring six different circuit input and output signals for each and compares the results, advantages and disadvantages of each approach. (12-15)

Task 3 — Plan, construct and test an electronic circuit	
Purpose The purpose of this task is to provide a framework within which the learner can: • Work in a team to plan the construction of an electronic circuit from a circuit diagram and then individually build the circuit. • Demonstrate the ability to test an electronic circuit.	
Task 3.1	
Focus 3	For this part of the task you need to work in a small team. Your team has been given an electronic circuit diagram. Work together to produce a plan of how this circuit diagram can be used to produce the circuit on breadboard. You should record your decisions. This should be in the form of minutes from your team meeting and discussion. You should also ensure that your tutor produces an observation record stating how you contributed to the team discussion and decision making process. Make a written record of the planning. Now you have agreed how the circuit will be made you need to individually produce the circuit on breadboard. Remember you will be rewarded for neatness, accuracy and how well the circuit works.
Task 3.2	
Focus 3	Having produced the circuit on breadboard for task 1 you now need to repeat the build process using stripboard. Remember you will be rewarded for the safe building of the circuit, the quality of the finished board (layout and use of space) and for the positioning and soldering of the joints.
Task 3.3	
Focus 3	Having now used breadboard and stripboard you now need to construct your circuit on the printed circuit board that you have been given. Remember you will be rewarded for quality of finish (positioning components, soldering, neat and industry standard appearance) and for its correct function.
Task 3.4	
Focus 4	You have been given a simulation package version of an electronic circuit. Use the simulation package to measure and record six input and output signals. You will need to take screen dumps of what you do. Your tutor will also need to complete an observation record to record what you did.

Task 3.5	
Focus 4	For this part of the task you can use the actual circuit board of the electronic circuit you constructed in task 1. This could be either the breadboard, stripboard or PCB circuit produced. Choose the appropriate test equipment and record the six input and output signals. Again your tutor will also need to complete an observation record to record what you did and should capture both the setting-up and use of the test equipment. You should produce a table of your measurements.
Task 3.6	
Focus 4	Compare the results of tasks 1 and 2 and state the advantages and disadvantages of each of the two methods.

Unit 7 Engineering the Future

Tutor brief

Subject: Engineering		Level: 1
Unit 7: Engineering the Future		**Assessment time: 10 hours**
LO. 1	Know about the new developments in materials and engineering technology that impact on everyday life	
LO. 2	Know how products are recycled or safety disposed of at the end of their useful life	
LO. 3	Be able to identify renewable energy sources and the environmental issues of each one	
PLTS	Independent enquiries (IE3), creative thinkers (CT3), reflective learners, team workers, self-managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • PowerPoint presentation, printed on A4. Electronic copies are not required.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Process flow or algorithm. No larger than A3. Electronic.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • PowerPoint presentation, printed on A4. Electronic copies are not required.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

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Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following is a sample assessment activity. In this case the assignment covers all four learning outcomes, although this would not always be the case. In this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

The tasks as set will give learners this opportunity, although some of the tasks can be amended to accommodate local needs. The following indicates where this flexibility exists:

Task 1.1

Centres may wish to focus learners on specific materials that are used by local industry or that they are familiar with through class exercises and work placements. The areas of space exploration, underwater research and building construction can be changed to more relevant areas as appropriate.

Task 1.2

The research of engineering technologies could be more focused on specific areas of engineering that relate to centres' industrial links and individual student interest.

Task 1.3

Centres may wish to focus this task on alternative energy resources that reflect local investment in green technology. This may include initiatives by local industry or investments from power companies. Centres should make the most of any green initiatives by engineering companies that they have links with.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 7: Engineering the Future.

Task 1 — New Developments in Materials and Engineering Technology

Assessment focus 1.1

Know about the new developments in materials and their uses.

Band 1	Band 2	Band 3
Gives examples of three different new or smart engineering materials and states an appropriate application for each. (0–6)	Describes the properties and an appropriate application of three different new or smart engineering materials. (7–10)	Describes the properties and an appropriate application of three different new or smart engineering materials, and explains how properties and use are linked. (11–14)

Assessment focus 1.2

Know about engineering technology that impacts on everyday life.

Band 1	Band 2	Band 3
Uses own and others' ideas and experiences to identify three new engineering technologies and gives an example of how each is being used in everyday life. (0–6)	Uses own and others' ideas and experiences to describe the application of three new engineering technologies in use in everyday life. (7–10)	Uses own and others' ideas and experiences to describe the application of three new engineering technologies in use in everyday life and shows how new technology can have an impact on society and the environment. (11–14)

<table>
<tr><th colspan="2">Task 1: New developments in materials and engineering technology</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate a knowledge of new developments in materials and their use
• Demonstrate knowledge of engineering technology that impacts on everyday life.</td></tr>
<tr><th colspan="2">Task 1.1</th></tr>
<tr><td>Focus 1.1</td><td>As a chief consultant to the UK manufacturing and engineering industries you are required to be a leading source of information for new developments and technology within this sector.
The organisers of an engineering conference have asked you to deliver a presentation to companies who manufacture components for use in the following specialist areas:
• space exploration
• underwater research
• building construction.
You should research both new and smart materials which could be used in these specialised areas, and then give a short presentation of your results. Your presentation will need to:
• identify one material that would be suitable for each of the three areas. For each, give one example of how it could be used
• clearly identify the characteristic properties of each of the materials you have identified
• describe how the properties of each material make it suitable for the specialised area proposed (a precise link must be given for each material linking to the characteristics given in (b) above).</td></tr>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 1.2</td><td>You have been asked to highlight how development of new technologies has had a direct impact on daily life. Your information sheet should:
• consider your own experience and the experiences of others and identify three new engineering technologies. Give an example of how each new technology is being used in everyday life
• for the new technologies identified in (a), describe what they are and how each of them is used
• describe in detail how these technologies have had an impact on both society and the environment. These could be either positive or negative impacts.</td></tr>
</table>

Task 2 — Recycling Engineered Products

Assessment focus 2

Know how products are recycled or safely disposed of at the end of their useful life

Band 1	Band 2	Band 3
Gives an example of two different products which can be recycled, stating for each how they are recycled, and two which cannot, stating how they can be safely disposed of. (0–6)	Outlines the recycling process for two different products, and identifies the benefits of recycling. Outlines the safe disposal of two different products and states why this is done instead of recycling. (7–11)	Describes the recycling process for two different products, and the method of safe disposal of two others. Explains why some products are recycled while others are not, and the benefits of recycling. (12–16)

Task 2: Investigating disposal and recycling of engineered products	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate that they know how products are recycled or disposed of safely.	
Task 2.1	
Focus 2	You are employed by an environmental organisation to provide advice on recycling to engineering companies. You have been asked to produce a report about the benefits of recycling and the disposal of non-recyclable products. Your report should will need to: • identify two household products that are recyclable and two household products that are not recyclable • describe the recycling process for the two recyclable products. This should include a step-by-step guide of the process (a flowchart or algorithm may be useful). Identify why the two non-recyclable products are unable to be recycled and explain a safe disposal process for each product • evaluate the benefits of recycling, including financial viability.

Task 3 — Renewable Energy and Environmental Issues

Assessment focus 3

Be able to identify renewable energy sources and the environmental issues associated with each one.

Band 1	Band 2	Band 3
Identifies how energy is generated from two different renewable sources. States the environmental impact of using renewable sources and how energy can be stored.	Describes how energy is generated from two different renewable sources, and outlines the positive and negative environmental impacts of these forms of energy generation. Identifies how energy from these sources could be stored.	Describes clearly how energy is generated from two different renewable sources, and for each compares the positive and negative environmental impacts. Describes how energy from these sources could be stored, with an indication of the benefits and disadvantages of storing it.
(0–6)	(7–11)	(12–16)

Task 3: Investigating renewable energy sources	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate that they know how to identify renewable energy sources and the environmental issues associated with each one.	
Task 3.1	
Focus 3	You work for a company which is investing in new technology to provide greener alternatives to both energy generation and consumption because of the depletion of fossil fuels. You need to research alternative energy sources and produce a report for your manager. Your report should: a) give a clear description of how energy is generated by two renewable energy sources b) identify the positive and negative environmental impacts of energy generated by both methods described c) describe how surplus energy generated in each case may be stored and give an indication of the benefits and shortcomings of storing energy in each case.

Level 2

Unit 1 Exploring the Engineering World

Tutor brief

Subject: Engineering		Level: 2
Unit 1: Exploring the Engineering World		**Assessment time: 20 hours**
LO. 1	Know about engineering sectors and their products and services	
LO. 2	Know about job opportunities available within the engineering industry and the role of professional engineering institutions	
LO. 3	Know about the achievements in engineering that relates to social and economic development	
LO. 4	Understand the rights and responsibilities of employers and employees in engineering	
PLTS	Independent enquiries, creative thinkers, reflective learners, team workers, self-managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 4	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 1 of the Level 2 Engineering Diploma. In this unit, four tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

The tasks as set will give learners this opportunity but some of the tasks can be amended to accommodate the local needs of the centre using these assessment instruments. The following indicates where this flexibility exists:

Task 1.1

Centres may wish to focus learners on the specific sectors of engineering that reflect local industry trends or that are relevant to work placements or existing links with employers.

Task 2.1

Centres may wish to utilise links with local and/or national engineering companies to support learners in identifying opportunities and progression routes within engineering organisations. Site visits and guest speakers would be a valuable aid to this task.

Task 2.2

Centres may wish to identify engineering institutions that represent sectors of local engineering establishments.

Task 3.1

Learners should be encouraged to focus on engineering achievements that have significant local impact or that are directly relevant to engineering sectors of interest. This may include a local birthplace of an inspirational engineer, the site of specific research or development or a reflection of local commercial infrastructure.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 1: Exploring the Engineering World.

Task 1 — Engineering sectors and their products or services

Assessment focus 1

Know about engineering sectors and their products or services.

Band 1	Band 2	Band 3
Describes two different sectors in engineering and identifies products or services from each. (0-4)	Describes two different sectors in engineering and identifies the function of engineering products or services from those sectors. (5-7)	Describes two different sectors in engineering and explains the operation of commercially available products provided by engineering companies from different sectors in engineering. (8-10)

Task 1 — Engineering sectors and their products or services	
Purpose: The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of engineering sectors and their products or services.	
Task 1.1	
Focus 1	To help familiarise yourself with the engineering industry, you need to investigate and research different sectors of engineering. This may include sectors that are relevant to your local area, or those that you are familiar with or interested in. 1) Describe two different sectors of engineering. Give examples of products or services provided by each of these two sectors. 2) Identify and describe the function of the products or services provided from each of the engineering sectors identified above. 3) Give examples of commercially available products or services available from engineering companies within the sectors you have identified and explain the function and operation of each product or service.

Task 2 — Opportunities in Engineering

Assessment focus 2

Know about job opportunities available within the engineering industry and the role of professional engineering institutions

Band 1	Band 2	Band 3
Describes four examples of job opportunities within engineering at a local and/or national level. Outlines the roles of the Engineering Council UK and of its licensed professional engineering institutions. (0-8)	Describes four examples of career progression opportunities within engineering at a local and/or national level. Describes the function of the engineering council and its relationship to licensed professional engineering institutions. (9-14)	Evaluates the qualifications and skills required for a range of career opportunities within engineering at a local and/or national level. Evaluates the reasons for professional engineering registration at a national and international level. (15-20)

Task 2 — Opportunities in Engineering	
Purpose: The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of job opportunities available within the engineering industry and the role of professional engineering institutions.	
Task 2.1	
Focus 2	You need to research local and/or national engineering companies that may offer opportunities to students who are currently studying or have recently completed engineering programmes. You should explore a variety of job roles across a range of engineering sectors. You may wish to make use of the links that your centre has with local engineering companies or you could use the internet search engines or recruitment websites to aid your investigation. 1) Describe four different job roles that are available in the engineering companies you have researched. 2) For each of the job opportunities you have identified, describe the career progression opportunities available. Evaluate the experience, skills and qualifications needed in order to gain such a position and identify opportunities for further progression beyond this role.
Task 2.2	
Focus 2	1) Describe the role of the Engineering Council UK and of its licensed professional engineering institutions. 2) Describe the function of the Engineering Council UK and how it regulates the engineering profession, its relationship to licensed professional engineering institutions and the professional registration of engineers. 3) Evaluate the obligations and benefits for professional engineering registration at both a national and international level.

Task 3 — Achievements in Engineering

Assessment focus 3

Know about the achievements in engineering that relate to social and economic development in the 19th, 20th and 21st centuries.

Band 1	Band 2	Band 3
Describes the key achievements in engineering in the 19th, 20th and 21st centuries and refers to social and economic development. (0-8)	Describes impacts on economic and social life of key developments and achievements in engineering in the 19th, 20th or 21st centuries. (9-14)	Explains impacts of key developments and achievements in engineering in the 19th, 20th or 21st centuries on economic and social life. (15-20)

<table>
<tr><th colspan="2">Task 3 — Achievements in Engineering</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate knowledge of the achievements in engineering that relate to social and economic development in the 19th, 20th and 21st centuries.</td></tr>
<tr><th colspan="2">Task 3.1</th></tr>
<tr><td>Focus 3</td><td>You need to research the main achievements in engineering over the last few centuries. An engineering achievement can be defined as a milestone in human history made possible by developments in engineering.
1) Describe a key achievement in engineering from the 19th, 20th and 21st centuries. Your description should give a clear account of what was achieved in each case, identifying significant dates and key people involved and referring to social and economic developments.
2) Describe key developments that made these achievements possible and comment on their economic or social impact.
3) Evaluate how these key developments in engineering directly impacted social and economic life at a local and national level.</td></tr>
</table>

Task 4 — Responsibilities of Employers and Employees

Assessment focus 4

Understand the responsibilities of employers and employees in engineering

Band 1	Band 2	Band 3
Describes key responsibilities of employers and employees as defined in the current Employment Act and other relevant legislation. (0-4)	Refers to given employment legislation to comment on the rights and responsibilities of employers and employees within engineering. (5-7)	Comments on the rights and responsibilities of employers and employees within engineering; explains how employers can encourage employees to meet their responsibilities in accordance to employment legislation. (8-10)

Task 4: Responsibilities in the engineering workplace	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of the responsibilities of employers and employees in engineering.	
Task 4.1	
Focus 4	A manager for a medium sized engineering establishment would be responsible for ensuring that the team was familiar with appropriate employer legislation. a) Produce a brief which could be circulated to the team describing the key responsibilities of employers and employees in accordance with the current Employment Act. b) Describe the responsibilities of employers and employees in relation to employment legislation applicable to working in the engineering sector and say why such legislation is needed. c) Senior management at the company have identified 'awareness of employment legislation' as a high priority. Explain how you would encourage the team to carry out their responsibilities while at work, in relation to the legislation identified in b) above.

Unit 2 Investigating Engineering Design

Tutor brief

Subject: Engineering		Level: 2
Unit 2: Investigating Engineering Design		**Assessment time: 12 hours**
LO. 1	Know about the construction and function of an engineered product or system	
LO. 2	Be able to prepare a product design specification	
LO. 3	Be able to prepare initial design proposals	
LO. 4	Be able to prepare and submit a final design solution	
PLTS	Independent enquiries, creative thinkers (CT3), reflective learners, team workers, self-managers, effective participators (EP2)	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated sketches, photographs, flow charts, circuit diagrams where suitable, no larger than A3.	Classroom/ workshop	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated sketches, photographs, flow charts, circuit diagrams where suitable, no larger than A3.	Classroom/ workshop	Supervised
Task 3	• Design specifications, sketches, notes, diagrams, flow charts. • Final annotated design to scale. • A4 written evidence must be clearly legible, preferably word-processed.	Classroom/ workshop	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 2 of the Level 2 Engineering Diploma. In this case the assignment covers all four learning outcomes, although this would not always be the case. For this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 2: Investigating Engineering Design.

Task 1 — Construction and function of engineered products or systems

Assessment focus 1

Know about the construction and function of an engineered product or system

Band 1	Band 2	Band 3
Describes the construction and function of an engineered product or system. (0-6)	Describes the construction, function and mode of operation of an engineered product or system. (7-10)	Describes the construction, function and mode of operation of an engineered product or system, and evaluates its range of performance and fitness for purpose. (11-14)

<table>
<tr><th colspan="2">Task 1 — Construction and function of engineered products or systems</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• demonstrate knowledge of the construction and function of an engineered product or system.</td></tr>
<tr><th colspan="2">Task 1.1</th></tr>
<tr><td>Focus 1</td><td>a) Choose an engineered product or system that you have investigated and describe its construction.
b) Describe the function of the engineered product or system.</td></tr>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 1</td><td>Describe how the product or system works.
This could include flow charts, circuit diagrams, freehand sketches etc.</td></tr>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 1</td><td>Evaluate the performance of the product or system and discuss its fitness for purpose in terms of ergonomics, efficiency and reliability.</td></tr>
</table>

Task 2 — Produce a product design specification

Assessment focus 2.1

Design brief

Band 1	Band 2	Band 3
Identifies the physical constraints in a design brief for an engineered product or system. (0-4)	Identifies the physical constraints and performance requirements in a design brief for an engineered product or system. (5-7)	Identifies the physical constraints, performance requirements and reliability indicators for an engineered product or system. (8-9)

Assessment focus 2.2

Design specification

Band 1	Band 2	Band 3
Produces a product design specification that contains the dimensional constraints and functional requirements for an engineered product or system. (0-4)	Produces a product design specification that contains the dimensional constraints and functional requirements and operating performance needs for an engineered product or system. (5-7)	Produces a product design specification that contains the dimensional constraints, functional requirements, operating performance and the economic and manufacturing considerations for an engineered product or system. (8-9)

Task 2 — Produce a product design specification	
Purpose The purpose of this task is to provide a framework within which the learner can: • Prepare a design specification.	
Task 2.1	
Focus 2.1	You have been given a design brief for an engineered product or system. Identify the physical constraints of the engineered product or system.
Task 2.2	
Focus 2.1	Identify the performance requirements of the engineered product or system.
Task 2.3	
Focus 2.1	Identify the reliability indicators of the engineered product or system.
Task 2.4	
Focus 2.2	Produce a product design specification which includes: a) Dimensional constraints b) Functional requirements c) Required operating performance parameters d) Economic and manufacturing considerations.

Task 3 — Prepare and submit a design solution

Assessment focus 3

Be able to prepare initial design proposals

Band 1	Band 2	Band 3
Uses own and others' ideas and experiences to produce three initial design proposals for consideration. (0-6)	Uses own and others' ideas and experiences to produce and then compare three initial design proposals. (7-10)	Uses own and others' ideas and experiences to produce three initial design proposals and justifies the choice for a final design solution. (11-14)

Assessment focus 4

Be able to prepare and submit a final design solution

Band 1	Band 2	Band 3
Prepares and submits final design solution documents. (0-6)	Prepares and submits final design solution documents including a written design report or a presentation. (7-10)	Prepares and submits final design solution documents including a written design report and a presentation. (11-14)

Task 3 — Prepare and submit a design solution	
Purpose The purpose of this task is to provide a framework within which the learner can: • Prepare initial design proposals and submit a final design solution.	
Task 3.1	
Focus 3	You have been provided with a design specification for an engineered product or system. Produce three different initial design proposals.
Task 3.2	
Focus 3	Carry out a reasoned comparison of the three proposals. The comparison should include objective testing.
Task 3.3	
Focus 3	Choose a final proposal and explain your selection, considering the requirements of the specification.
Task 3 — activity 3.4	
Focus 4	Submit a final design solution. This should include sketches, drawings and where appropriate, circuit diagrams and/or flow diagrams.
Task 3.5	
Focus 4	Produce a final design report. This can be either a detailed written design report or a presentation including a design log and mathematical and scientific calculations. The report should be well presented and easy to follow.
Task 3.6	
Focus 4	Deliver a presentation of the final design solution. The presentation, which could be delivered using PowerPoint or a similar program, should include the use of models (which could be CAD generated) and software simulations of the design solution.

Unit 3 Engineering Applications of Computers

Tutor brief

Subject: Engineering		Level: 2
Unit 3: Engineering Applications of Computers		**Assessment time: 20 hours**
LO. 1	Know about computer applications in process control and manufacturing	
LO. 2	Be able to use computer-based systems to solve and engineering problem	
LO. 3	Understand microprocessor control applications in everyday consumer products	
LO. 4	Know about computer aided technology in maintenance operations	
PLTS	Independent enquiries (IE3), creative thinkers, reflective learners, team workers, self-managers (SM2), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

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The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated photographic evidence. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated photographic evidence. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 4	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated photographic evidence. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised

Candidate brief

This assignment for is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment which gives learners the opportunity to generate evidence for the assessment foci within unit 3 of the Engineering Diploma at Level 2.

To achieve the learning outcome 2 learners' evidence must include witness statements/observation records which are supported by annotated photographs showing learners using computer-based equipment to solve an engineering problem. It may also be necessary to include screen prints which show how software has been used.

In task 3 the learner should adopt a systems (black box) approach when identifying and explaining the component parts of a microprocessor control system – it is not necessary to give detailed descriptions of the internal architecture and operation of a processor chip. Similarly, if the learner identifies a transducer then they should explain the input and output characteristics but not the detailed inner workings.

Task 4 requires that the learner be given maintenance data for analysis – ideally this should be sourced from a product or equipment with which the learner is familiar. For example speed and power values gathered from an electric motor under test.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 3: Engineering Applications of Computer.

Task 1 — Investigating how computer systems are used to control processes and manufacturing operations

Assessment focus 1

Know about computer applications in process control and manufacturing

Band 1	Band 2	Band 3
Describes an example of how two different industries use computers in process control and manufacturing. (0–6)	Describes and compares how two different industries use computers in process control and manufacturing. (7–10)	Describes, compares and evaluates how two different industries use computers in process control and manufacturing. (11–14)

Task 1	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate their knowledge of computer applications in process control and manufacturing.	
1.1	
Focus 1	Engineering businesses use computer-based systems in many different ways. In this task you will be investigating two types of application: • process control, for example monitoring and adjusting the condition of liquids in an electro-plating bath • manufacturing, for example the operation of a computer numerically controlled (CNC) machine tool. There should be opportunities for research when you are on work experience. a) Choose two different types of industry and for each find one example of where a computer-based system is used in and engineering situation. You are looking for one application which involves process control and one which is to do with manufacturing. Prepare a short report which describes how the systems are used for your two chosen applications. b) Add an additional section to the report in which you compare the use and effectiveness of the two computer systems identified in task (a) above. c) Add a further section to your report in which you report back on a wider investigation into the use of computer systems in the two types of industry identified in task (a).You must include an evaluation of the effectiveness of the computer systems which you have investigated.

Task 2 — Using a computer-based system to solve an engineering problem

Assessment focus 2

Be able to use computer-based systems to solve an engineering problem

Band 1	Band 2	Band 3
Sets up and uses appropriate computer-based equipment to solve a given engineering problem. (0–8)	Sets up appropriate computer-based equipment to solve a given engineering problem in safe manner and presents a solution. (9–14)	Sets up appropriate computer-based equipment to solve a given engineering problem in a safe manner, presents a detailed solution, justifies the use of the equipment used and appraises the solution. (15–18)

<table>
<tr><th colspan="2">Task 2</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate that they can use computer-based systems to solve engineering problems.</td></tr>
<tr><th colspan="2">Task 2.1</th></tr>
<tr><td>Focus 2</td><td>For this task your tutor will give you an engineering problem to solve.
This might be simulating the manufacture of a product using a CAD/CAM package or setting up and programming a computer linked to a piece of hardware such as a conveyor system. If you are working with hardware you must confirm with your tutor that safe working practices will be maintained.
Read through the specification of the problem you are being asked to solve and confirm with your tutor what you propose to do.
a) Plan how the problem is to be solved and produce a checklist of the computer-based equipment needed (hardware and software). Set up the equipment and use it to find a solution to the problem.
b) Write a short report which describes how you solved the problem and worked safely.
c) Add another section to the report in which you explain why you chose to use the computer-based equipment that you selected. Also include in this section a review of your solution to the given problem. For example, did you solve the problem effectively or were there things that should have been done differently?</td></tr>
</table>

Task 3 — Investigating how microprocessors are used to control the operation of consumer products

Assessment focus 3

Understand microprocessor control applications in everyday consumer products

Band 1	Band 2	Band 3
Describes how two different microprocessor systems control the features or actions of consumer products.	Describes how two different microprocessor systems control the features or actions of consumer products and identifies the component parts of a microprocessor control system and explains how they work.	Evaluates the use of a microprocessor control system in an consumer product, identify the component parts of a microprocessor control system, explain how they work and describe how the system might be applied to another product.
(0–6)	(7–10)	(11–14)

Task 3	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate an understanding of microprocessor control applications.	
Task 3.1	
Focus 3	For this task you must limit your research to products which are in everyday use by the general public, for example a microwave oven, a TV, an electronic toy. You are looking to find out and describe how the microprocessor (chip) controls the operation of the product. For example, an 'intelligent' toaster has a sensor which monitors the condition of the bread and passes data a microprocessor – how is this done and what does the microprocessor do with the data? Present your findings as a written report which should include block diagrams/flow charts and an image for each of the chosen products. a) Select two different consumer products which contain a microprocessor and find out how they work. Prepare a short report in which you describe how each microprocessor is used to control the operation of the product. b) Include a section in the report in which, for each microprocessor control system, you identify the individual components used and explain how they work together as a system. Support your explanations with relevant block diagrams. c) For one of the products identified in tasks (a) and (b) evaluate the use of the microprocessor control system and then describe how it could be used in a completely different consumer product.

Task 4 — Investigating the use of computer technology when maintenance procedures are carried out on equipment and products

Assessment focus 4

Know about computer aided technology in maintenance operations

Band 1	Band 2	Band 3
Describes two different computer applications in a given maintenance operation. (0–6)	Describes two different computer applications in a given maintenance operation and explains how computers enable detailed fault diagnosis in a product or piece of plant or equipment. (7–10)	Describes two different computer applications in a given maintenance operation, explains how computers enable detailed fault diagnosis in a product or piece of plant or equipment and interprets computer generated data from an engineering maintenance/diagnostic operation and proposes an appropriate course of action. (11–14)

<table>
<tr><th colspan="2">Task 4</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate an understanding of microprocessor control applications.</td></tr>
<tr><th colspan="2">Task 4.1</th></tr>
<tr><td>Focus 4</td><td>There are many different types of maintenance procedure, for example diagnosing faults in equipment, replacing worn out parts, planned maintenance, monitoring and adjusting the operation of a system.

Computer based systems are very useful for maintenance purposes and can be used in many different ways, for example:
• storing data about service schedules
• holding information about spare parts
• analysing the reliability of equipment
• diagnostic testing
• downloading data from engine management systems
• monitoring the performance of a communications network and making adjustments to the operating software.

Your task is to identify two different situations where a computer system is used to carry out or assist a maintenance procedure.

There should be opportunities for research when you are on work experience.

a) Find two different engineering situations where computer systems are used in a maintenance operation and describe what is happening.
b) Identify a product or piece of plant/equipment where fault diagnosis carried out by a computer system. Explain in detail the diagnostic process and what happens to data which the computer collects.
c) For this task your tutor will give you some computer generated data which relates to a maintenance/diagnostic operation on a piece of equipment in the school/college workshop. Look through the data, interpret it and propose an appropriate course of action — for example this might be to replace a worn out part or to adjust the settings on a control unit.</td></tr>
</table>

Unit 4 Producing engineering solutions

Tutor brief

Subject: Engineering		**Level: 2**
Unit 4: Producing engineering solutions		**Assessment time: 20 hours**
LO. 1	Understand health and safety procedures, standards and risk assessment in engineering activities	
LO. 2	Be able to plan for an engineering product or services	
LO. 3	Be able to select suitable materials, parts or components for an engineered product or service	
LO. 4	Be able to use processes, tools and equipment to make an engineered product or carry out a service	
LO. 5	Be able to apply inspection techniques to the engineered product or service	
PLTS	Independent enquiries (IE6), creative thinkers, reflective learners (RL3), team workers, self-managers (SM2), effective participators (EP3)	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	**Final evidence produced**	**Location**	**Supervision**
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Any relevant process flows, sketches or diagrams.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Any relevant process flows, sketches or diagrams. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following is a sample assessment activity. In this case the assignment covers all five learning outcomes, although this would not always be the case. In this unit, two tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 4: Producing Engineering Solutions.

Task 1 — Health and safety standards and risk assessment

Assessment focus 1

Understand health and safety procedures, standards and risk assessment in engineering activities

Band 1	Band 2	Band 3
Identifies health and safety procedures and standards appropriate for a given engineering activity and identifies why a risk assessment could be necessary during the activities. (0-4)	Describes responsibilities of self and others when working on a given engineering activity and identifies substances or processes where a risk assessment would be necessary during the activity and states why it is. (5-7)	Compares health and safety responsibilities of self and others when working on a given engineering activity. Carries out a risk assessment identifying hazards and risks and states whether the risk is acceptable or not and how it can be controlled. (8-10)

Task 1 — Health and safety standards and risk assessment	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate an understanding of health and safety procedures and standards and risk assessment.	
Task 1.1	
Focus 1	1) Identify the health and safety procedures and standards that are appropriate for the engineering activity that you are about to carry out. Identify why a risk assessment could be necessary prior to the activity. 2) Describe the responsibilities of yourself and others in relation to the engineering activity that you are about to carry out. Identify the substances or processes where a risk assessment will be necessary for the engineering activity that you are about to carry out, stating the reasons for this. 3) Compare the health and safety responsibilities of yourself and others when working on the engineering activity that you have been given. Carry out a risk assessment identifying the hazards and risks, stating whether the risk is acceptable and how it can be controlled.

Task 2 — Planning an engineering activity

Assessment focus 2

Be able to plan an engineering product or service

Band 1	Band 2	Band 3
Produces a plan to include materials or components, tools and equipment and sequence of events for the manufacture of an engineered product or to carry out a service. (0-4)	Produces a detailed plan for the manufacture of an engineered product or service, and justifies the sequence of operations and reasons behind the choice of tools and equipment. (5-7)	Applies plan and proposes improvements based on application. Records all suggested improvements and justifies why the improvements have been suggested and the intended result of improvements. (8-10)

Task 2 — Planning an engineering activity	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate an ability to plan an engineering product or service.	
Task 2.1	
Focus 2	Produce a plan for the engineering activity that you are required to carry out which includes the following: • materials or components • tools and equipment • sequence of operations. You may use the attached worksheet for your plan. Explain the reason for using the sequence of operations and the choice of tools and equipment for your engineering activity plan. Once you have used your plan, identify and suggest possible improvements. Record and explain your suggestions and their intended results.

Task 2: Engineering Activity Plan

Activity: ------------------------------------ **Name:** ------------------------------------ **Date:** ------------------------------------

Operation number	Description of operation	Health and safety	Materials/components	Tools/equipment

Task 3 — Carrying out an engineering activity

Assessment focus 3

Be able to select suitable materials, parts or components for an engineered product or service

Band 1	Band 2	Band 3
Uses information given on own plan to identify and select materials, parts or components for the production of an engineered product or the carrying out of a service. (0-4)	Uses information given on own plan to identify, select and prepare materials, parts or components for the production of an engineered product or the carrying out of a service. (5-7)	Justifies the selection and preparation of materials, parts or components for the production of an engineered product or the carrying out of a service, based on the use of own plan. (8-10)

Assessment focus 4

Be able to use processes, tools and equipment to make an engineered product or carry out a service

Band 1	Band 2	Band 3
Produces, with guidance, an engineered product or carries out a service following own plan and uses processes, tools and equipment in a correct and safe manner. (0-10)	Produces, with limited guidance, an engineered product or carries out a service following own plan and correctly selects all processes, tools and equipment in a correct and safe manner, considering self and others. (11-15)	Independently produces an engineered product or carries out a service following own plan and self selects and uses additional drawings or documentation, processes, tools or equipment in an effective and safe manner, considering self and others. (16-20)

Assessment focus 5

Be able to apply inspection techniques to the engineered product or service

Band 1	Band 2	Band 3
Performs inspection techniques and checks on an engineered product or service to check compliance with plan. (0-4)	Performs inspection techniques and checks on an engineered product or service to check compliance with plan and records key measurements and assesses compliance with initial plan. (5-7)	Evaluates inspection techniques employed and the results obtained as a result. Summarises what has been learnt during the process and what might be carried out differently next time to ensure compliance. (8-10)

<table>
<tr><th colspan="2">Task 3 — Carrying out an engineering activity</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate an ability to select suitable materials, parts or components for an engineered product or service.
• Demonstrate an ability to use processes, tools and equipment to make an engineered product or carry out a service.
• Demonstrate an ability to apply inspection techniques to the engineered product or service.</td></tr>
<tr><th colspan="2">Task 3.1</th></tr>
<tr><td>Focus 3</td><td>Use your plan to identify and select materials, parts or components for the production of an engineered product or the carrying out of a service.
Prepare materials, parts or components for the task.
Explain why you chose the materials, parts or components that you have selected and justify your choice.</td></tr>
<tr><th colspan="2">Task 3.2</th></tr>
<tr><td>Focus 4</td><td>Follow your plan to produce an engineered product or carry out a service. Select and use processes, tools and equipment in a correct and safe manner, considering the safety of yourself and others.</td></tr>
<tr><th colspan="2">Task 3.3</th></tr>
<tr><td>Focus 5</td><td>Inspect the engineered product or service to check that it complies with your plan.
Record key measurements and compare the results with the initial plan to assess compliance.
Evaluate your use of inspection techniques and the results that you obtained. Explain what you have learnt during the process and what might be done differently next time to ensure compliance.</td></tr>
</table>

Unit 5 Electrical and Electronic Circuits and Systems

Tutor brief

Subject: Engineering		Level: 2
Unit 5: Electrical and Electronic Circuits and Systems		**Assessment time: 10 hours**
LO. 1	Understand safe working practices in the workshop/laboratory and understand relevant electrical and electronic principles	
LO. 2	Be able to recognise and select components used in electrical and electronic circuits	
LO. 3	Be able to construct an electrical circuit and understand its basic operating principles	
LO. 4	Be able to test and find faults on electronic circuits	
PLTS	Independent enquiries, creative thinkers (CT5), reflective learners, team workers, self-managers (SM2), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- written evidence, such as reports, essays, minutes
- artefacts, such as artwork, manufactured products and other non-written physical evidence
- performance evidence, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• Annotated photographic evidence. • A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 2	• Annotated photographic evidence. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Specialist	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 5 of the Level 2 Engineering Diploma. In this case the assignment covers all four learning outcomes, although this would not always be the case. For this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 5: Electrical and Electronic Circuits and Systems.

Task 1 — Construct an electronic circuit and demonstrate safe working practices

Assessment focus 1

Be able to demonstrate safe working practices in the workshop/laboratory and understand relevant electrical and electronic principles

Band 1	Band 2	Band 3
Demonstrates safe working practices when constructing, testing and fault finding on electronic circuits. (0-6)	Demonstrates safe working practices when constructing, testing and fault finding on electronic circuits and determines current, voltage and power in a simple DC circuit. (7-11)	Demonstrates safe working practices when constructing, testing and fault finding on electronic circuits and determines current, voltage and power in a simple DC circuit, and calculates appropriate ratings for fuses and other protection devices in an AC circuit stating any assumptions made. (12-15)

Assessment focus 3.1

Be able to construct an electronic circuit

Band 1	Band 2	Band 3
Uses appropriate techniques to construct an electronic circuit from a given circuit diagram, with assistance. (0-6)	Uses appropriate techniques to construct an electronic circuit from a given circuit diagram with limited assistance. (7-11)	Uses appropriate techniques to construct an electronic circuit from a given circuit diagram, independently. (12-15)

Assessment focus 3.2

Understand the basic operating principles of an electronic circuit

Band 1	Band 2	Band 3
Describes the overall function of the circuit they have constructed. (0-2)	Describes the overall function of the circuit they have constructed, and explain the function of each individual component. (3-4)	Describes the overall function of the circuit they have constructed, explains the operation of the circuit with reference to the function of each individual component, and explains the overall operation/action of the circuit. (5-6)

Task 1 — Construct an electronic circuit and demonstrate safe working practices and understand principles	
Purpose The purpose of this task is to provide a framework within which the learner can: • be able to demonstrate safe working practices in the workshop/laboratory and understand relevant electrical and electronic principles • be able to construct an electronic circuit and understand its basic operating principles.	
Task 1.1	
Focus 3.1	You have been given an electronic circuit diagram together with the required components and circuit board. Construct the circuit ensuring you follow all health and safety guidelines.
Task 1.2	
Focus 1	Ensure all safe working practices are followed during the construction.
Task 1.3	
Focus 3.2	a) Provide a written description of the overall function of the circuit. b) Explain the function of each component in the circuit. c) Explain in detail the operation of the circuit.
Task 1.4	
Focus 1	You have been given a circuit diagram of a potential divider circuit. Determine the following values: a) Total resistance in the circuit b) Total current in the circuit c) Voltage across each resistor d) Total power drawn from the supply.
Task 1.5	
Focus 1	You have been supplied with data for an AC mains operated appliance. Calculate the required fuse rating for the circuit.

Task 2 — Recognise and select components

Assessment focus 2

Be able to recognise and select components used in electrical and electronic circuits

Band 1	Band 2	Band 3
Identifies six different components used in electrical and electronic circuits. (0-6)	Identifies nine different components used in electrical and electronic circuits and selects an appropriate component for an electrical/electronic circuit application. (7-8)	Identifies 12 different components used in electrical and electronic circuits and selects appropriate components for two different electrical/electronic circuit application. (9-10)

Task 2 — Recognise and select components	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate how to recognise components for use in electrical/electronic components.	
Task 2.1	
Focus 2	You have been given 12 different electrical/electronic components. Identify as many as you can.
Task 2.2	
Focus 2	You have been given an electronic circuit diagram. Select two suitable components for use in the circuit.
Task 2.3	
Focus 2	You have been given another electronic circuit diagram. Select a further two suitable components for use in this circuit.

Task 3 — Testing and fault finding on electronic circuits

Assessment focus 4

Be able to test and find faults on electronic circuits

Band 1	Band 2	Band 3
Uses appropriate techniques and test instruments to carry out basic voltage, current and signal tests on a given working circuit in order to verify that it is functioning correctly. (0-8)	Uses appropriate techniques and test instruments to carry out basic voltage, current and signal tests on a given working circuit in order to verify that it is functioning correctly and uses appropriate fault-finding techniques and test instruments to locate and identify a fault on a similar circuit. (9-15)	Uses appropriate techniques and test instruments to carry out basic voltage, current and signal tests on a given working circuit in order to verify that it is functioning correctly, use appropriate fault-finding techniques and test instruments to locate and identify two different faults on a similar circuit. (16-20)

Task 3 — Testing and fault finding on electronic circuits	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate the ability to test and find faults on electronic circuits.	
Task 3.1	
Focus 4	You have been given an electronic circuit and appropriate test equipment. Use the equipment to measure and record the following: a) Voltage b) Supply current c) Input waveform d) Output waveform.
Task 3.2	
Focus 4	You have been given an electronic circuit, which has a fault on it, together with appropriate test equipment and the voltages, current and waveforms for the circuit when it is not faulty. Use the information and test equipment to locate the fault.
Task 3.3	
Focus 4	You have been given a second electronic circuit, which has a fault on it, together with appropriate test equipment and the voltages, current and waveforms for the circuit when it is not faulty. Use the information and test equipment to locate the fault.

Unit 6 Application of Manufacturing Techniques in Engineering

Tutor brief

Subject: Engineering		Level: 2
Unit 6: Application of Manufacturing Techniques in Engineering		**Assessment time: 20 hours**
LO. 1	Be able to work effectively in a production team and reflect on their performance	
LO. 2	Know about production information and how this is used to plan and schedule for manufacturing	
LO. 3	Be able to set up and use tools and CNC equipment safely to process materials	
LO. 4	Be able to apply appropriate quality control techniques and interpret quality data	
PLTS	Independent enquiries (IE4), creative thinkers, reflective learners (RL1,5), team workers (TW4), self-managers (SM2,3), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- written evidence, such as reports, essays, minutes
- artefacts, such as artwork, manufactured products and other non-written physical evidence
- performance evidence, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 2	• Production plan and schedule. • A4 written evidence must be clearly legible, preferably word-processed.	Classroom/ workshop	Supervised
Task 3	• Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • Activity plan. • Annotated photographic evidence where suitable.	Classroom/ workshop	Supervised
Task 4	• Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • A4 written evidence must be clearly legible, preferably word-processed. • Activity plan. • Annotated photographic evidence where suitable.	Classroom/ workshop	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

Working as a team to manufacture a small batch of components using a CNC lathe.

The following is a sample assessment activity. In this case the suggestion covers the whole of Learning Outcomes 1 to 4 but this need not always be the case. In this unit, four tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 6: Application of Manufacturing Techniques in Engineering.

Learner guidance

Your task is to work, as a member of a three-person team, on the production of a small batch of components machined on a CNC lathe. The team will be given bar stock (mild steel, aluminium or a stable plastic) of sufficient length to make 12 identical components.

You need to show that you can:

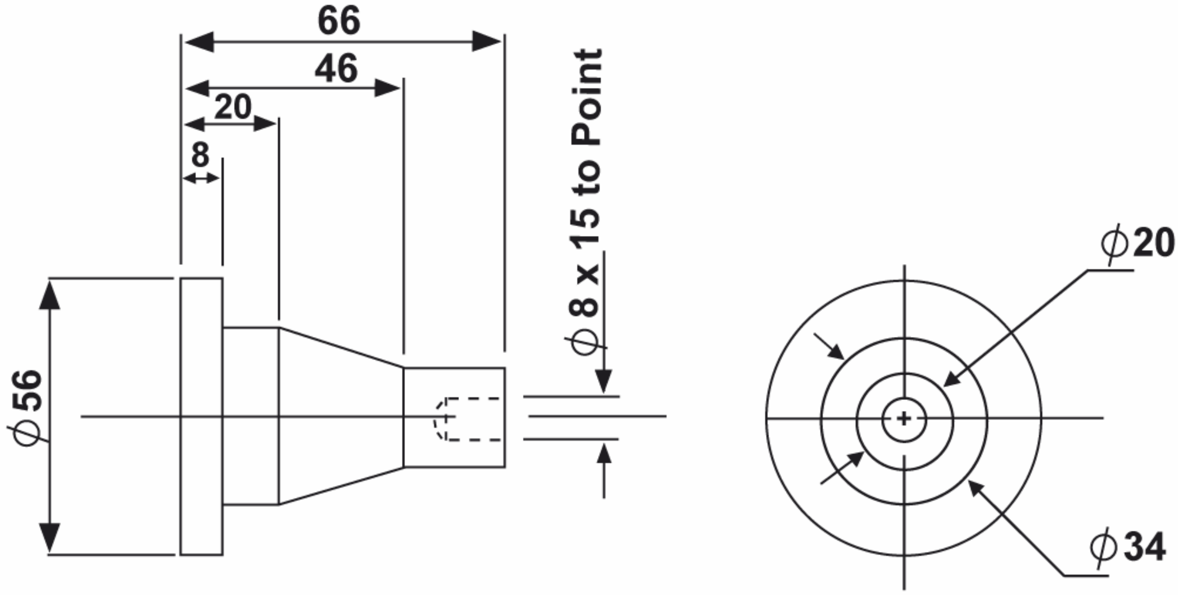
- plan the manufacture of the component
- set up and use a CNC machine tool
- use quality control techniques to monitor the manufacturing process
- work effectively in a team
- review your role in the team, identifying your strengths and weaknesses.

The activities within the tasks include reading a drawing, interpreting manufacturing data (eg cutting speeds and feed rates), team negotiation, planning and scheduling, manufacturing, evaluating the success of the project and reviewing your contribution.

The way you will be working should simulate what happens in industry when a number of specialists work together on a project. You may have differences of opinions within your team but these must be resolved because, just as in an actual industrial situation, targets have to be met and products shipped to the customer.

There is one objective which covers all the assessment foci of the unit to successfully manufacture the batch of components.

The following is a drawing of the component which you are going to manufacture.



General tolerance ±0.4		
All dimns mm	20 All over	
Fillet rad 2	Scale 1:1	
Matl. MS or ALUM	Component No 1	

Task 1 — Working as a member of a production team

Assessment focus 1

Be able to work effectively in a production team and reflect on their performance

Mark B

Band 1	Band 2	Band 3
Participate effectively in a production team and describes own role in the team, with an indication of own strengths and weaknesses. (0–3)	Participates effectively in a production team and explains how own role was part of the overall team and gives an indication of own strengths and weaknesses. (4–5)	Participate effectively in a production team and analyses own contribution to team, recognising strengths and weaknesses, and suggests how it could have been improved. (6–7)

This task involves working with people and keeping a record of the contribution you made to the project. The activities will spread over the whole time spent working on this assignment and evidence should be presented in the form of:

- a logbook
- team meeting minutes
- witness statements
- tutor observation records
- annotated photographs of team working
- a personal performance review.

During the life of the assignment you must have regular review meetings with your tutor so that they can check how you are collecting and keeping evidence.

Task 1	
Focus 1	a) Work effectively as a member of a production team and write a short report in which you describe your role and identify your own strengths and weaknesses. b) Add to the report a fuller explanation of your role as a team member. c) Explain how your contribution to the team affected the success of assessment foci 2, 3 and 4. d) Suggest ways that your contribution could have been improved taking account of your strengths and weaknesses.

Task 2 — Using production information to plan and schedule a manufacturing process

Assessment focus 2.1

Know about production information

Mark A

Band 1	Band 2	Band 3
Describes essential production information found in product drawings and a specification for a given engineered product. (0–4)	Describes the essential production information found in product drawings and a specification for a given engineered product with interpretation. (5–7)	Describes the essential production information from product drawings and a specification for a given engineered product with correct interpretation. (8–10)

Assessment focus 2.2

Production plans and schedules

Mark A

Band 1	Band 2	Band 3
Produces a production plan and schedule for the manufacture of a quantity of the same engineered product. (0–4)	Produces a detailed production plan and realistic schedule for the manufacture of a quantity of the same engineered product. (5–7)	Produces a detailed production plan and realistic schedule for the manufacture of a quantity of the same engineered product and justifies the sequence of operations and schedule. (8–9)

Correctly interpreting data presented in an engineering drawing is important so that time is not wasted making costly mistakes when cutting materials.

The activities for task 2 are based on the drawing shown at the beginning of this assignment brief. Work in your team to interpret it and produce a production plan; then on an individual basis present what you have established as a short report.

<table>
<tr><th colspan="2">Task 2.1</th></tr>
<tr><td>Focus 2.1</td><td>a) From the drawing identify and describe four pieces of essential production information.
b) Choose one of the pieces of production information which you identified in activity (a), interpret what it means and describe how it will influence decisions when the production plan for the component is developed.
c) Interpret all the information presented in the drawing and describe how it will be used when the production plan and schedule for the component are developed.</td></tr>
<tr><th colspan="2">Task 2.2</th></tr>
<tr><td>Focus 2.2</td><td>You now need to think about what is involved in the manufacture of 12 components using a CNC machine. The aim is to produce a ‘first off’ which hopefully will be correct, but if not then make provision for adjusting the CNC programme. Having corrected it go on to manufacture the remaining 11 components which should all be identical and within tolerance.
a) Write a production plan and schedule which take account of the following:
• materials
• machine tool
• cutting tools
• timescales
• sequence of machining operations
• measuring equipment for quality assurance (QA) purposes
• QA documentation.
b) Add more detail to your plan and schedule so that key milestones are included. You are looking to produce documents which contain enough information for someone in a workshop to be able to ‘pick up and run’ with them without having to ask you for any help or guidance.
c) Write a short report in which you justify the sequence of manufacturing operations and scheduling the production of the component. You should take account of workshop and machine tool availability, given that there may only be one CNC lathe in your school/college workshop but several teams wanting to use it. You could perhaps think about doing the manufacturing when you are on work experience if the employer has a training workshop and is willing to let your team use one of their machines (you would need to talk to your tutor about health and safety and supervision).</td></tr>
</table>

Task 3 — Setting up and using CNC machinery

Assessment focus 3

Be able to set up and use tools and CNC equipment safely to process materials

Mark B

Band 1	Band 2	Band 3
With guidance sets up and uses CNC tools and equipment to manufacture a quantity of the same simple engineered product safely, maintaining a clean and tidy working environment. Comments on the success of this activity. (0–10)	With limited guidance prepares given material, sets up and uses CNC tools and equipment to manufacture a quantity of the same simple engineered product safely, maintaining a clean and tidy working environment. Reviews the success of this activity. (11–17)	Independently selects and prepares material, sets up and uses CNC tools and equipment to manufacture a quantity of the same simple engineered product safely, maintaining a clean and tidy working environment. Evaluates the success of this activity. (18–24)

For this task you are going to demonstrate that you can programme and safely use a CNC machine. You must work in an organised manner, keep the machine tidy and when you have finished work clean it down and leave ready for the next person to use.

Each member of your team should take a turn at entering programme data into the machine. Make sure that as this happens your tutor keeps an observation record and takes photographs.

Task 3	
Focus 3	For this task you are going to assume the role of a CNC machine tool technician. You will refer to the component drawing and production plan as you enter a programme into the machine using its keypad or input interface. Programming CNC machines is a complex skill and takes a long time to learn so for this task you may need some help — you have three options to choose from when deciding which mark band to aim for. Ensure that you use the appropriate PPE and ask your tutor to check that all your settings are safe before you proceed to machine the components. The checking of the safety aspects will not affect your mark if you are aiming for bands 2 or 3. a) With help from your tutor or workshop technician, programme and set up the CNC lathe so that the component can be manufactured. Produce a first off, carry out dimensional checks, make adjustments to the programme and then complete the manufacture of the batch. You must maintain a clean and tidy working environment and make a brief comment in your logbook about how successful you were in carrying out the activity. b) Carry out activity (a) with only limited help and on completion write a review of how successful you were. c) Carry out activity (a) with no help and on completion write a detailed evaluation of how successful you were. Include a comment about what you might do differently in the future to improve the performance of the manufacturing operation.

Task 4 — Using quality control techniques

Assessment focus 4

Be able to apply appropriate quality control techniques and interpret quality data

Mark A

Band 1	Band 2	Band 3
Uses quality control techniques correctly, including statistical methods, to establish whether a sample of engineered products conforms to the standards specified. (0–4)	Records quality control and statistical data obtained by using appropriate techniques, including statistical methods, in an accurate and appropriate format and establishes the extent to which a sample of engineered products conforms to the standards specified. (5–7)	Records quality control and statistical data obtained by using appropriate techniques, including statistical methods, in an accurate and appropriate format and establishes the extent to which a sample of engineered products conforms to the standards specified. Analyses reasons for success/failure of production, with a suggestion for improvement where appropriate. (8–9)

As a team you will have produced a small batch of components. In industry when large batches of components are manufactured it is not economic to inspect everyone and so a sample is taken, for example 50 components every hour when a machine is running continuously.

From your batch select 10 finished components which you can use for quality assurance purposes (do not include the first off because it may be faulty).

Task 4	
Focus 4	a) Choose one outside diameter and one axial length to check. Then use suitable equipment to measure the two dimensions on each of the 10 components and record your results in a table like this:

Component	**Diameter**		**Length**	
	Measured	Specified	Measured	Specified
1				
2				
3				
etc				

Process this data using a statistical method eg find the mean and range and establish if the batch conforms to specification for these two dimensions.

Select two components from the batch and use a plug gauge to check the diameter of the drilled hole (ask your tutor for a suitable gauge).

Select one component and carry out a full dimensional and visual inspection.

Now write a brief inspection report about the components, making sure you address the following two points:

Based on what you found out in the activities above, does the batch of components conform to the requirements of the drawing?

Would a customer be prepared to take delivery of the components?

b) Make an accurate record of the data you collected in activity (a) and present in a way that lets an independent person make a judgement about whether the components are to specification.

c) Analyse reasons why the production of the components was a success or a failure and suggest ways that the process could be improved or modified if a second batch of components were to be made.

Unit 7 Application of Maintenance Techniques in Engineering

Tutor brief

Subject: Engineering		Level: 2
Unit 7: Application of Maintenance Techniques in Engineering		**Assessment time: 10 hours**
LO. 1	Understand different types of maintenance for engineering products, plant or equipment including the use of statistical trends	
LO. 2	Be able to carry out routine maintenance tasks and devise a maintenance procedure	
LO. 3	Understand the effects of poor maintenance and the range of spares and replacement parts	
LO. 4	Be able to carry out a risk assessment in a maintenance environment	
PLTS	Independent enquiries (IE4), creative thinkers, reflective learners (RL5), team workers, self-managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refers to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom/ workshop	Supervised
Task 3	• Annotated photographic evidence. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following is a sample assessment activity. In this case the assignment covers all four learning outcomes, although this would not always be the case. In this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 7: Applications of Maintenance Techniques in Engineering.

Task 1 — Types of maintenance and statistical analysis

Assessment focus 1.1

Know about types of maintenance

Band 1	Band 2	Band 3
Describes two given different types of maintenance appropriate to engineered products, plant or equipment. (0-4)	Explains the use of two given types of maintenance for engineered products, plant or equipment. (5-7)	Explains the use of two given types of maintenance for engineered products, plant or equipment and justifies the use of one of these. (8-10)

Assessment focus 1.2

Know about statistical trends

Band 1	Band 2	Band 3
Uses a statistical method to analyse and evaluate a trend, judging its relevance and value in a product, plant or equipment performance. (0-4)	Calculates mean-time-to-failure from given data based on equipment failure rate and weighting factors and draw a conclusion. (5-7)	Describes how statistical data including mean-time-to-failure data can act as an aid to determining equipment reliability. (8-9)

Task 1 — Types of maintenance and statistical analysis	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of types of maintenance and carry out statistical analysis.	
Task 1.1	
Focus 1.1	a) Describe two different types of maintenance that are carried out on engineered product, plant or equipment. b) Explain where these different types of maintenance procedures are used. c) Choose one of the above types of maintenance and justify why this is appropriate to your chosen engineered product, plant or equipment.
Task 1.2	
Focus 1.2	Use the data you have been given to analyse the trend that the data predicts. State the relevance and value of this trend. Use the data you have been given to predict the mean-time-to-failure of the equipment and explain the likely consequence. Describe how the data you have produced can be used to predict the reliability of your chosen engineered product, plant or equipment.

Task 2 — Routine maintenance

Assessment focus 2.1

Be able to carry out routine maintenance

Band 1	Band 2	Band 3
Follows a given maintenance procedure to correctly carry out two routine adjustments to an engineered product, plant or equipment. (0-4)	Follows a given maintenance procedure to correctly carry out two routine adjustments and routine servicing including replacement or replenishment of consumable items. (5-7)	Interprets a given maintenance procedure to correctly diagnose and carry out two routine adjustments and routine servicing to an engineered product, plant or equipment including replacement or replenishment of consumable items. (8-10)

Assessment focus 3.1

Understand the implications of properly maintained products, plant or equipment

Band 1	Band 2	Band 3
Describes two implications if products, plant or equipment are not properly maintained. (0-4)	Describes two implications and explains a way of reducing the impact of improper maintenance. (5-6)	Describes two implications of improper maintenance. Explains and justifies a way of reducing the impact of improper maintenance. (7-8)

Task 2 — Routine maintenance	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate how to carry out a routine maintenance procedure and understand the implications of maintenance.	
Task 2.1	
Focus 2.1	You have been given a maintenance procedure to carry out which includes making two adjustments to the equipment. Carry out these adjustments. The maintenance procedure requires the replacement of a part. Carry out this replacement. Carry out a diagnostic check to see if further maintenance is required.
Task 2.2	
Focus 3.1	Describe two problems that might occur if the product, plant or equipment is not properly maintained. Explain and justify how the impact of these problems could be reduced.

Task 3 — Risk assessments and maintenance procedures

Assessment focus 4

Be able to carry out a risk assessment in a maintenance environment

Band 1	Band 2	Band 3
Carries out a risk assessment for a given engineering maintenance task using given documentation. (0-4)	Carries out a risk assessment for a given engineering maintenance task using appropriate documentation taking into account correct use and storage of PPE. (5-6)	Carries out a risk assessment for a given engineering maintenance task using appropriate documentation taking into account correct use and storage of PPE, health and safety regulations and warning signs. (7-8)

Assessment focus 2.2

Be able to devise a maintenance procedure

Band 1	Band 2	Band 3
Uses the experience of following a maintenance procedure to devise a different maintenance procedure for a given engineered product, plant or equipment. (0-4)	Uses the experience of following a maintenance procedure to devise a different detailed maintenance procedure for a given engineered product, plant or equipment. (5-6)	Uses the experience of following a maintenance procedure to devise a different detailed maintenance procedure that is easy to follow for a given engineered product, plant or equipment. (7-8)

Assessment focus 3.2

Range of spares, replacement parts and stock levels

Band 1	Band 2	Band 3
Identifies spares or replacement parts for a given maintenance task. (0-3)	Identifies spares or replacement parts for a given maintenance task and describes the consequences of not maintaining the appropriate stocklevels for those spares and replacement parts. (4-5)	Identifies spares or replacement parts for a given maintenance task, describes the consequences of not maintaining the appropriate stocklevels and uses statistical data to justify appropriate stock levels for those spares and replacement parts. (6-7)

Task 3 — Risk assessments and maintenance procedures	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate how to carry out a risk assessment and develop a maintenance procedure.	
Task 3.1	
Focus 4	You have been given the documentation required for an engineering maintenance procedure. Carry out a risk assessment for this procedure. Include in your risk assessment how PPE should be correctly used and stored. Also include how health and safety regulations and warning signs should be used.
Task 3.2	
Focus 2.2	Devise a maintenance procedure for the engineering product, plant or equipment. The procedure should include the following aspects: • sequence to follow, timescales, tooling/resources required, documentation to use, safety practices, relevant diagnostic routines. Present your maintenance procedure in a logical and easy to follow fashion.
Task 3.3	
Focus 3.2	Identify the spares or replacement parts required for the maintenance procedure that you have designed. Describe what would happen if appropriate stock levels were not maintained. Use a statistical method to show what appropriate levels should be maintained.

Unit 8 Exploring Engineering Innovation, Enterprise and Technological Advancements

Assignment

The following represents a typical externally-set assessment that will give learners an opportunity to generate evidence for all of learning outcomes for Unit 8 of the Engineering Diploma at Level 2.

The assessment consists of a series of short-answer questions and candidates will be given 90 minutes to complete the paper.

Answer **ALL** questions in the spaces provided.

The assessment focuses on the Case study *RoboMop*.

1. Convinced Lucy has a good idea a friend has warned her that she must register *RoboMop* with the UK Patent office to stop anybody stealing her intellectual property. As Lucy is not familiar with the process, advise Lucy on what she should do next.

a) Listed below on the left are the four main types of Intellectual Property. On the right is an explanation of how each offers protection (as identified by the UK Patent Office). Connect each the type of Intellectual property to the correct description.

Patents	legally protect a new idea, innovation, product or process
Trade mark	legally protects the appearance of a product
Copyright	used for the for the identification of a brand and is used to identify companies and products
Registration	used to protect the creative skill or item of work and is not required to be registered

(4)

b) Identify how Lucy may benefit from registering her intellectual property for her product *RoboMop*.

....

....

....

(3)

c) One type of Intellectual Property would be most suitable to Lucy's product at this time. Explain why the other three are not appropriate at this time.

....

....

....

(3)

(Total 10 marks)

2. Before Lucy can launch her product she must research and develop her idea.

   (a) List areas of research Lucy must undertake before she can reach the development stage of her project.

   ....

   ....

   ....

   (3)

   (b) Briefly explain why this research is essential to the success of *RoboMop*

   ....

   ....

   ....

   (3)

   (c) Describe two appropriate primary and two secondary sources Lucy could use for her research.

   ....

   ....

   ....

   ....

   (4)

   (Total 10 marks)

---

3. As this is Lucy's first invention she has neglected to produce a financial plan for her proposal.

a) Describe four reasons why Lucy will need to raise financial backing.

   ....

   ....

   ....

   ....

   (4)

b) Give three suggestions on how Lucy could raise financial backing

....

....

....

(3)

c) Suggest three suitable organisations that could be interested in helping Lucy and give the reasons for your answer.

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....

(3)

(Total 10 marks)

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4. Suggest a suitable material for the manufacture of the outer casing of *RoboMop* to meet the requirements outlined in the case study. Why have you selected this material and determine the specific properties of this material that would benefit *RoboMop*.

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(Total 10 marks)

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5. Lucy's invention was initially intended for use in her home to make cleaning floors in hard to reach places more accessible. Describe how else this invention could impact on life in the home, workplace and built environment and evaluate the potential impact of this product.

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(Total 10 marks)

6. Lucy is very conscious that the manufacture of RoboMop is environmentally friendly and that it operates as a green product.

a) Describe how Lucy can increase energy efficiency, reduce waste and the use of raw materials in the manufacture of *RoboMop*.

....

....

....

....

(4)

b) Identify design features that Lucy could include to ensure the operation of *RoboMop* is more environmentally friendly.

....

....

....

(3)

c) Lucy is insisting that RoboMop will need to obtain its power from a natural sustainable source. Describe a method on how Lucy could achieve this.

....

....

....

(3)

(Total 10 marks)

TOTAL MARKS FOR PAPER 60

END

Mark scheme

Question number	Correct answer	Mark
1a	Patents are used to legally protect a new idea, innovation product or process [1 mark]. Registration of a design legally protects the appearance of a product [1 mark]. A trade mark is used for the identification of a brand and is used to identify companies or products [1 mark]. A copyright is used to protect a creative skill or item of work and is not required to be registered [1 mark].	4 marks
1b	Lucy will be able to be acknowledged for her good idea [1 mark], she will be able to legally stop others from using her idea without permission [1 mark] and be able to sell her product for financial gain or charge others to use her idea [1 mark].	3 marks
1c	A design, trademark or copyright would not be appropriate at this time as the final design of the *RoboMop* may be very different [1 mark], the product is not yet established [1 mark] and copyright does not apply to ideas for artefacts [1 mark].	3 marks
2a	Lucy will need to research three of the following areas: • The market potential. [1 mark] • The existence of similar or competitive products. [1 mark] • The views and thoughts of potential users. [1 mark] • The financial cost of launching the product. [1 mark]	3 marks
2b	The market potential of the product to determine if anyone will want to use the product and if the product will sell [1 mark]. The existence of any similar or competitive products to determine who the main competitors are and what in addition our product will offer [1 mark], the financial cost of launching the product is required to determine if the funds are available [1 mark].	3 marks
2c	Primary sources could include questioners [1 mark], interviews [1 mark] and surveys [1 mark] to determine the needs and views of potential users. Secondary sources could include the internet [1 mark] to research competitors and the market potential of the product, magazine [1 mark], research publication [1 mark]. *Or 1 mark for any other suitable answer*	4 marks

Question number	Correct answer	Mark
3a	For the product to succeed Lucy will need to ensure that sufficient funds are available for the following key areas: • to carry out sufficient research and development [1 mark] • to pay for the production and manufacture, including design process, parts and labour [1 mark] • money to publicise and sell the product [1 mark] • money for training and customer support [1 mark].	4 marks
3b	Funds can be raised by finding a suitable sponsor [1 mark] or borrowing money from a bank [1 mark] or alternatively applying for a grant [1 mark].	3 marks
3c	Suitable sponsors may include manufacturers of similar products such as Dyson, Hoover, or Electrolux [1 mark]. Small business loans can be applied for at high street banks such as Barclays or Nat West [1 mark] and government grants may be applied for if the product meets a specified need for example to help the elderly [1 mark]. *Or any other suitable answer*	3 marks
4	The outer casing of *RoboMop* is required to be durable [1 mark], solvent resistant (resistant to chemical detergents) [1 mark], stable at normal household temperatures [1 mark] and capable of being reused [1 mark]. A thermoplastic material would be most suitable [1 mark] as this would be cost effective [1 mark] and recyclable [1 mark]. A suitable material would be Ultra Polyvinylchloride (UPVC) [1 mark] as this would be appropriate for moulding [1 mark] and therefore manufacturing in quantity [1 mark]. *(These are suggested answers but suitable alternatives would also be acceptable.)*	10 marks

Question number	Correct answer	Mark
5	Lucy's invention would be helpful to people who are unable to clean their own floors at home [1 mark]. It may also assist in cleaning offices and workplaces [1 mark] and could also be used in industrial applications to clean factories and large industrial spaces [1 mark]. People who could benefit from this at home would include the elderly [1 mark], people with disabilities and anyone who is short on time [1 mark]. Office managers and cleaning companies would benefit in the workplace [1 mark]. Factory floor mangers, hospitals and large industrial companies could also benefit from this product [1 mark]. Lucy's invention would allow people who may previously be unable to clean their floors at home the opportunity to do so [1 mark]. It will also allow for savings on the cost of cleaning within the workplace [1 mark]. By adapting the cleaning solution used *RoboMop* could be used in industrial cleaning or sterilisation for industrial and clinical needs [1 mark]. *(These are suggested answers but suitable alternatives would also be acceptable.)*	10 marks
6a	Consideration needs to be given to the use of biodegradable [1 mark] and recyclable [1 mark] products throughout the manufacture of *RoboMop* to reduce the need of raw materials. To keep waste to a minimum lean manufacture is to be encouraged [1 mark] and the forming and finishing process is to be kept to a minimum to reduce manufacturing time and the consumption of energy and resources [1 mark].	4 marks
6b	In the operating instructions Lucy could encourage the use of 'Grey water' or rain water instead of tap water for use with diluting the detergent [1 mark]. She could also ask the user to consider how frequently they need to clean their floor to help reduce energy from unnecessary use [1 mark]. In addition she could encourage the use of environmentally friendly detergents [1 mark]. *(These are suggested answers but suitable alternatives would also be acceptable.)*	3 marks
6c	The use of battery power would be ideally suited for *RoboMop* due to its mobility [1 mark], as the product is intended to be used at night the batteries could be charged throughout the day and the use of solar cells [1 mark] would give sufficient power to charge the batteries. Therefore the product would need to be stored by a window during the day to gain a sufficient charge. [1 mark]	3 marks

Level 3

Unit 1 Investigating Engineering Business and the Environment

Assignment

The following represents a typical externally-set assessment that will give learners an opportunity to generate evidence for all of learning outcomes for Unit 1 of the Engineering Diploma at Level 3.

The assessment consists of a series of multiple-choice questions, short-answer questions and long-answer questions and candidates will be given 90 minutes to complete the paper.

SECTION A

Answer **ALL** questions in the spaces provided.

1. An engineering company designs and manufactures navigation aids for use on light aircraft. Which two engineering sectors is this company associated with?

(i)	aerospace and electronics	[x]
(ii)	aerospace and telecommunications	[x]
(iii)	electronics and navigation	[x]
(iv)	electronics and telecommunications	[x]

(1 mark)

2. When used in the UK and in Europe, the term SME usually refers to a business with fewer than?

(i)	10 employees	[x]
(ii)	50 employees	[x]
(iii)	250 employees	[x]
(iv)	500 employees	[x]

(1 mark)

3. Which one of the following departments of an engineering company would be responsible for employee welfare?

(i)	finance	[x]
(ii)	production	[x]
(iii)	purchasing	[x]
(iv)	personnel	[x]

(1 mark)

4. Which is the company interface that will operate where a supplier delivers faulty goods to a manufacturing plant?

(i)	marketing with product development	[x]
(ii)	finance with manufacture	[x]
(iii)	quality control with purchasing	[x]
(iv)	sales with production planning	[x]

(1 mark)

5. Step-by-step information on how a component is manufactured would be found in:

(i)	a detail drawing	[x]
(ii)	an operating manual	[x]
(iii)	an equipment specification	[x]
(iv)	a process sheet or work instruction	[x]

(1 mark)

6. An economic factor that affects any kind of engineering company is:

(i)	a shortage in the supply of grain	[x]
(ii)	a rise in the price of copper	[x]
(iii)	an increase in the cost of oil	[x]
(iv)	a trade deficit in the uk	[x]

(1 mark)

7. The gross domestic product per head is a measure of a country's:

(i)	population	[x]
(ii)	number of unemployed workers	[x]
(iii)	productivity	[x]
(iv)	flexibility	[x]

(1 mark)

8. With regard to the production of an aircraft engine, the direct labour element is provided by the people who:

(i)	are to use the completed engine	[x]
(ii)	are sub-contracted to supply the engine parts	[x]
(iii)	deliver the engine to the end user	[x]
(iv)	assemble the engine ready for delivery	[x]

(1 mark)

9. A by-product from an engineering process is:

(i)	the main purpose of the process	[x]
(ii)	an undesirable waste product	[x]
(iii)	a pollutant	[x]
(iv)	a further product from the process which can be put to some use	[x]

(1 mark)

10. Engineering companies often choose sites close to motorways. This is mainly because:

(i)	it helps reduce transport costs	[x]
(ii)	it reduces employees' travel costs	[x]
(iii)	Government grants are available	[x]
(iv)	customers can travel easily to visit the company site	[x]

(1 mark)

11. The following figures relate to the production of a small component:

Fixed costs:	£20,000
Variable cost per unit:	£4
Selling price:	£6

Which one of the following gives the breakeven point in sales turnover?

(i)	£20,000	[x]
(ii)	£30,000	[x]
(iii)	£40,000	[x]
(iv)	£60,000	[x]

(1 mark)

12. Which one of the following costs CANNOT be identified directly with a product?

(i)	prime cost	[x]
(ii)	material cost	[x]
(iii)	overhead cost	[x]
(iv)	variable cost	[x]

(1 mark)

13. A company can predict the amount of money that it has to operate with at any given time using it's

(i)	cash-flow forecast	[x]
(ii)	marketing budget	[x]
(iii)	sales forecast	[x]
(iv)	strategic plan	[x]

(1 mark)

14. An engineering company will define its organisational goals in it's:

(i)	marketing plan	[x]
(ii)	operational plan	[x]
(iii)	production plan	[x]
(iv)	strategic plan	[x]

(1 mark)

15. Production managers determine methods of meeting predicted demands by means of a process called:

(i)	capacity planning	[x]
(ii)	operational planning	[x]
(iii)	process planning	[x]
(iv)	strategic planning	[x]

(1 mark)

16. The Health and Safety at Work Act applies:

(i)	only to employers	[x]
(ii)	only to employees	[x]
(iii)	to employers and employees	[x]
(iv)	only to dangerous activities	[x]

(1 mark)

17. Acid rain can result from processes that generate:

(i)	chlorine dioxide	[x]
(ii)	nitrous oxide	[x]
(iii)	carbon dioxide	[x]
(iv)	sulphur dioxide	[x]

(1 mark)

18. Oxides of nitrogen, carbon monoxide and other toxic gases are constituents of:

(i)	gas used for welding and brazing	[x]
(ii)	fumes generated by a soldering iron	[x]
(iii)	exhaust gases from an internal combustion engine	[x]
(iv)	fuel burned by a diesel engine	[x]

(1 mark)

19. Risk assessment applies to:

(i)	the availability of First Aid Equipment	[x]
(ii)	the likelihood that an accident can occur when something goes wrong	[x]
(iii)	the way that a particular engineering activity is performed and the circumstances and environment in which it is performed	[x]
(iv)	the hazardous processes used in a production plant, workshop or laboratory and how these are brought to the attention of employees and visitors	[x]

(1 mark)

20. An engineer suffers a dislocated shoulder when a crate containing heavy metal parts falls from an overhead conveyor. The engineer returns to work after a medical check reveals that no permanent injury has been sustained. Which one of the following applies?

(i)	There is no need to report or keep a record of this incident but engineers should be warned not to work near the overhead conveyor in future.	[x]
(ii)	There is no need to report or keep a record of this incident but visual and audible warnings should be given when the conveyor is in use.	[x]
(iii)	A record should be made of the incident in the company's accident book and all personnel should be made aware of the hazard.	[x]
(iv)	The incident constitutes a major injury under RIDDOR and a report should be made.	[x]

(1 mark)

TOTAL SECTION A: 20 MARKS

SECTION B

Short answer questions (answer all four questions).

21. List THREE different engineering functions and for EACH function give a typical example of the information that it requires for its normal operation.

Engineering function: ....

Example of information:...

(2)

Engineering function: ....

Example of information:...

(2)

Engineering function: ....

Example of information:...

(2)

(6 marks)

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22. Explain the following terms:

(a) Gross National Product (GNP)...

....

....

(2)

(b) Gross Domestic Product (GDP)...

....

....

(2)

(4 marks)

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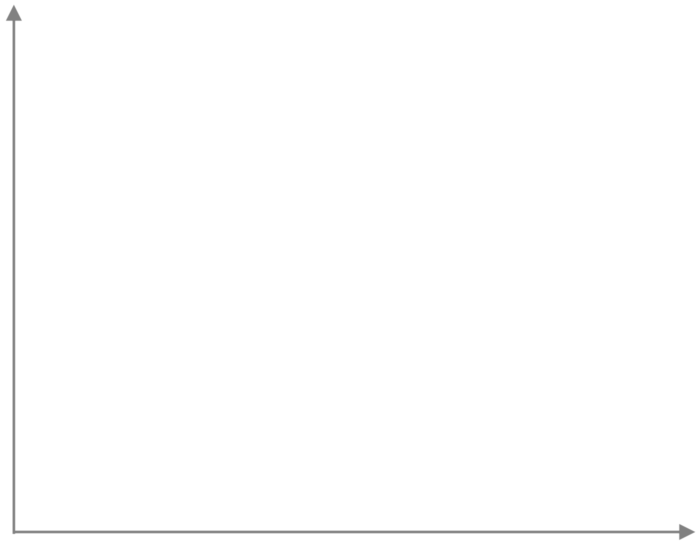
23. (a) Sketch a typical break-even chart.



(3)

(b) Label the following features on your answer to (a):

(i) fixed cost line

(ii) variable cost line

(iii) break even point

(3)

(6 marks)

24. Engineering companies must organise their activities in such a way as to comply with relevant Health and Safety legislation. State TWO examples of Health and Safety legislation that relate to engineering activities and, in each case, describe a typical control measure that is taken to ensure that the legislation is complied with.

Legislation: ....

....

Control measure:..

....

....

....

(2)

Legislation: ....

....

Control measure: ....

....

....

....

(2)

(4 marks)

TOTAL SECTION B: 20 MARKS

SECTION C

Long answer questions (answer both questions). Answers can be written on additional sheets of A4 lined paper.

25. A large engineering company is active in two major sectors of engineering. It is also involved with the design and small-scale manufacture of specialised vehicles used in the defence industry.

    The company employs a UK-based workforce and has distributors around the world. It is planning to extend its manufacturing base to China using the same plant and production processes as used in the UK.

    The company is organised on the basis of a divisional structure for its large-scale manufacturing operation but employs a matrix structure in conjunction with defence projects and consultancy.

(a) Describe the advantages and disadvantages of manufacturing in China and use this to justify the strategic decision to transfer some of the company's mechanical manufacturing operation to China.

....

....

....
(3)

b) Describe an advantage or disadvantage of using a matrix structure for specialised defence projects and use this to justify the use of a matrix structure for this area of business.

....

....
(2)

c) Describe the form and content of a typical defence contract and explain how this information is used to inform company operation.

....

....

....
(3)

d) In conjunction with its planned mechanical production facility in China, the company is considering outsourcing the manufacture of parts/components to Chinese companies. Explain an advantages or disadvantage of this strategy.

....

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(2)

(10 marks)

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26. An engineering company is involved with the design, manufacture, installation and commissioning of transmitters and antennas used to provide microwave links between off-shore platforms and the mainland. Each link is supplied to meet a particular client's specification and involves the supply of two engineered products:

- an antenna which is fitted to a tower
- an equipment rack which contains the transmitting and receiving equipment located in a cabin next to the tower.

The tasks that need to be performed in conjunction with a particular client's requirements are as follows:

Task	**Time required**
Agree specification with client	2 days
Site survey	2 days
Design, planning and materials procurement	10 days
Equipment manufacture	5 days
Equipment installation	1 day
Equipment cabling and power supply	1 day
Antenna manufacture	2 days
Antenna installation	2 days
Antenna cabling	1 day
Initial testing and alignment	1 day
Customer acceptance tests	2 days

(a) Draw a labelled network diagram for the project and use it to identify the critical path

....

....

....

(3)

(b) Estimate the total time to complete the project

....

....

(2)

(c) Installation of the antenna system involves an engineer working at an appreciable height above ground, often in exposed conditions where high wind and ice may be present. Describe and explain the steps required in order to carry out a risk assessment for the installation of the antenna.

....

....

....

(3)

(d) The manufacture of an antenna involves a direct labour cost of £450 and a direct materials cost of £150. The production overhead is £900 (of which £500 is a fixed cost and £400 is a variable cost).If four separate antennas are required for a particular installation, determine the overall profit if the antennas are charged at £8000.

....

....

(2)

(10 marks)

TOTAL SECTION C: 20 MARKS

TOTAL MARKS FOR PAPER 60

END

Mark scheme

QUESTION NUMBER	KEY (ANSWER)
1	(ii)
2	(iii)
3	(iv)
4	(iii)
5	(iv)
6	(iii)
7	(iii)
8	(iv)
9	(iv)
10	(i)
11	(iii)
12	(iii)
13	(i)
14	(iv)
15	(i)
16	(iii)
17	(iv)
18	(iii)
19	(ii)
20	(iv)

<table>
<tr><th>Question number</th><th>Correct answer</th><th>Mark</th></tr>
<tr><td>21</td><td>Three different engineering functions should be listed together with three examples of information that the function requires for its normal day-to-day operation. One mark should be awarded for each function and a further one mark for an appropriate example of the information that it requires.

Any three from:

<u>Engineering function</u>
• Production or manufacturing
• Quality assurance
• Research and development
• Product support/maintenance
• Technical sales
• Or other appropriate.

<u>Information used</u>
• Process sheets or work instructions
• Quality standards or quality manuals
• Strategic plans or tactical plans
• Service sheets or maintenance manuals
• Specifications, data sheets or price lists
• Or other appropriate.</td><td>6 marks</td></tr>
<tr><td>22</td><td>The explanations should mention the following:

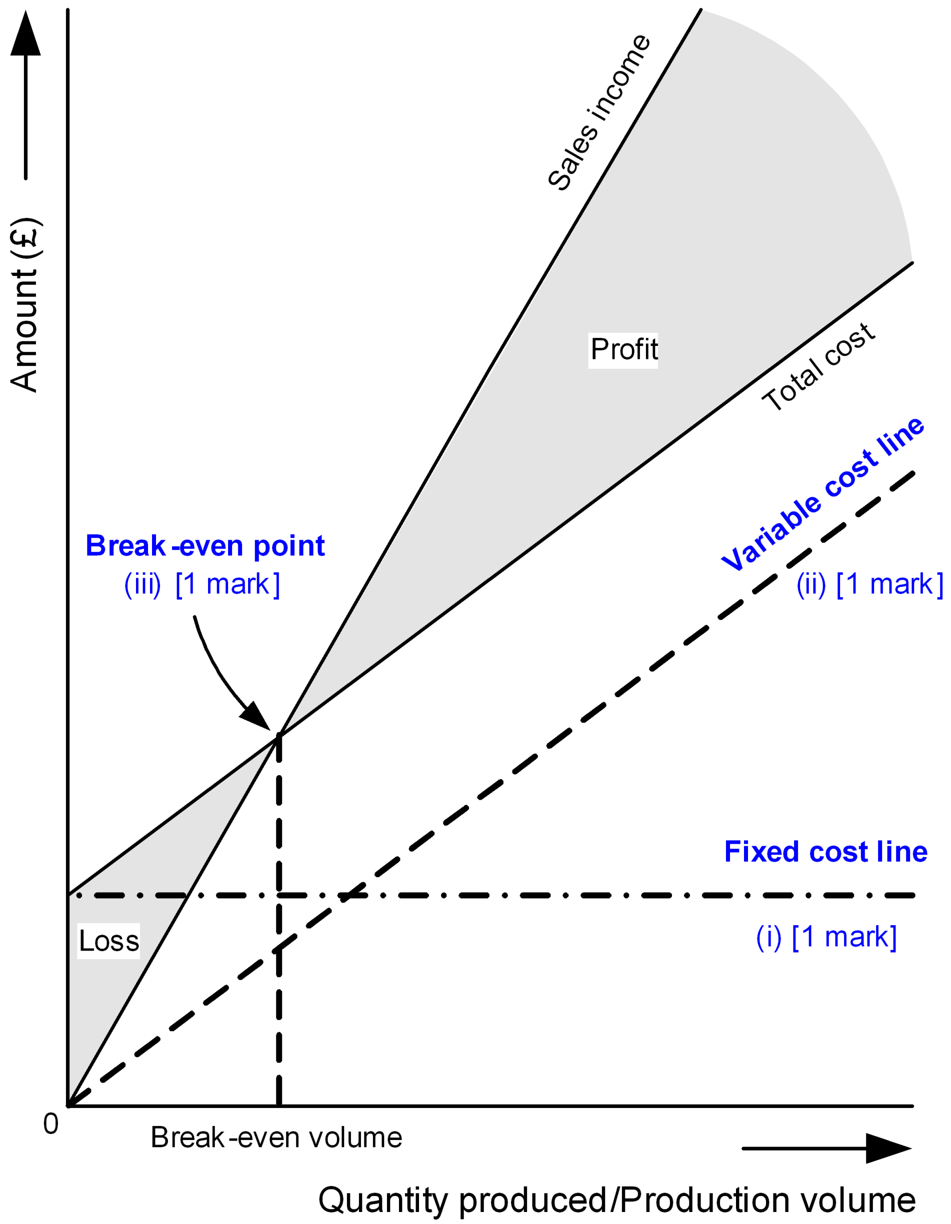
GNP:

Total annual value [1 mark] of all goods and services [1 mark] produced by a particular nation.

GDP:

Total annual value of all goods and services produced within a particular country’s borders [1 mark] regardless of where the owners of those goods and services actually live [1 mark].</td><td>4 marks</td></tr>
</table>

23a Sketch a typical break-even chart.



Break-even chart should show the features above.

Axes correctly labelled [1 mark]

Total cost line shown [1 mark]

Income line shown [1 mark]

23b Label the following features on your answer to (a):

(i) fixed cost line

(ii) variable cost line

(iii) break-even point

Total 6 marks

Question number	Correct answer	Mark
24	Answers should make reference to any of the legislation listed in the unit content. For example: *Legislation*: Control of Substances Hazardous to Health (COSHH) [1 mark]. *Control measures (1 mark for any of the following)*: You must not carry out work which could expose your employees to hazardous substances without first considering the risks and the necessary precautions [1 mark] Or alternatively: You must prevent your employees being exposed to hazardous substances [1 mark]. Or alternatively: You must clearly label all hazardous substances (eg chemicals) and ensure that they are stored safely and securely [1 mark]. *Legislation*: Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) [1 mark]. *Control measures (1 mark for any of the following)*: If there is an accident connected with work and your employee, or self-employed person working on the premises sustains a major injury, or a member of the public suffers an injury and is taken to hospital from the site of the accident, you must notify the enforcing authority without delay by telephoning or completing the appropriate forms [1 mark]. Or alternatively: You must keep a record of any reportable injury, disease or dangerous occurrence. This must include the date and method of reporting; the date, time and place of the event; personal details of those involved; and a brief description of the nature of the event or disease [1 mark]. Or alternatively: You must not carry out work which could expose your employees to hazardous substances without first considering the risks and the necessary precautions [1 mark]. Or alternatively: You must prevent your employees being exposed to hazardous substances. [1 mark]. Or any other appropriate response.	**4 marks**
	Total marks for section B:	**20 marks**

Section C

Question number	Correct answer	Mark
25a	Advantages could include: Lower labour costs [1 mark] Access to expanding markets in China and the Pacific rim [1 mark] Disadvantages could include: Distance from the home (European) market and consequent increase in transport costs and carbon footprint [1 mark] And any other appropriate answers.	**3 marks**
25b	Specialised defence projects tend to be one-off projects and may require short-term input from a number of specialists drawn from different departments within the company. Matrix structures are highly flexible and therefore well suited to the delivery of projects of this type. One disadvantage of this approach is the potential lack of commitment from contributing areas (who may have other priorities) and the need for skilled and effective project management. [2 marks]	**2 marks**

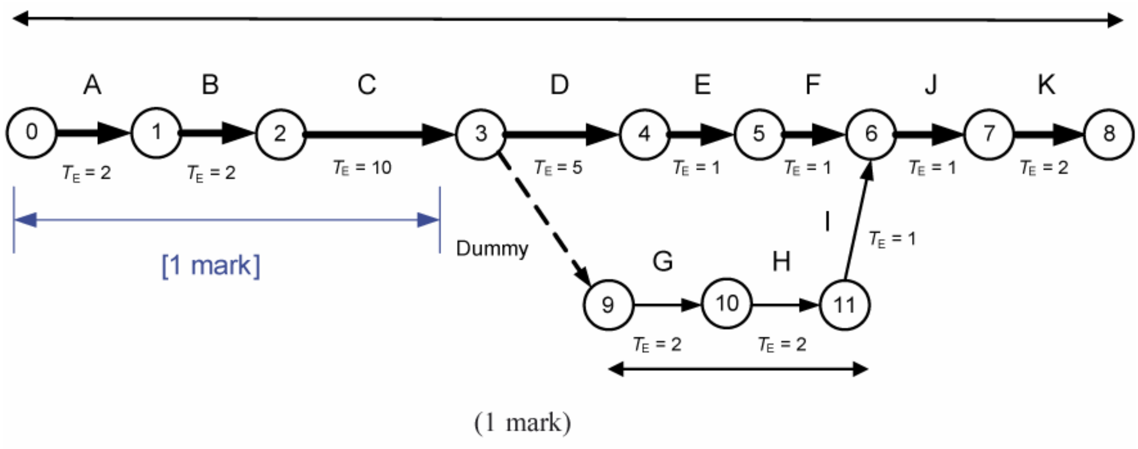
Question number	**Correct answer**	**Mark**
25c	The typical format and content of an engineering contract is as follows: Preliminary information: DATE – the effective date of the contract [CONTRACT NAME] – the name given to the contract - by and between - [BUYER NAME] – the name of the purchaser - and - [SELLER NAME] – the name of the company PRELIMINARY STATEMENT, DEFINITIONS AND INTERPRETATION Any one or more of the above [1 mark] SCOPE OF CONTRACT – informs the company what the contract is about CONTRACT PRICE and arrangements for PAYMENT and DELIVERY – financial information (may also include information relating to local taxes) Any one or more of the above [1 mark] Arrangements for INSTALLATION, COMMISSIONING AND ACCEPTANCE WARRANTIES – what assurances are given concerning the product or service TERMINATION, CONFIDENTIALITY and BREACH OF CONTRACT and arrangements for the SETTLEMENT OF DISPUTES Other SCHEDULES (eg DEFINITIONS AND INTERPRETATION) and ANNEXES providing further information relevant to the product or service. Any one or more of the above [1 mark]	**3 marks**

Question number	Correct answer	Mark
25d	Advantages could include: Reduced costs resulting from savings in employment costs and overheads. Disadvantages could include: Dangers associated with dependence on other manufacturers/supplier. Or alternatively: Less control on quality and potential conformance issues. [2 marks]	**2 marks**

26a

1 mark for identifying critical path (bold arrows on diagram)
1 mark for identifying dummy path
1 mark for identifying pre-manufacture (mark highlighted in blue)

(1 mark)



(3 mark)

Question number	Correct answer	Mark
26b	24 days [2 marks] Or 22 days [1 mark]	**2 marks**
26c	Produce an accurate description of the activity (breaking it down into individual tasks) [1 mark] Decide on the hazards that are associated with each task [1 mark] Estimate the risk associated with each of these hazards [1 mark] Or alternatively: Assess each risk under the headings of high', 'medium' and 'low' [1 mark] Or alternatively: Decide on what measures should be adopted to control these risks (starting with the 'high' category first). [1 mark]	**3 marks**
26d	Calculations should be based on: Total production cost = £300 + (£400 x 4) + (£450 x 4) + (£150 x 4) = £4,500 [1 mark] Profit = income − total production cost = £8,000 − £4,500 = £3,500 [1 mark]	**2 marks**

Unit 2 Applications of Computer Aided Designing

Tutor brief

Subject: Engineering		Level: 3
Unit 2: Applications of Computer Aided Designing		**Assessment time: 20 hours**
LO. 1	Know about computer systems and methods of data storage	
LO. 2	Know about the capabilities of design, presentation, testing, and analysis software packages and how they are used as tools within engineering	
LO. 3	Be able to use a CAD package to produce 2D drawings	
LO. 4	Be able to use design software to produce 3D models for use as presentation drawings or as data for other software	
LO. 5	Be able to use testing and analysis simulation software as a design support tool	
PLTS	Independent enquiries (IE3), creative thinkers (CT1,5), reflective learners, team workers, self- managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor. • Drawings or sketches, no larger than A3, printed only.	Classroom	Supervised
Task 2	• Original example drawings. • Printed 2D CAD drawings, no larger than A3. Electronic versions are not required.	Classroom	Supervised
Task 3	• 3D representation printed no larger than A3. Electronic versions are not required. Notes and annotations where suitable. • Annotated drawing at each stage of the process.	Classroom	Supervised
Task 4	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assessment

The following represents a typical assignment to give learners the opportunity to generate evidence for the assessment foci within Unit 2 of the Engineering Diploma at Level 3.

Throughout the use of this assignment support must be given to learners to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated. It is important in task 1.1 that the system investigated includes input and output devices, processing and operating systems as well as data storage devices. Likewise the software investigated for task 1.4 should not only be commercially available but should have features of design, presentation, testing and analysis. The drawings required for task 2.1 should be simple. The detail drawing should have opportunities to be used to produce both a wire frame and meshed surface drawing for task 3.1. It should also have the potential to be used with software beyond the use of 2D extrusion techniques such as rendered solid models. The drawing file given for task 3.3 should be more complex than those used earlier to allow image realisation to industrial standards. Finally the functional requirements of the component and its material used in manufacture for task 4.1 should be such that when the analysis is carried out in task 4.3 improvements can be ‘spotted’, otherwise mark band 3 will not be achievable.

The tasks as set will give learners this opportunity but some of the tasks can be amended to accommodate the local needs of the centre using these assessment instruments. The following indicates where this flexibility exists:

Task 2.1

The examples of engineering drawings given could be different. This would also enable tasks 2.2, 3.1 and 3.2 to be different.

Task 3.3

The drawing file given for each learner could be varied.

Task 4.1

The component and functional requirements along with the material to be used could be varied for each learner. This would also enable tasks 4.2 and 4.3 to be different.

Task 1 — Identify component parts of computers and methods of data storage

Assessment focus 1

Know about computer systems and methods of data storage

Band 1	Band 2	Band 3
Identifies the component parts of a typical computer system, gives a description of their functions, roles and relationships with data storage. (0-4)	Identifies the component parts of a typical computer system, gives a description of their functions, roles and relationships with data storage and describes two typical applications of a method of data storage. (5-8)	Identifies the component parts of a typical computer system, gives a description of their functions, roles and relationships with data storage and describes two typical applications of a method of data storage and compares them in terms of retrieval speed and storage size. (9-10)

Assessment focus 2

Know about the capabilities of design, presentation, testing and analysis software packages and how they are used as tools within engineering

Band 1	Band 2	Band 3
Explores and states the capabilities of commercially available software selected for the purpose of design, presentation, testing and analysis and gives examples of their use in engineering. (0-6)	Explores and states the capabilities of commercially available software selected for the purpose of design, presentation, testing and analysis and gives examples of their use in engineering and prepares a case study to illustrate how software can be used in the pre-production of a simple engineered product that requires only one engineering process. (7-8)	Explores and states the capabilities of commercially available software selected for the purpose of design, presentation, testing and analysis and gives examples of their use in engineering and prepares a case study to illustrate how software can be used in the pre-production of a simple engineered product and identifies how software can be used for more complex products, which involve more than one engineering process. (9-10)

Task 1 — Identifying component parts of computers and methods of data storage and exploring commercially available software	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of computer systems and methods of data storage. • Demonstrate knowledge of design, presentation, testing and analysis software.	
Task 1.1	
Focus 1	Write a report of a computer system that you have investigated. The system should include data input and output devices, a processor, an operating system and a data storage device. The report should include the following: a) Identification of the system components b) Description of the functions and roles of each component and the relationship between each component and the storage of data.
Task 1.2	
Focus 1	Describe two typical applications of a method of data storage.
Task 1.3	
Focus 1	Compare the two applications you described in task 2 in terms of retrieval speed and storage size.
Task 1.4	
Focus 2	Write a report on an example of commercially available software that you have investigated. The report should include: a) The purpose of design, presentation, testing and analysis of the software. b) Examples of how this software is used in relation to engineering examples. c) A case study that illustrates how this software can be used to assist in the pre-production process of a simple engineered product – at this stage when selecting the engineered product to use in your case study you should select one that is simple and does not need more than one engineering process. d) In your case study identify how this software can be used for more complex products which require more than one engineering process.

Task 2 — Produce 2D drawings to British Standards

Assessment focus 3

Be able to use a CAD package to produce 2D drawings to British Standards

Band 1	Band 2	Band 3
Produces a 2D CAD working detail drawing and an assembly drawing using orthographic projection. (0-6)	Produces a 2D CAD working detail drawing and an assembly drawing using orthographic projection and produces an isometric projection of both drawings. (7-8)	Produces a 2D CAD working detail drawing and an assembly drawing using orthographic projection and produces an isometric projection of both drawings and produces a circuit and a system diagram using representation and symbols. (9-12)

Task 2— Produce 2D drawings to British Standards	
Purpose The purpose of this task is to provide a framework within which the learner can: • Produce 2D drawings to British Standards using a CAD package.	
Task 2.1	
Focus 3	You are given two examples of engineering drawings. Using a CAD package reproduce these drawings in orthographic projection for the following: a) a working detail drawing b) an assembly drawing. Remember for each of the two drawings you will be rewarded for drawing accuracy, appropriate dimensioning and title box, and for correct projection and adherence to British Standards (BS).
Task 2.2	
Focus 3	Produce an isometric projection for both drawings supplied for task 2.1.
Task 2.3	
Focus 3	a) Produce an electrical or electronic circuit diagram using the correct BS symbols. b) Produce a pneumatic or hydraulic circuit diagram using the correct BS symbols.

Task 3 — Produce 3D models for use as presentation drawings

Assessment focus 4

Be able to use design software to produce 3D models for use as presentation drawings or as data for other software users

Band 1	Band 2	Band 3
Produces a 3D representation of a simple component as a wire frame drawing and a meshed surface drawing for use as data or as a 3D model. (0-6)	Produces a 3D representation of a simple component that requires the drawing, surfaces and model to be defined by methods other than simple extrusion of 2D shapes and manipulates the model to display different orientations of the component. (7-10)	Produces a 3D representation of an industrial component for use as data for other software use or as presentation drawing and image and manipulates the model to display different orientations of the component. (11-14)

<table>
<tr><th colspan="2">Task 3 — Produce 3D models for use as presentation drawings</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Produce 3D models for use as presentation drawings using design software</td></tr>
<tr><th colspan="2">Task 3.1</th></tr>
<tr><td>Focus 4</td><td>Produce a 3D representation of the simple component given for task 2.1 as:
a) a wire frame drawing
b) a meshed surface drawing.
Your drawings should demonstrate that the representations they show are fit for the use as data or a 3D model. You need to save and print your drawings.</td></tr>
<tr><th colspan="2">Task 3.2</th></tr>
<tr><td>Focus 4</td><td>Improve one of your drawings produced for 3.1 to produce a more complex drawing.
This should be achieved by using methods other than simple 2D extrusion.
You should also demonstrate how software can be used to manipulate and orientate the models on screen. You also need to save and print your drawings. Your tutor will also need to complete an observation record to record what you did.</td></tr>
<tr><th colspan="2">Task 3.3</th></tr>
<tr><td>Focus 4</td><td>You will be given a drawing file similar to that produced for 3.2 but of a more complex nature. Improve this drawing so that it is capable of being used as a presentation drawing and image realisation. You need to save and print your drawings. Again your tutor will also need to complete an observation record to record what you did.</td></tr>
</table>

Task 4 — Conduct a virtual operational performance test or material analysis

Assessment focus 5

Be able to use testing and analysis simulation software as a design support tool

Band 1	Band 2	Band 3
Conducts a virtual operational performance test or material analysis of a product or material for a given purpose and presents the results for analysis. (0-6)	Conducts a virtual operational performance test or material analysis of a product or material for a given purpose and presents the results for analysis and evaluates them against the design specification for the product or material. (7-10)	Conducts a virtual operational performance test or material analysis of a product or material for a given purpose and presents the results for analysis and evaluates them against the design specification for the product or material and explains the strategy used to resolve issues in the case of non-compliance. (11-14)

Task 4 — Conduct a virtual operational performance test or material analysis	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate the use of testing and analysis software.	
Task 4.1	
Focus 5	You are to use simulation software to carry out a material analysis in a virtual environment. You will be given a component complete with functional requirements and the material it is to be made from. a) Carry out the analysis to establish whether it is capable of performing the specified functions. b) Present the results of your analysis in a format suitable for further analysis.
Task 4.2	
Focus 5	a) Analyse the results you have obtained and produce a written format of your analysis. b) Compare your results with the requirements of the specification and functional requirements.
Task 4.3	
Focus 5	Write a report explaining how the analysis you did for 4.2 can be used to modify the design to ensure the product moves into compliance.

Unit 3 Selection and Application of Engineering Materials

Tutor brief

Subject: Engineering		Level: 3
Unit 3: Selection and Application of Engineering Materials		**Assessment time: 20 hours**
LO. 1	Know about the structure and their effects on the mechanical properties of engineering materials	
LO. 2	Know about the forms of supply, applications and the selection of engineering materials	
LO. 3	Know about the impact of processing on the structure of engineering materials	
LO. 4	Know about the effects of loading, modes of failure and carry out testing of engineering materials	
PLTS	Independent enquiries (IE4), creative thinkers, reflective learners, team workers, self- managers (SM2), effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Screen shots or photocopies of on screen data. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	External	Un-supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed.	Specialist	Supervised
Task 4	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated photographic evidence. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following is a sample assessment activity. In this case the suggestion covers all four learning outcomes, although this need not always be the case. In this unit, four tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

The allocated time for completing this assessment is only 10 hours but because learners are working at level 3 it is expected that, as a minimum, they match this with own time spent on research and preparing reports. The assignment can be carried out over an extended period.

The assignment activities for learning outcome 4 have synergy with Unit 9: Principles and Application of Engineering Science L0.1 – Be able to apply mechanical principles and determine the effects of forces in engineering systems.

Learner evidence must include witness statements/observation records which are supported by annotated photographs showing correct use of test equipment.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 3: Selection and Application of Engineering Materials.

Task 1 — Investigating the properties of engineering materials, their forms of supply and how to select them

Assessment focus 1

Know about the structure and their effects on the mechanical properties of engineering materials

Band 1	Band 2	Band 3
Describes crystal lattice and polymer structures and their effect on the mechanical properties of metals and plastics. (0–4)	Describes crystal lattice and polymer structures and their effect on the mechanical and electrical properties of metals and plastics. (5–6)	Describes crystal lattice and polymer structures and their effect on the mechanical, electrical and thermal properties of metals and plastics. (7–8)

Assessment focus 2.1

Forms of supply and applications

Band 1	Band 2	Band 3
Describes a form of supply and an application of a given metal, a given polymer and a given composite material. (0–3)	Describes the properties, a form of supply and an application of a given metal, a given polymer and a given composite material. (4–6)	Justifies an application of a given metal, a given polymer and a given composite material in terms of the material properties and form of supply. (7–9)

Assessment focus 2.2

Information sources and materials selection

Band 1	Band 2	Band 3
Uses a given information source to select material for a given purpose. (0–3)	Selects an information source and uses it to select material for a given purpose. (4–5)	Selects an information source and justifies its use to select material for a given purpose (6–7)

Design engineers must have knowledge about the properties and forms of supply of materials when deciding which ones to specify for particular applications. For example, it is no use making the silencer of a car out of polythene because it will melt when the engine is running.

Designers also need to know about the properties of materials when deciding on the type of manufacturing process to use when making a component. For example a piece of sheet metal being formed to shape by bending will need to have a degree of malleability so that it retains its finished profile.

It is also important to know in what form materials can be purchased from stockholders so that when they arrive at the factory they are suitable for the processes being carried out. The aim is normally to select a form of supply which produces the least amount of waste after a manufacturing operation has taken place, for example using hollow tube which is almost to size for the body of a pneumatic cylinder.

The way that a material behaves in service and reacts when being machined or formed is dependent on its internal structure.

<table>
<tr><th colspan="2">Task 1</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Demonstrate an understanding of engineering materials and their forms of supply.</td></tr>
<tr><th colspan="2">Task 1.1</th></tr>
<tr><td>Focus 1</td><td>a) Carry out research and then put together a report which presents answers to the following:
• with reference to specific metallic materials, describe three commonly found crystal lattice structures and their effect on the mechanical properties of the materials
• with reference to specific polymeric (plastic) materials, describe two types of internal structure and their effect on the properties of the materials.
b) Add descriptions about the effect that the internal structure has on the electrical properties of the materials.
c) Add to your report descriptions of the effects that the internal structure has on the thermal properties of materials.</td></tr>
<tr><th colspan="2">Task 1.2</th></tr>
<tr><td>Focus 2.1</td><td>Choose a metal, a polymer and a composite material.
d) For each describe:
• one form of supply when they are delivered to a workshop from the materials store
• one use (application) for the material.
e) For each material describe its properties.
f) For each of the three materials justify the application in terms of its properties and form of supply.</td></tr>
</table>

Task 1.3	
Focus 2.2	You are a member of a team which is designing an industrial food processing machine and have been tasked with selecting a suitable material for its heat exchanger. Here are the operating requirements:

Operating temperature	500°C
Chemical reaction with foodstuffs	None
Strength to weigh ratio	Good
Coefficient of linear expansion	Less than 0.000015 K^{-1}
Thermal conductivity	Less than 16 $Wm^{-1} K^{-1}$
Electrical resistivity	Not important

g) Make a suitable selection using the following data source:

'*Engineering Tables and Data* – Howaston, Lund and Todd, ISBN 0412389703'

h) Choose your own information source and use it to make the selection

i) Justify your choice of the reference source in activity (1h) in terms of:

- how straightforward it was to access
- how easy it was to use
- the range and depth of data held within the information source.

When presenting your evidence you should include photocopies or screen shots, marked up with a highlighter pen to show data you have referred to.

Task 2 — Investigating how processing methods affect the structures of engineering materials

Assessment focus 3.1

Impact of processing

Band 1	Band 2	Band 3
Describes the occurrence of work hardening and grain growth in metals and the glass transition temperature in polymers. (0–3)	Describes the change in the properties of metals due to the occurrence of work hardening and grain growth and due to the occurrence of the glass transition temperature in polymers. (4–5)	Describes the change in the properties of metals due to the occurrence of work hardening and grain growth, and the change in properties of polymers due to the occurrence of the glass transition temperature making reference to the micro-structure of the materials. (6–7)

Assessment focus 3.2

Heat treatment

Band 1	Band 2	Band 3
Distinguishes between annealing, quench hardening and tempering, case hardening and precipitation hardening of materials. (0–4)	Distinguishes between annealing, quench hardening and tempering, case hardening and precipitation hardening processes stating the materials to which they are applicable and property changes that occur. (5–6)	Distinguishes between annealing, quench hardening, tempering, case hardening and precipitation hardening processes stating the materials to which they are applicable, the property changes that occur and the structural changes that take place during the processes. (7–8)

Engineers alter the mechanical properties of metallic materials by cold working them eg cold rolling or by using heat treatment eg heating and quenching in an oil bath.

The type of process used depends on which properties are to be modified or recovered. For example:

- A particular combination of cold working followed by heat treatment can achieve a 20 fold increase in the tensile strength of aluminium alloy used in the construction of aircraft
- Applying gentle heat to a piece of mild steel which has become brittle due to over bending, will help it recover its original ductility.

<table>
<tr><th colspan="2">Task 2.1</th></tr>
<tr><td>Focus 3.1</td><td>a) Describe what is meant by ‘work hardening’ and ‘grain growth’ in metals and why they occur. Also describe what is meant by the ‘glass transition temperature’ of a polymer.
b) Describe the changes which take place in the properties of metals caused by ‘work hardening’ and ‘grain growth’, including in your answer reference to at least one specific metallic material. Also describe the significance of the glass transition temperature on the properties of polymers, making reference to one specific polymeric material.
c) Describe the link between micro-structure and work hardening/grain growth in metals and glass transition temperature in polymers.</td></tr>
<tr><th colspan="2">Task 2.2</th></tr>
<tr><td>Focus 3.2</td><td>To change the mechanical properties of metallic materials the following types of heat treatment process are carried out:
• annealing
• quench hardening
• tempering
• case hardening
• precipitation hardening.
d) For each process describe its purpose and how it is carried out.
e) For each process describe its purpose, how it is carried out and the changes in mechanical properties which it causes. Make reference to specific metallic materials that the processes relate to.
f) Add to your answer for task (1e) by describing the structural changes which take place in the materials that you have identified.</td></tr>
</table>

Task 3 — Investigating how the application of loads to materials can cause them to fail in service

Assessment focus 4.1

Mechanical loading

Band 1	Band 2	Band 3
Calculates direct stress, factor of safety and shear stress in given loaded materials. (0–3)	Calculates direct stress, factor of safety and shear stress in given loaded materials. (4–5)	Calculates direct stress and strain, factor of safety, shear stress and strain, modulus of elasticity and shear modulus of given loaded material. (6–7)

Assessment focus 4.2

Modes of failure

Band 1	Band 2	Band 3
Describes three modes of failure that can occur in engineering materials. (0–3)	Describe three modes of failure that can occur in engineering materials and the service conditions under which two of them are likely to happen. (4–5)	Describe three modes of failure that can occur in engineering materials, the service conditions under which two of them are likely to happen and the characteristic appearance of the two failure modes. (6–7)

When deciding on the dimensions of load bearing components a design engineer will carry out stress and strain calculations. To inform the calculations they use data about the material it is to be made from, for example yield and tensile strengths, modulus of elasticity. They will also think about possible modes of failure dependent on the material's internal structure and the conditions under which the component is operating.

The first activity uses scientific principles which link to Unit 9: Principles and Application of Engineering Science, learning outcome 1 – Be able to apply mechanical principles and determine the effects of forces in engineering systems.

Task 3.1	
Focus 4.1	A 500 mm long aluminium tie rod has a rectangular section measuring 8 mm x 16 mm and carries a load of 14 kN. One end is located against a lug using a 7.5 mm diameter steel pin which is in single shear.

Material	Yield stress σ_y (MPa)	Modulus of elasticity E (GPa)
Aluminium Alloy	395	72
High yield steel	400	210

a) Calculate the direct stress in the tie bar, the factor of safety (yield) that it is working at and the shear stress in the pin.

b) Now calculate the direct strain in the tie rod and the shear strain in the pin if its transverse deflection is 0.031 mm over the engaged axial length of 8 mm.

c) Complete the following results table for two materials which have been tested.

Material	Direct stress (MPa)	Direct strain (x 10^{-3})	Modulus of elasticity (GPa)
A	25	0.193	

Material	Shear stress (MPa)	Shear strain (x 10^{-3})	Shear Modulus (GPa)
B	100	2.17	

Task 3.1	
Focus 4.2	Select three of the following modes of failure:

- elastic failure, ductile failure, brittle fracture, fatigue, creep.

d) Describe the failure mechanism for each of the three modes.

e) Choose two of the modes from activity (3d) and describe the service conditions under which they are likely to happen.

f) Using diagrams and images to illustrate your answer, describe the characteristic appearance of the failure modes chosen in task 3e). You should relate your answer to specific materials and include references to surface appearance and texture.

Task 4 — Testing engineering materials

Assessment focus 4.3

Materials testing

Band 1	Band 2	Band 3
Carries out a destructive and a non-destructive material test and record the test data. (0–3)	Carries out a destructive and a non-destructive material test and analyses the test data to verify the material properties or nature of faults. (4–5)	Carries out a destructive and a non-destructive material test, analyses the test data to verify the material properties or nature of faults and describes industrial settings where such tests would be routine. (6–7)

When materials are delivered to a factory for processing it is important to check that they are of the correct quality and conform to specification. A visual inspection may not indicate that there is a problem and this is why testing is carried out.

Materials tests are also carried out when a product fails in service. Investigators need to be able to confirm that the product is made from the material specified by the designer and that any flaws, such as internal and surface cracks, are within tolerance.

This activity involves the use of specialised equipment and you will find the following web links useful for research purposes.

Destructive test equipment:

www.tiniusolsen.com/products/bench-machines/bench-machines.html

Non-destructive equipment:

www.advanced-ndt.co.uk

If you do not have access to this type of equipment at your school/college it may be possible to complete the assignment when you are on work experience. You would need to check if the company has a materials testing facility.

Confirm with you tutor about health and safety issues involved with using test equipment and make sure that they keep an observation record and take photographs of you correctly performing the tests.

Task 4	
Focus 4	Your teacher will provide you with a sample of a known material and a component which has flaws in it. h) Carry out a tensile test to destruction on the sample and a non-destructive ultrasonic test on the component. Record the test data which you have generated. i) Using the data collected in activity (4a) either, determine two properties relating to the specimen comparing them with accepted values found in reference data or identify the nature of the faults in the component. j) Find an industrial application for each of the tests carried out in activity (4a). Describe the purpose of the test and what happens to the data generated by it.

Unit 4 Instrumentation and Control Engineering

Tutor brief

Subject: Engineering		Level: 3
Unit 4: Instrumentation and Control Engineering		**Assessment time: 15 hours**
LO. 1	Understand the difference between analogue and digital signals and the need for various forms of transmission media	
LO. 2	Know about the use of sensors, transducers and instrumentation displays in instrumentation and control applications	
LO. 3	Understand then principles and difference between open loop and closed loop systems	
LO. 4	Understand the use of programmable logic controllers in instrumentation and control applications	
LO. 5	Understand applications of control engineering	
PLTS	Independent enquiries, creative thinkers, reflective learners, team workers, self-managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • Annotated photographs evidence Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 4	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria.	Classroom	Supervised
Task 5	• A4 written evidence must be clearly legible, preferably word-processed. • Drawings or sketches, no larger than A3, printed only.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignments

The following is a sample assessment activity. In this case the suggestion covers all five learning outcomes, although this may not always be the case. For this unit, five tasks might be appropriate, determined by the links between the assessment foci. The final task will allow learners to combine everything they have covered in the first four tasks, to help give a holistic view of the topic, which may allow the combination of some of the tasks to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 4: Instrumentation and Control Engineering.

Task 1 — Analogue and Digital Signals, Communication and Transmission Media

Assessment focus 1

Understand the difference between analogue and digital signals and the need for various forms of transmission media

Band 1	Band 2	Band 3
Describes the fundamental characteristics of analogue and digital signals and explains the need for the different types of transmission media. (0–5)	Describes the fundamental characteristics of analogue and digital signals, explains the need for the different types of transmission media and explains the methods of connecting and interfacing analogue and digital signals taking into account their characteristics and the properties of different types of transmission media. (6–9)	Describes the fundamental characteristics of analogue and digital signals, explains the need for the different types of transmission media, explains different methods of connecting and interfacing analogue and digital signals taking into account their characteristics and the properties of different types of transmission media and explains the process of signal conversion from analogue to digital, digital to analogue, serial to parallel and parallel to serial. (10–13)

Task 1	
Focus 1	Electronic signals can be either analogue or digital and each has its place in the world of communications and transmission. a) Describe the basic characteristics of (i) analogue signals and (ii) digital signals. Explain why three different types of transmission media are needed. b) Analogue and digital signals can be connected and interfaced. Explain two ways in which this can be done, referring to the characteristics of different types of transmission. c) Explain the following forms of signal conversion: • analogue to digital (ADC) • digital to analogue (DAC) • series to parallel • parallel to serial.

Task 2 — Instrumentation and Control Systems – how Analogue and Digital Signals are used.

Assessment focus 2

Know about the use of sensors, transducers and instrumentation displays in instrumentation and control applications

Band 1	Band 2	Band 3
Describes instrumentation and control systems and explains the role of digital and analogue sensors, transducers and displays in instrumentation and control applications. (0–4)	Describes instrumentation and control systems and explains the role and operation of digital and analogue sensors, transducers and displays in instrumentation and control applications. (5–7)	Describes instrumentation and control systems and explains the role and operation of digital and analogue sensors, transducers and displays in instrumentation and control applications and evaluates a complete instrumentation and control system and explains the process of code conversion and display technology (as appropriate to the system). (8–10)

Task 2	
Focus 4.2	A wide range of scientific knowledge has been applied to the design of sensors and actuators. In this task you will investigate some of these to see how they are used in instrumentation and control applications. a) Describe instrumentation and control systems and explain the role of three of the following transducers, sensors and displays: • a temperature sensor • a position sensor • an angular speed sensor • an optical shaft encoder • a moving coil meter • an LCD • a CRT. b) Describe the principles of operation of the three transducers, sensors or displays that you selected in a) above. c) For a complete instrumentation and control system, explain how codes and signals are converted throughout the system and for display purposes. Give a full evaluation of the complete system.

Task 3 — Open and Closed Loop Control Techniques

Assessment focus 3

Understand the principles and difference between open loop and closed loop systems

Band 1	Band 2	Band 3
Describes the principles of open loop and closed loop control. (0–4)	Describes the principles of open loop and closed loop control and explains the simplified arrangement of a practical closed loop control system, differentiating between positive and negative feedback and feed-forward. (5–7)	Describes the principles of open loop and closed loop control, explains the simplified arrangement of a practical closed loop control system, differentiates between positive and negative feedback and feed-forward and evaluates the operation of a complete control system that incorporates proportional, integral and derivative control. (8–10)

Task 3	
Focus 3	In our quest to control a machine or piece of plant, control engineers make use of sensors and actuators to control the way the machine reacts to our commands. This is achieved using closed loop control systems. a) Using diagrams and illustrations to help, describe (i) open loop control and (ii) closed loop control. Explain the operation of a practical closed loop control application, differentiating between negative and positive feedback and feed forward. b) Control systems can become very complicated as we aim to refine the control that we want on a piece of plant. Most systems are defined by the techniques they incorporate, which usually include a mixture of proportional (P), integral (I) and derivative (D) control. Explain what each of these terms means and with reference to a given (or selected) control system application, evaluate the operation when PID systems are used.

Task 4 — Programmable Logic Controllers

Assessment focus 4

Understand the use of programmable logic controllers in instrumentation and control applications

Band 1	Band 2	Band 3
Describes a PLC system and explains its advantages and disadvantages. (0–4)	Describes a PLC system and explains its advantages, disadvantages and operation and programs it to carry out a single specified task. (5–7)	Describes a PLC system, explains its advantages, disadvantages and operation, programs it to carry out a single specified task and evaluates the operation of a typical industrial application of a PLC system and its associated control program. (8–10)

Task 4	
Focus 4	Using programmable logic controllers (PLCs) is just one way of controlling a plant or process. Others exist, such as hard-wiring to a relay control panel, peripheral interface controllers (PICs) and microcontrollers. a) Describe a basic PLC system for a given application and its operation. Explain the advantages and disadvantages of using PLCs with regards to construction, programming, cost, applications and any other characteristics. b) Using software which you have been given access to, write a PLC ladder logic program which will control a production process (real or simulated) or some other chosen activity. c) Evaluation a given PLC system, program and its application. For instance – how well does it achieve the desired function, how could it be improved, could it do anything else to improve the system it is controlling?

Task 5 — Applications of Control Engineering, Sensors and Signal Conditioning

Assessment focus 4.5

Understand applications of control engineering

Band 1	Band 2	Band 3
Describes an application of control engineering and draws a block diagram of the system, indicating the types of sensors, transducers, actuators and displays. (0–7)	Describes an application of control engineering, draws a block diagram of the system, indicates the types and roles of sensors, transducers, actuators, signal conditioning, displays and control program used. (8–13)	Describes and evaluates an application of control engineering, draws a block diagram of the system, indicates and justifies the types and roles of sensors, transducers, actuators, signal conditioning, displays and control program used. (14–17)

Task 5	
Focus 5	Having investigated signal types, transmission of data, control systems, sensors and control devices, this task provides an opportunity for you to investigate and apply your knowledge to a whole system. a) For a given control system, write a description of the process being controlled and how it is controlled. Start by producing an overall block diagram of the system and describe signal conditioning and the control program used. b) Identify as many of the sensors, transducers, actuators and displays as possible and explain why you chose these and the signal conditioning and control program used. Evaluate the application in terms of its speed, accuracy, stability, efficiency etc.

Unit 5 Maintaining Engineering Plant, Equipment and Systems

Tutor brief

Subject: Engineering		**Level: 3**
Unit 5: Maintaining Engineering Plant, Equipment and Systems		**Assessment time: 10 hours**
LO. 1	Know about the cost of maintenance and the consequences of plant, equipment or system failure including the effects on production.	
LO. 2	Be able to deploy effective maintenance strategies when planning a maintenance activity.	
LO. 3	Know how the data gathered from monitoring the performance and condition of engineering plant, equipment or system can be used.	
LO. 4	Be able to carry out a risk assessment and follow a maintenance plan using documentation for a maintenance activity on a closed loop engineering system.	
PLTS	Independent enquiries, creative thinkers, reflective learners (RL6), team workers, self-managers (SM3,4), effective participators.	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • Annotated photographic evidence where suitable.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignment

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 5 of the Level 3 Engineering Diploma. In this case the assignment covers all four learning outcomes, although this would not always be the case. For this unit, three tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 5: Maintaining Engineering Plant, Equipment and Systems.

NOTE – the first three tasks which follow can be combined into one large assessment instrument if required, or used in the smaller version, depending on resources and timetabling. Tasks 4 and 6 can also be combined into one task, again, depending on resource access and timetabling.

Task 1 — Investigating effective maintenance

Assessment focus 1.1

Know about the consequences of plant, equipment or system failure and the effects on production

Band 1	Band 2	Band 3
Describes the consequences of failure for given plant, equipment or a system and describes the effects on production. (1–4)	Describes the consequences of failure for given plant, equipment or a system, describes the effects on production and explains the effect on customer expectation and corporate image. (5–7)	Describes the consequences of failure for given plant, equipment or a system, describes the effects on production, explains the effect on customer expectation and corporate image and compares two consequences of plant, equipment or system failure for their effect on corporate image. (8–9)

Assessment focus 1.2

Know about the cost of maintenance

Band 1	Band 2	Band 3
Describes how the costs of maintenance are represented for given plant, equipment or a system. (1–3)	Describes how the costs of maintenance are represented for given plant, equipment or a system and describes the benefits of keeping accurate cost records of maintenance. (4–5)	Describes how the costs of maintenance are represented for given plant, equipment or a system and describes the benefits of keeping accurate cost records of maintenance including a justification for the use of the records in a maintenance environment. (6–7)

Assessment focus 2.1

Effective maintenance strategies

Band 1	Band 2	Band 3
Describes two given types of maintenance strategies. (1–4)	Describes two given types of maintenance strategies and describes how one would be used for given plant, equipment or a system. (5–6)	Describes two given types of maintenance strategies and describes how one would be used then justifies why it would be used for given plant, equipment or a system. (7–8)

Task 1.1	
Focus 1.1	In any industry when any machine or item of plant suffers a malfunction, production stops. When production has stopped, the company is not earning money, profits may fall and job losses may result. Select an engineering industry that you are familiar with and answer the following questions: a) Describe the consequences of equipment or system failure and how it can affect production. b) As well as costing money due to loss of production, the company’s reputation can suffer. Describe the effect that equipment or system failure can have on customers and on a company’s ability to obtain any future work and the possible penalties that can follow contractual or regulatory breech. c) Identify two consequences of failure and compare them for their effect on the company’s future image and reputation.
Task 1.2	
Focus 1.2	a) Carrying out maintenance costs money. Identify and describe how the costs are represented for the routine maintenance of a particular machine, eg a car, a lathe, an electro-hydraulic lifting machine. b) When something breaks down or is shut down for routine maintenance, it is helpful to have previous maintenance records available. Describe the advantages of keeping such records for a car, a machine shop, a hotel lift system, a printing press or central heating system. c) Explain why keeping maintenance records can be of benefit to the item of equipment and the company in general.
Task 1.3	
Focus 2.1	There are several maintenance strategies which can be used and the suitability of each can depend on the industry under consideration. These include planned maintenance, total preventative maintenance, breakdown, scheduled, corrective, reactive, predictive, run to failure, emergency, post fault and scheduled servicing. a) Describe two of the maintenance strategies listed above. b) Describe how one of these strategies would be used for a piece of plant, eg bakery oven, factory conveyor belt, a lorry, an aircraft, etc. Explain why the strategy used for that particular plant is most suitable.

Task 2 — Planning and carrying out maintenance activities

Assessment focus 2.2

Plan a maintenance activity

Band 1	Band 2	Band 3
Develops a maintenance plan and uses two appropriate methods to present the plan for a given type of maintenance strategy. (1–4)	Develops a maintenance plan and uses two appropriate methods to present the plan for a given type of maintenance strategy and explains how the methods used to present a maintenance plan help deploy a maintenance strategy. (5–6)	Develops a maintenance plan and uses two appropriate methods to present the plan for a given type of maintenance strategy, explains how the methods used to present a maintenance plan help deploy a maintenance strategy, justifies a maintenance plan and considers an alternative approach to improve the deployment of a maintenance strategy. (7–8)

Assessment focus 4

Be able to carry out a risk assessment and follow a maintenance plan using documentation for a maintenance activity on a closed loop engineering system

Band 1	Band 2	Band 3
Completes a risk assessment, then follows a given maintenance plan and uses supporting documentation to carry out, with guidance, appropriate maintenance activities on a closed loop engineering system. (1–6)	Completes a risk assessment, then follows a given maintenance plan deploying other relevant safety conditions and uses supporting documentation to carry out, with limited guidance, appropriate maintenance activities on a closed loop engineering system. (7–10)	Completes and evaluates a risk assessment, then follows a given maintenance plan deploying other relevant safety conditions and effectively uses supporting documentation to carry out, independently, appropriate maintenance activities on a closed loop engineering system. (11–14)

Task 2.1	
Focus 2.2	Before any maintenance work is carried out, it is essential to plan the process. Any service records which exist from previous work should be available and this should be considered in the plan. Your tutor will allocate a maintenance strategy to you (eg, TPM, scheduled, predictive, run to failure, etc). a) Produce a maintenance plan for the maintenance strategy that you have been given. You must present your plan using two appropriate methods (eg Gantt Chart, maintenance log, job cards, computerized methods, etc) which you can select or be given by your tutor. b) Explain how your chosen presentation methods helped the processes involved with the selected maintenance strategy. c) As well as the approach you chose, there is always at least one alternative. Describe a suitable alternative approach to planning the maintenance tasks and explain why the one you chose was preferred in this instance.
Task 2.2	
Focus 4	Before any maintenance operations are carried out, a risk assessment must be carried out to evaluate the dangers which exist and which can arise during and after the work. You will be allocated a maintenance task to carry out on an item of plant. a) Complete a risk assessment for the task that you are to carry out and say how well you think you have covered all the main hazards. Follow the service manual or maintenance checklist that you have been given to carry out all of the maintenance activities safely.

Task 3 — Working with maintenance data.

Assessment focus 3

Know how the data gathered from monitoring the performance and condition of engineering plant, equipment or system can be used

Band 1	Band 2	Band 3
For a given monitoring technique describes how data would be collected and interpreted when considering physical, cost related, and other aspects. (1–6)	Describes how data would be collected and interpreted and uses data from a given monitoring technique to review physical, cost related, and other aspects that show the performance and condition of engineering plant, equipment or a system. (7–10)	Describes how data would be collected and interpreted and uses data from a given monitoring technique to review and then justify the use of this data to help improve the performance and condition of engineering plant, equipment or a system. (11–14)

Task 3.1	
Focus 3	Many modern pieces of equipment have built in monitoring systems, such as temperature or vibration detectors and sensors, lubricant level sensors, etc which may operate dials, gauges or alarms. This automatic monitoring can also exist alongside the results of manual monitoring, perhaps things are measured or checked by operators or maintenance personal on a regular schedule. For an item of plant which is available, you will be allocated a specific monitoring technique. a) Describe how data is collected and interpreted for your specific monitoring technique. b) Use the data to review the condition and performance of the item of plant. c) Using data from a given monitoring technique, explain how and why the data can be used to improve performance and condition of the plant.

Unit 6 Investigating Modern Manufacturing Techniques used in Engineering

Tutor brief

Subject: Engineering		Level: 3
Unit 6: Investigating Modern Manufacturing Techniques used in Engineering		**Assessment time: 20 hours**
LO. 1	Understand the differences between traditional and modern manufacturing production systems used with engineering industries	
LO. 2	Understand how different types of manufacturing processes utilise computer aided manufacturing systems	
LO. 3	Be able to plan for the production of an engineering product for industry	
LO. 4	Be able to work in a team and apply quality control and quality assurance systems	
PLTS	Independent enquiries (IE3), creative thinkers, reflective learners, team workers (TW1,2), self-managers (SM3), effective participators (EP3)	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • Annotated photographic evidence where suitable.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Annotated photographic evidence.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 4	• Plan/Schedule/Process flows, Charts and Diagrams, Printed no larger than A3. • Authenticated 'Individual Learner Observation Record form' detailed the observed activities with reference to the grading criteria. • A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

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Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignments

The following is a sample assessment activity. In this case the suggestion covers all the learning outcomes, although this would not always be the case. In this unit, four tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the assessment foci associated with Unit 6: Investigating Modern Manufacturing Techniques used in Engineering.

Task 1 — Comparing Traditional and modern manufacturing production systems

Assessment focus 1

Understand the differences between traditional and modern manufacturing production systems used within engineering industries.

Band 1	Band 2	Band 3
Explores the issues and explains the differences between traditional and modern manufacturing production systems in terms of number and volume of products manufactured, give examples of typical products for each system. (0–6)	Explains the differences between traditional and modern manufacturing production systems in terms of number and volume of products manufactured, gives examples of typical products for each system and compares the layout and arrangements of the processes and equipment for a traditional and a modern manufacturing production systems and discusses how they affect the flow of materials and products. (7–10)	Explains the differences between the traditional and modern manufacturing production systems in terms of number and volume of products manufactured, gives examples of typical products for each system and compares the layout and arrangements of the processes and equipment for a traditional and a modern manufacturing production systems and discusses how they effect the flow of materials and products and analyses how a lean manufacturing system overcomes limitations in a traditional manufacturing production system. (11–13)

Task 1		
Focus 1	a)	Explain the different types of traditional and modern manufacturing production systems and the differences between them. In your report or presentation, include explanations of jobbing shop, batch and mass production and give relevant product examples for each.
	b)	Compare the systems in terms of their advantages and disadvantages, production line layout and processes, and the flow of materials through each system.
	c)	Outline the concept of Lean Manufacturing, including Just in Time (JIT) and Flexible Manufacturing Systems (FMS) and explain how they overcome the limitations of traditional manufacturing production systems.

Task 2 — The use of Computer Aided Manufacturing (CAM) systems in manufacturing processes

Assessment focus 2

Understand how different types of manufacturing processes utilize computer aided manufacturing systems

Band 1	Band 2	Band 3
Explains the processes and level of computer-aided manufacturing used to manufacture selected products in two different engineering manufacturing industries. (0–6)	Explains the processes and level of computer-aided manufacturing used to manufacture selected products in two different engineering manufacturing industries and analyses and compares the processes and level of automation used to manufacture selected products. (7–10)	Explains the processes and level of computer-aided-manufacturing used to manufacture selected products in two different engineering manufacturing industries, analyses and compares the processes and level of automation used to manufacture selected products and presents a justification for the selection of processes and level of automation used. (11–13)

Task 2	
Focus 2	Modern engineering industries include energy, polymer, chemical, electronic, aerospace and automotive engineering. a) Explain how two or more of these engineering industries use computer aided manufacturing (CAM) and/or computer aided engineering (CAE). b) Referring to actual products from at least two different engineering industries, analyse the processes used for each and compare how manual, semi-automated and automated manufacturing processes are used. c) Explain why the companies that manufactured the products you referred to above decided to use particular manufacturing systems.

Task 3 — Generating an industrial production plan

Assessment focus 3

Be able to plan for the production of an engineered product for industry

Band 1	Band 2	Band 3
Produces a project network analysis to show the critical path for the production of a quantity of the same engineered product. (0–7)	Produces a project network analysis to show the critical path for the production of a quantity of the same engineered product and develops a detailed production plan and realistic schedule. (8–13)	Produces a project network analysis to show the critical path for the production of a quantity of the same engineered product, develops a detailed production plan and realistic schedule, reviews and justifies the production plan and schedule suggesting ways in which it could be improved used. (14–17)

Task 3	
Focus 3	Depending on your location and availability of resources/industrial access, you may be given a choice of industry and/or product to investigate or you may be presented with a scenario. a) For your chosen product, you need to produce a detailed schedule/plan for the production of a quantity of the same product, including an analysis of the time it will take and resources needed. Your production plan must contain the following elements: • a project network analysis/critical path analysis including the start and finishing times • the sequence of operations, materials, process methods, tools, equipment and machinery to be used, critical production and quality control points, inspection and quality checks and health and safety requirements. Your plan should be written so that someone else could follow it. b) When you have completed your production plan and schedule, explain why the steps and processes must be carried out in the order that you specified. Suggest ways in which you plan and schedule could be improved or made more efficient.

Task 4 — Team work, quality control and quality assurance procedures

Assessment focus 4

Be able to work in a team and apply quality control and quality assurance systems

Mark A

Band 1	Band 2	Band 3
Produces appropriate charts to control the output against a required standard. (0–4)	Produces appropriate charts to control the output against a required standard and analyses in detail the process control data to explain how variations affect the process and product. (5–7)	Produces appropriate charts to control the output against a required standard, analyses in detail the process control data to explain how variations effect the process and product and uses relevant parts of the ISO 9001 standards to help propose and evaluate an appropriate course of action to alleviate unwanted process variations. (8–10)

Mark B

The following marks will be awarded by your teacher as you are observed carrying out the tasks

Band 1	Band 2	Band 3
Works in a team to collect sufficient and appropriate data from an engineering manufacturing process. (0–3)	Works effectively in a team to collect sufficient and appropriate data from an engineering manufacturing process. (4–5)	Plays a key role as a member of a team to collect sufficient and appropriate data from an engineering manufacturing process. (6–7)

Task 4	
Focus 4	This task requires you to work in a team and you will study how manufacturing processes need to be managed and quality controlled to ensure the final product meets the requirements and specification of the customer. The specifications used will depend on the product being made or service provided. You will need to plan and carry out various activities within your team, develop and design methods of accessing information, then show how you used it. This could be done as part of your work experience or through research. Working as a team you must undertake the following tasks: a) Allocate specific tasks to members of the team. Some may be research tasks which can be carried out during your work experience placements. The research should cover the following elements: a Quality Control b Quality Assurance c National and International Standards d The use of statistical tools e ISO 9001. Once the team has gathered this information it should be shared. Material should be discussed within the team and each member of the team should take notes. Within your own portfolios, produce the appropriate charts to control the standard of a product using quality control and quality assurance systems. b) With any product, there are some unwanted variations in the production processes. Describe ways in which the production control data can vary and explain how some of the undesirable variations in the process can affect production. c) Using ISO 9001 explain how the processes you have investigated could be improved.

Unit 7 Innovative Design and Enterprise

Tutor brief

Subject: Engineering		Level: 3
Unit 7: Innovative Design and Enterprise		**Assessment time: 6 hours**
LO. 1	Know how a successful new product evolves	
LO. 2	Know about individuals who have become successful engineering entrepreneurs	
LO. 3	Understand how engineering activities impact on the society and the government	
LO. 4	Be able to produce or improve designs in an innovative way	
LO. 5	Know about opportunities for success when bringing a new product to market	
PLTS	Independent enquiries (IE3), creative thinkers (CT1,5), reflective learners, team workers, self-managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment **must** be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed. • Drawings or sketches, no larger than A3, printed only. • Bibliography of research sources, authenticated by tutor. • Annotated photographic evidence where suitable.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor. • Annotated diagrams and photographs where suitable.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 4	• Annotated diagrams and photographs where suitable. • PowerPoint presentation, printed on A4. Electronic copies are not required. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised
Task 5	• A4 written evidence must be clearly legible, preferably word-processed. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignments

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 7 of the Level 3 Engineering Diploma. In this case the suggestion covers all five learning outcomes, although this may not always be the case. Five tasks might be appropriate for this unit, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 7: Innovative Design and Enterprise.

Task 1 — Development of new products

Assessment focus 1

Know how a successful new product evolves

Band 1	Band 2	Band 3
Identifies two products that are recognised as being innovative, and compares them to traditional counterparts in terms of their design/operation, method of manufacture, marketing approach.	Identifies two products that are recognised as being innovative, compares them to traditional counterparts in terms of their design/operation, method of manufacture, marketing approach and explains the features of one of the products that has led to it being regarded as innovative.	Identifies two products that are recognised as being innovative, compares them to traditional counterparts in terms of their design/operation, method of manufacture, marketing approach and explains the features of one of the products that has led to it being regarded as innovative and the factors that have made it a success.
(1–4)	(5–7)	(8–10)

Task 1	
Focus 1	Carry out research into two innovative products that you are familiar with. a) Compare your chosen products with their more traditional equivalents. Concentrate on the following aspects of the products: • how the products were designed and how well they operate • the methods of manufacture used for each product • the way that the products were marketed and the success of the marketing campaign used. Explain what it is about one of the products that makes it innovative and what has led to its success.

Task 2 — Successful entrepreneurs in engineering

Assessment focus 2

Know about individuals who have become successful engineering entrepreneurs.

Band 1	Band 2	Band 3
Identifies two successful entrepreneurial engineering-based individuals, and describes their route to success. (1–4)	Identifies two successful entrepreneurial engineering-based individuals, describes their route to success and the key factors that led to their success. (5–8)	Identifies two successful entrepreneurial engineering-based individuals, and describes their route to success, identifies the key factors that led to their success and analyses the reasons for their success in their careers. (9–10)

Task 2	
Focus 2	Make a study of two successful engineering entrepreneurs. Consider what made them successful, for example how they spotted a niche in the market, how they developed their product and how they persuaded people to take on board their new ideas. Describe their route to success, identifying the key milestones in their rise to fame. Analyse the reasons behind each entrepreneur's success, including the impact of the key factors that lead to their achievements.

Task 3 — Impact of engineering on society and the environment

Assessment focus 3

Understand how engineering activities impact on society and the environment

Band 1	Band 2	Band 3
Describes ways in which two engineering activities have had an impact on social activity, behaviour and the environment. (1–4)	Explains ways in which engineering activity has had an impact on social activity and behaviour and how environmental issues have been addressed. (5–7)	Uses a range of case studies to discuss different ways in which engineering activity has had an impact on social activity and behaviour, and different ways in which environmental issues have been addressed. (8–10)

Task 3	
Focus 3	Research the activities carried out by different local or national engineering companies and produce a report on the effects that these activities can have. a) Describe how two of the different activities have impacted on society and the environment. b) Use your research to analyse how a range of engineering activities have affected society and the environment and the different methods used to counter the effects. Discuss the possible positive and negative impacts and how these relate to social and environmental issues.

Task 4 — Produce or improve designs

Assessment focus 4

Be able to produce or improve designs in an innovative way

Band 1	Band 2	Band 3
Produces and presents a new design, or an improvement to an existing one, that displays innovation in terms of a least two key product features. (1–8)	Produces and presents a new design, or an improvement to an existing one, that displays innovation in terms of at least two key product features, explaining the value of the innovative features. (8–12)	Produces and presents a new design, or an improvement to an existing one, that displays innovation in terms of at least two key product features, explaining the value of the innovative features and the thinking and research processes that have led to the innovations. (3–16)

Task 4	
Focus 4	d) Your task is to either design an innovative product or improve the design of an existing product in an innovative way. The choice of product is up to you. However, you should consider the following: i) It can be a completely new product or it can be an improvement to an existing product. ii) If you choose to improve an existing product, the improvements should be in areas such performance, appearance or method of manufacture. iii) Where possible any design solution or improved design should incorporate new technologies, materials and processes. Within your design solution you should show innovation within at least two key product features. You should try to explain the value of your design/improvements and the research processes that have lead to your final solution. e) When you have completed your design work you will be expected to give 10-minute presentation about your design solution to your peers. You should be prepared to answer questions regarding your design solutions.

Task 5 — What makes a new product a success

Assessment focus 5

Know about opportunities for success when bringing a new product to market

Band 1	Band 2	Band 3
Describes how new products can be brought to market.	Describes how new products can be brought to market and reviews the ways in which two innovative products, one that was a commercial success and one that failed, were brought to market.	Describes how new products can be brought to market, reviews the ways in which two innovative products were brought to market, one that was a commercial success and one that failed and analyses the possible reasons for these two opposite outcomes.
(1–6)	(7–10)	(11–14)

Activities for task 5		
Focus 5	a)	Describe the different stages involved when a new product is launched.
	b)	Research a product that was a commercial success and a product that was not. Explain how these products were brought to market and analyse the reasons behind their success or failure.

Unit 8 Mathematical Techniques and Applications for Engineers

Assignment

The following represents a typical externally-set assessment that will give learners an opportunity to generate evidence for all of learning outcomes for Unit 8 of the Engineering Diploma at Level 3.

The assessment consists of a series of questions involving the use of appropriate mathematical modelling techniques to solve real engineering problems and candidates will be given 1 hour and fifteen minutes to complete the paper.

Answer ALL SIX questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

1. (a) The table below shows the velocity, v m s^{-1}, of a projectile at time t s after it was launched from an aircraft

Time, t (seconds)	5	10	15	20	25
Velocity, v (m s^{-1})	115	175	235	295	355

(i) Assuming that the velocity is changing at a constant rate, plot a velocity-time graph for the projectile for the period $0 \le t \le 25$.

y axis = velocity, in m s^{-1} from 0 – 400, 10 mm = 50 m s^{-1}

(ii) Use your graph to determine a formula for *v* in terms of *t*.

v = ……………….. **(2)**

(b) The Work-Energy Principle can be written as:

$$W_T = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

Write down an expression for WT in fully factorised form.

(2)

(c) The distance s m travelled by a car t seconds after passing a road sign is given by the formula $s = 27t + 3t^2$.

Find how long it takes the car to travel a distance of 66 m past the road sign.

Time = ………………. s

(3)

(9 marks)

2. (a) Show, using a sketch of a right angled triangle, that if $\sin\theta = \frac{8}{17}$, where θ is an acute angle, then $\cos\theta = \frac{15}{17}$.

(3)

(b) A voltage, v volts, in a circuit is given by the equation $v = 1 + \cos\theta$.

Sketch a graph of the voltage v over the range $\theta = 0°$ to $\theta = 360°$.

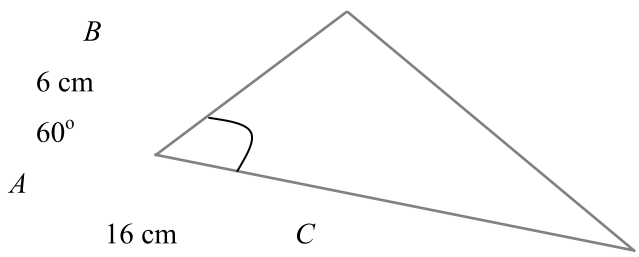
Use your graph to determine the value of voltage when $\theta = 270°$

When $\theta = 270°$, $v =$ ……………………

(4)

(c) A triangular metal plate *ABC* has *AB* = 6 cm, *AC* = 16 cm and

angle *BAC* = 60^{o}. Find the length of *BC*.



BC = ……………………..

(3)

(10 marks)

3 (a) A sealed cylindrical tank has diameter 0.5 m and height 1.5 m. Find the total external surface area of the tank.

Surface area = …………………….. m^2

(3)

(b) Determine the length of an arc of a circular vehicle test track given that the track has a diameter of 1.5 km and the angle subtended by the arc at the centre of the track is 120°.

Length = ………………………… km

(3)

(c) A flywheel revolves at 300 rpm. Express this in radians **per second**.

(3)

(9 marks)

4. The following data was obtained (to the nearest whole number) on a batch of 199 resistors with a marked value of 100 Ω:

Actual resistance value (Ω)	96	97	98	99	100	101	102	115
Frequency	1	1	3	20	56	61	37	20

(a) (i) Calculate, to the nearest whole number, the mean resistance value of the batch.

Mean = ………………………….. Ω

(4)

(ii) Calculate the median resistance value of the batch.

Median = ………………………….. Ω

(3)

(b) State, with a reason, which of these two averages you would use to summarise the data.

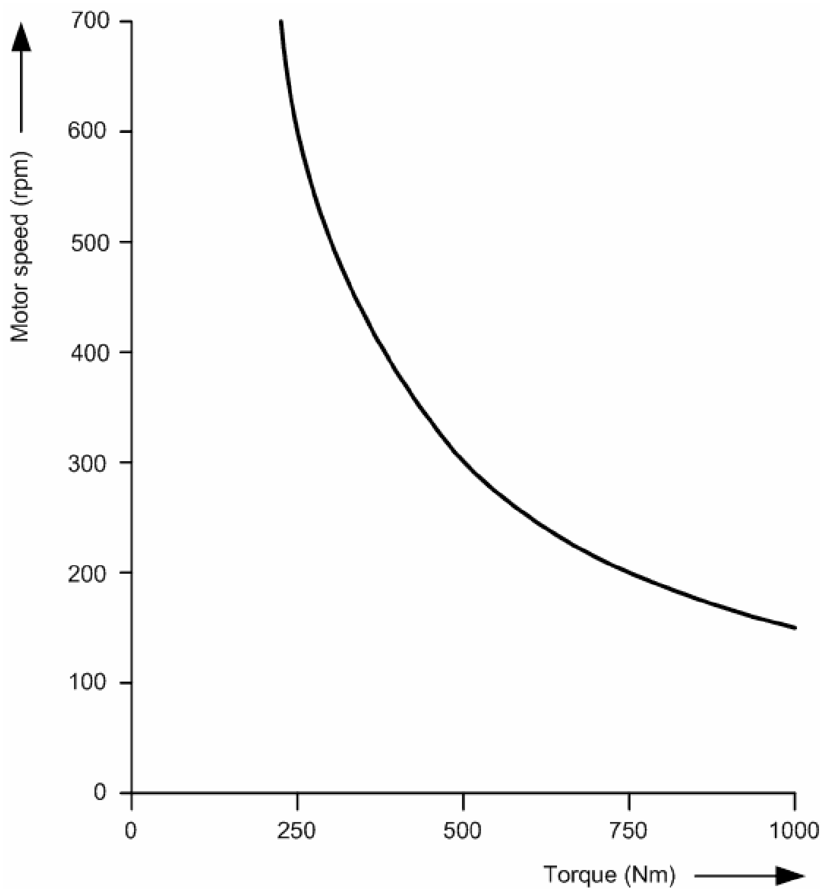
....

....

....
(2)

(9 marks)

5.



(a) The graph above shows how the speed of a motor varies with torque.

Draw a tangent to the graph and use it to determine the rate of change of torque with speed when the torque is 500 Nm.

$\Delta T/\Delta s$ = ……………………….. Nm/rpm
(3)

(b) The velocity v of an aircraft at time t is given by the equation $v = 2t^2 + 5$.

(i) Use calculus to derive an expression for the acceleration of the body at time t.

a = ……………………..

(2)

(ii) Find the acceleration at $t = 2$ s

a = ……………….. m/s^2

(1)

(c) Use calculus to determine the distance travelled by the aircraft between $t = 0$ and $t = 4$ s.

Distance = ……………………………. m

(4)

(10 marks)

6. (a) (i) Make l the subject of the formula $t = 2\pi\sqrt{\dfrac{l}{g}}$

l = …………………………

(3)

(ii) Find l when $t = 2$ s and $g = 9.81$ m/s^2. .

l = ………………………… m

(2)

(b) Given that $A = 20\log_{10}\left(\frac{V_{out}}{V_{in}}\right)$,

determine V_{out} when $V_{in} = 0.15$ and $A = 36$.

V_{out} = ...

(4)

(c) The voltage developed across a capacitor is given by the relationship,

$$V_C = V(1 - \mathrm{e}^{-\frac{t}{CR}})$$

Determine the value of C when $v_c = 50$, $V = 100$, $R = 1 \times 10^6$, and $t = 200$.

C = ………………………..

(4)

(13 marks)

TOTAL FOR PAPER 60 MARKS

END

Unit 9 Principles and Applications of Engineering Science

Tutor brief

Subject: Engineering		**Level: 3**
Unit 9: Principles and Applications of Engineering Science		**Assessment time: 30 hours**
LO. 1	Be able to apply mechanical principles to determine the effects of forces in engineering systems	
LO. 2	Be able to apply mechanical principles to determine the effects of motion, work and energy transfer in engineering systems	
LO. 3	Be able to apply electrical principles to determine the effects of electrical charge and current and determine the voltage, current, resistance and power in electrical circuits	
LO. 4	Be able to apply the principles of heat and thermodynamics to determine the effects of expansion and compression of gases and energy transfer in engineering systems	
LO. 5	Know about the principles of chemistry and the effects of chemical processes reactions	
LO. 6	Be able to apply the principles of fluid dynamics to determine the effects of viscosity and the forces acting in hydrostatic systems	
PLTS	Independent enquiries(IE4), creative thinkers, reflective learners, team workers, self-managers, effective participators	

Assignment overview

The following activities represent a typical assignment to give learners the opportunity to generate evidence for the assessment foci within this unit.

Scenarios and role plays used to deliver this assignment should be based on the assessment grids and Approaches to Assessment advice in the specifications.

Mark allocations are given in the unit specification.

If contextualising this assignment to better meet the needs of your learners please ensure to refer to the assignment controls to ensure validity of any changes.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used each learner's work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Assignment controls

Unit specifications: Annexe E

Annexe E, within the unit specifications, provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Where learners are working in groups it is inevitable that occasionally materials will be produced collaboratively. However, any material that will be used for purposes of assessment must be the learner's own work. This applies particularly to such materials as notes on meetings, storyboards etc, which are traditionally produced by one person within a team. It cannot be stressed enough that moderators will require all evidence presented to them in support of assessment decisions to be the individual learner's own work.

The table below indicates any controls for each task within this assignment. Where '*written evidence*' is used it may take any form which is suitable to the brief, as long as it enables the candidate scope to meet all the evidence requirements.

Specialist locations refer to areas such as workshops, music studio, etc which are required to complete the task.

Task	Final evidence produced	Location	Supervision
Task 1	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 2	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 3	• A4 written evidence must be clearly legible, preferably word-processed.	Classroom	Supervised
Task 4	• A4 written evidence must be clearly legible, preferably word-processed. • Drawings or sketches, no larger than A3, printed only. • Bibliography of research sources, authenticated by tutor.	Classroom	Supervised

Candidate brief

This assignment is designed to provide opportunities for you to achieve the assessment criteria which is set out in the marking grid for the unit and to provide evidence of your ability, knowledge and understanding of the content in the section 'What you need to cover' in the unit specification.

Evidence from each activity in this unit should be gathered in a process portfolio, which should be clearly indexed and referenced. Each page of the portfolio should be numbered and include the following information: candidate name, candidate number, centre name and centre number. Portfolios can be gathered and stored as hard copy or electronically. If e-portfolios are used your work should be stored in a single folder labelled as follows: *Process Portfolio/Level X/Unit X – Unit title/candidate's number/candidate's name.*

Self evaluation

When producing the portfolio of work for this unit you should firstly plan your work and agree an appropriate time frame with your tutor, and then you should give periodic updates on your progress to your tutor.

These updates should include reflections on your progress as well as feedback on the work completed and any problems you have experienced in meeting your delivery schedule and how you have dealt with these.

On completion of the assignment it is a good idea to produce a brief written evaluation of, and comments on, the work you have done. This should include how you have managed your work against the assignment time frame and those areas you feel you could improve upon in the future. This is likely to help you in planning and completing future assignments.

Marking

The maximum marks available for each assessment focus represent its relative significance within the unit. Your tutor will decide which mark band should be applied to your work for each area of assessment focus. This will be on the principle of best fit. For example, work may be classified as band mark 2 despite aspects of the work falling into band 1 and other areas of work falling into band mark 3.

To improve your marks and move across the mark bands from band 1 to band 3 your work will have to generally increase in depth, breadth and attention to detail and quality, with some clear description as you move across the mark bands.

Assignments

The following represents a typical assignment that will give learners the opportunity to generate evidence for Unit 9 of the Level 3 Engineering Diploma. In this case the suggestion covers all six learning outcomes, although this may not always be the case. Four tasks might be appropriate for this unit, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Purpose

The purpose of this assignment is to provide a framework within which the learner can achieve all of the Assessment Foci associated with Unit 9: Principles and Applications of Engineering Science.

Task 1 — Force, motion, work and energy transfer

Assessment focus 1

Be able to apply mechanical principles to determine the effects of forces in engineering systems

Band 1	Band 2	Band 3
Solves a system of two perpendicular coplanar forces and applies the principle of moments to a loaded system. (0-4)	Solves a system of three non-perpendicular coplanar forces and determines the conditions for static equilibrium for a loaded beam. (5-7)	Solves a system of four non-perpendicular coplanar forces, determines the conditions for static equilibrium for a loaded beam and determines beam reactions due to loading. (8-10)

Assessment focus 2

Be able to apply mechanical principles to determine the effects of motion, work and energy transfer in engineering systems

Band 1	Band 2	Band 3
Solves practical engineering problems involving linear motion and applies Newton's laws of motion. (0-4)	Solves practical engineering problems involving linear motion and angular motion, applies Newton's laws of motion and applies the principle of conservation of energy. (5-7)	Solves practical engineering problems involving linear motion and angular motion and friction, applies Newton's laws of motion, applies the principles of conservation of energy and conservation of momentum. (8-10)

<table>
<tr><th colspan="2">Task 1 — Force, motion, work and energy transfer</th></tr>
<tr><td colspan="2">Purpose
The purpose of this task is to provide a framework within which the learner can:
• Solve engineering problems involving force, motion, work and energy transfer.</td></tr>
<tr><th colspan="2">Tasks 1.1</th></tr>
<tr><td>Focus 1</td><td>

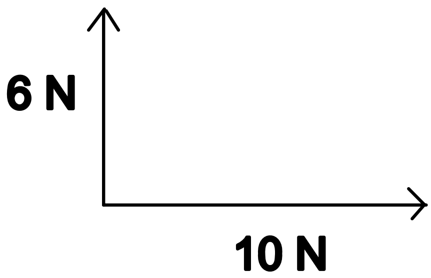


Figure 1

Figure 1 represents two perpendicular forces.

Calculate:

a) The magnitude of the resultant force

b) The angle between the resultant force and the 10 N force

</td></tr>
<tr><th colspan="2">Tasks 1.2</th></tr>
<tr><td>2
Focus 1</td><td>

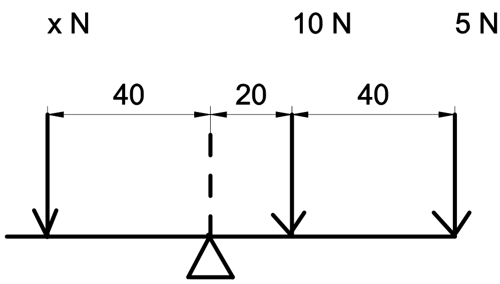


Figure 2

Figure 2 represents a horizontal beam supported by a single point fulcrum.

Calculate the magnitude x such that the beam is in equilibrium

</td></tr>
</table>

Tasks 1.3

Focus 1

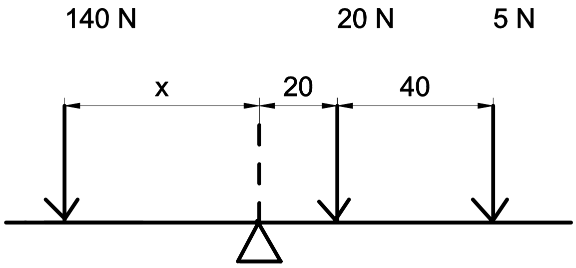


Figure 3

Figure 3 represents a horizontal beam supported by a single point fulcrum.

Calculate the distance x such that the beam is in equilibrium.

Tasks 1.4

Focus 1

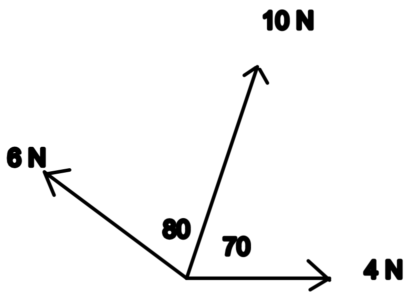


Figure 4

Figure 4 shows three forces acting on a point. Calculate the magnitude and direction of the resultant force.

Tasks 1.5

Focus 1

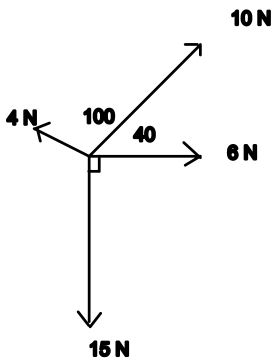


Figure 5

Figure 5 shows four forces acting on a point. Calculate the magnitude and direction of the resultant force.

Tasks 1.6	
Focus 2	An object with an initial velocity of $5ms^{-1}$ is subjected to a constant acceleration of 2.5 ms^{-2} for 6 seconds. Calculate: a) Final velocity b) Total distance travelled
Tasks 1.7	
Focus 2	An object with a mass of 1200 kg is subjected to a constant acceleration of $3ms^{-2}$. Calculate: a) Force required b) Resulting reactance force
Tasks 1.8	
Focus 2	A flywheel has an initial angular velocity of 3 $rad.s^{-1}$ and is subjected to a constant acceleration of 0.5 $rad.s^{-2}$ for 5 seconds. Calculate: a) Final velocity b) Number of revolutions turned during the 5 seconds
Tasks 1.9	
Focus 2	A vehicle of mass 800 kg starts from rest at the top of a 3 m high ramp. Ignoring friction, calculate the velocity of the vehicle at the bottom of the ramp.
Tasks 1.10	
Focus 2	Calculate the frictional force acting on a mass of 10 kg which is at rest on a plane surface of incline 15^0
Tasks 1.11	
Focus 2	A car with mass 800 kg travelling at 157 ms^{-1} and a lorry with mass 8 Tonnes travelling at 112 ms^{-1} have a head on collision. Calculate the magnitude and direction of the combined resultant velocity after the collision.

Task 2 — Electrical circuits

Assessment focus 3

Be able to apply electrical principles to determine the effects of electric charge and current and determine the voltage, current, resistance and power in electrical circuits

Band 1	Band 2	Band 3
Solves practical engineering problems involving direct current circuits with a single source and load. (0-5)	Solves practical engineering problems involving direct current circuits with up to three series/parallel branches and applies basic principles of electromagnetism. (6-7)	Solves practical engineering problems involving direct current circuits with up to three series/parallel branches, applies the principles of electromagnetic coupling (ie a transformer connected between an AC source and a purely resistive load), and solves a practical engineering problem involving an AC circuit in which only pure resistance is present. (8-10)

Task 2 — Electrical circuits

Purpose

The purpose of this task is to provide a framework within which the learner can:

- Solve practical problems involving DC and AC circuits and magnetism.

Task 2.1

Focus 3

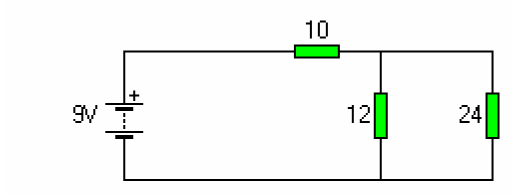


Figure 6

Use Figure 6 to calculate the following:

a) Total resistance in the circuit

b) Current supplied to the circuit

c) Total power dissipated

d) Voltage drop across each resistor

e) Current flowing in each resistor

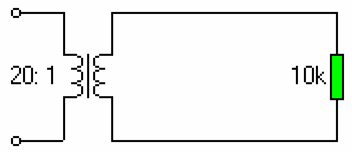
Task 2.2

Focus 3

a) A conductor carrying a current of 50 mA has an effective length of 300 mm inside a magnetic field of flux density 60 mT.

Calculate the force acting on the conductor.

b) Explain, with the aid of a suitable sketch, how a conductor inside a magnetic field can be used as the basis of an electric motor.

Task 2.3	
Focus 9.3	a) A conductor has an effective length of 25 mm in a magnetic field of flux density 750 mT and is rotating at a velocity of 20 ms^{-1}. Calculate the emf that will be induced in the conductor when it is at right angles to the field. b) Explain, with the aid of a suitable sketch, how a conductor inside a magnetic field can be used as the basis of an electric generator. c)  Figure 7 Figure 7 shows a transformer, assumed to be 100% efficient, connected to a load resistor. The input voltage has an rms value of 9V. Calculate the rms values of the following: i) Secondary voltage ii) Power dissipated in the resistor

Task 3 — Heat thermodynamics and fluid dynamics

The following is a sample assessment activity that covers Learning Outcomes 9.4 and 9.6. In this unit four tasks might be appropriate, determined by the links between the assessment foci. Centres are encouraged to take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.

Assessment focus 4

Be able to apply the principles of heat and thermodynamics to determine the effects of expansion and compression of gases and energy transfer in engineering systems

Band 1	Band 2	Band 3
Solves practical engineering problems involving heat and thermodynamics. (0-4)	Solves practical engineering problems involving heat and applies thermodynamics to the expansion and compression of gases. (5-7)	Solves practical engineering problems involving heat, applies thermodynamics to the expansion and compression of gases and applies the first law of dynamics. (8-10)

Assessment focus 6

Be able to apply the principles of fluid dynamics to determine the effects of viscosity and the forces acting in hydrostatic systems

Band 1	Band 2	Band 3
Solves practical engineering problems involving fluids at rest. (0-4)	Solves practical engineering problems involving fluids at rest and in motion. (5-7)	Solves practical engineering problems involving fluids at rest and in motion and applies Bernouli’s and Darcy’s equations. (8-10)

Task 3 — Heat thermodynamics and fluid dynamics	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate understanding of the principles of heat and thermodynamics.	
Task 3.1	
Focus 4	A 5 kg mass of ice at 0^0 C is to be changed into water at 15^0C. Calculate the heat energy required to: a) Change the ice into water at 0^0 C b) Raise the temperature of the water from 0^0 C to 15^0 C
Task 3.2	
Focus 4	A steel bar of length 2 m and cross-sectional area of 10 000 mm^2 has a linear expansion coefficient of 12 x 10^{-6} □/^{0}C. If the temperature rises by 12^0 C calculate the increases in: a) Length of the bar b) Volume of the bar
Task 3.3	
Focus 4	a) A gas with a mass of 2.5 kg and a volume 0f 1.36 m^3 is at a pressure of 101 kNm^{-2} and a temperature of 18^0C. Calculate the characteristic gas constant of the gas. b) The specific heat capacity at constant volume for the gas is 67 UJ/kg K. Calculate the specific heat capacity at constant pressure for the gas. c) A volume of gas has its temperature doubled. State the resultant change in volume of the gas.
Task 3.4	
Focus 4	Fluid flowing through a horizontal steady flow system causes an increase in internal energy of 57 J. If the heat energy input is 76 J calculate the magnitude and direction of the work done.

Task 3.5	
Focus 6	A U-type manometer shows a difference in height of 10 mm. The density of the fluid in the manometer is 700 kg m^{-3} and the atmospheric pressure is 101.325 kPa. a) Calculate the pressure of the fluid The atmospheric pressure is now reduced to 99.49 kPa. b) Calculate the new difference in height of the liquid
Task 3.6	
Focus 6	A flat circular plate of diameter 100 mm is immersed in a tank of liquid of density 950 kg m^{-3} to a depth of 500 mm. Calculate: a) Pressure acting on the plate b) Force acting on the plate
Task 3.7	
Focus 6	An open water tank has a diameter of 2 m and a depth of 4 m with an outlet pipe of diameter 25 mm at the bottom. The tank is filled to the top with water with a density of 1000 knm^{-3} and the outlet pipe is then opened. Calculate: a) Velocity of escaping water b) Volume of water that will escape in the first minute

Task 4 — Chemical principles

Assessment focus 5

Know about the principles of chemistry and the effects of chemical processes and reactions

Band 1	Band 2	Band 3
Describes the chemical composition, properties and industrial applications of arenes and phenols. (0-6)	Describes the chemical composition, properties, industrial applications, reactions and methods of producing arenes and phenols. (7-10)	Describes and explains the chemical composition, properties, industrial applications, reactions, methods of producing arenes and phenols. (11-14)

Task 4 — Chemical principles	
Purpose The purpose of this task is to provide a framework within which the learner can: • Demonstrate knowledge of the principles of chemistry and the effects of chemical processes and reactions.	
Task 4.1	
Focus 5	Write a report describing how benzene is used in chemical manufacture.
Task 4.2	
Focus 5	Write a report which explains the alkylation of benzene using the Friedel Crafts reaction.
Task 4.3	
Focus 5	Write a report which explains an industrial process associated with a petrochemical.

List of annexes

Annexe A: Internal Assessment of Principal Learning Units: Controls for Task Setting and Task Taking

Section 1: Introduction

It is a requirement of the *Criteria for accreditation of Specialised Diploma Qualifications at Levels 1, 2 and 3* that:

> 'Internal assessment [of Principal Learning] must normally be supervised and conducted under controlled conditions to ensure reliability and fairness. Requirements must be set out to ensure robustness at each stage of internal assessment, including:
>
> a the setting of tasks
>
> b the extent of supervision in carrying out tasks
>
> c the conditions under which assessment takes place
>
> d marking and standardising procedures
>
> e moderation and verification processes.'

This annexe provides guidance for tutors and assessors in regard to the variety and levels of controls required for the setting and carrying out of tasks and assignments, and the conditions under which assessment takes place. It details the broad controls that apply to all assessments of a particular type, but learners must also meet any specific controls or additional requirements that may be identified within the Assessment guidance section in individual units.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

Types of evidence

The types of assessment evidence which are called for within the Principal Learning units are:

- **written evidence**, such as reports, essays, minutes
- **artefacts**, such as artwork, manufactured products and other non-written physical evidence
- **performance evidence**, such as presentations, interviews and demonstrations of workshop skills.

Summary table of forms of evidence for learner activity

		Form of evidence				
		Witness statement and authentication	Video/DVD recording	Annotated photographs	Bibliography or list of sources	Product including Artefact, Report, Leaflet, etc
Learner activity	Demonstration of skills and performance	3	2	3		1 if possible
	Research	1			2	
	Interviews	2				1
	Artefacts	1		2		1 if possible
	Written evidence	1 if possible				1

For any activity at least one form of evidence should be supplied.

1: Required

2: Preferred in addition to any required evidence

3: May be used if 2 is not appropriate or as additional evidence

* with evidence of permission

Where a form of evidence is mandatory it is marked as 1. Other evidence may be supplied in addition to any mandatory evidence using the preferred evidence where possible

The requirements for written evidence are stated in the individual unit specification.

Further guidance on authentication can be found within Section 3 of this annexe.

- For all types of evidence the **task setting** requirements must be followed, which can be found in Section 2 of this annexe.
- For each type of evidence the specific **task taking** requirements must be followed, which can be found in Section 3 of this annexe.

The controls required for task marking, standardisation and moderation are published separately as part of the accompanying tutor support materials.

Section 2: Task setting

Assessment specification

Each internally assessed unit is assessed through a single assignment which addresses the overall theme of the unit to emphasise how the different learning outcomes all relate to each other. Each assignment may be broken down into a series of related tasks.

Use of awarding body materials

Edexcel will publish, as part of its tutor support materials, at least one assignment for each internally assessed unit. It is recommended that these assignments are used in the assessment of each unit. In order that these assignments can best meet learner interests and local needs they will include guidance for tutors and assessors to show the ways in which they may be adapted and contextualised.

Writing assignments

For those tutors or assessors wishing to design their own assignments, further guidance is provided in this specification, in the section 'Assessment and grading of the principal learning specifications'.

Centre's role and responsibilities in setting tasks

While it is not a requirement to use the Edexcel assignments, they will ensure that learners have the opportunity to fully meet the requirements of each assessment criterion. If tutors or assessors wish to design their own assignments it is important that these assignments, or tasks within them, also offer learners the opportunity to fully meet all these requirements. There is a particular risk that this might not happen if assignments originally designed for other units are used.

In some units the marking grid is divided into parts A and B. Tutors or assessors writing their own assignments must ensure that all tasks which will be marked against the A grid generate learner evidence that can be re-marked at a later stage during internal standardisation activity or external moderation.

If a centre-devised assignment is to be used, it is a requirement that another person, who understands the requirements of the specification, checks each new assignment for validity and feeds back to the author. This is especially important when a new tutor/assessor is required to produce assignments. Appropriate people would include a Domain or Lead Assessor. This review process should be documented and the evidence of the review should be made available for the external moderator if requested.

If the assignment is to be produced outside the teaching institution, for example by a supervisor at the learner's work experience placement, then the tutor or assessor at the teaching institution responsible for that unit, must sign off the assignment for validity before the learner attempts the assignment.

Complexity

If the level of complexity of the evidence required is not already identified within the specification, then an indication can be assumed from the amount of time set within the specification for the production of the assessment evidence, considering the level at which the specification is being taken. The expectations of what a Level 1 learner can accomplish in 10 hours are far different from that which can be expected from a Level 3 learner in the same time period.

Unless it is otherwise specified, learners should be set a task of equivalent complexity, whether they are expected to achieve marks at mark band 1 of the marking grid or mark band 3.

Group work

When producing assignments which require learners to work in groups, tasks must be written to allow each group member to fully meet the requirements of the assessment criteria.

Learners must not have their assessment opportunities reduced by the poor performance of other group members. Where this becomes apparent the tutor or assessor should intervene, or provide suitable alternative activities which do not greatly add to the learners' workloads.

Group tasks should not rely on the performance of individual members of the group to allow other group members to meet all of the assessment criteria.

It is important that each learner is assessed on their individual contribution to the achievements of the group.

Section 3: Task taking

In addition to any specific requirements about support which are identified within each unit within the specifications, the following guidelines should apply.

Conditions

If not specified within the unit, it is to be assumed that tasks or the whole assignment will normally be attempted at the end of the learning process.

Within each unit the following are identified:

- the typical time required for assessment
- the access allowed to resources
- the level of supervision.

Once an assignment has been completed and accepted by the assessor for marking the learner cannot make any further additions or amendments to the work. Where a future task or assignment builds on the work undertaken in an earlier task or assignment, the first task or assignment can be returned to the learner at the point it is needed. Where possible, it should be marked before it is returned and must be collected back in again when it is no longer needed for the second assignment, and stored in a secure place.

Guidance to learners

Where learners are required to gather information and resources, tutors or assessors should take the opportunity to discuss authentication and plagiarism at the outset.

At the start of the assignment learners will often be required to plan out their programme of work. The tutor/assessors should agree these plans and where appropriate agree milestones where they can monitor learners' responses. Appropriate intervention is to be encouraged to ensure learners have every opportunity of success. However, if the planning process forms part of the assessment criteria, care must be taken to ensure that the plan remains the learner's own work.

Role of the tutor

It is expected that all learners should develop as independent learners, but this does not mean that they should not be given any support in order to be able to research, write up and complete their reports. The hallmark of the independent learner, whatever the level, is knowing when and whom to ask for support in helping to carry the work forward.

All learners must be fully and equally briefed at the start of any task or assignment about the requirements of that task, including how they will be marked. They should be given the opportunity to ask any questions in order to clarify the requirements.

Once the assignment is under way, the tutor should respond to questions and requests for advice, but should normally refrain from intervening unasked. Responses can advise the learner on such matters as further sources of information, and can point out where further work is needed, but must always stop short of actually stating what to write. For example, it is permissible to tell the learner that for further marks they need to analyse, not just present, their findings. It is permissible to remind them what 'analyse' means. However, it is not permissible to talk them through their findings and prompt them to look at particular significant points.

In some units the amount of support and guidance a learner may receive in the course of carrying out the task or assignment is specified. This occurs, for example, when differentiation between mark bands is achieved in part by the support the learner needs to complete a practical task safely.

Tutors or assessors must always intervene where matters of health and safety are concerned. When this happens, the assessor should make a judgement about the appropriate marks that can be applied to the learner's work in the light of the intervention, and attach to the work a record of the intervention and justification for the marks awarded.

Authentication

All candidates must confirm that any work they submit for assessment is their own.

Once the assignment has been completed the assessor may need to interview or test the learner on their understanding of the information and/or the resources that they have identified and used. This may be necessary if, for example:

- the assessor needs to confirm the authenticity of the work
- the unit marking grid carries marks for information and/or resource gathering.

It will be up to the centre assessor to decide on the appropriate format, although the activity should be of a 'closed book' nature.

If the assessor decides to interview the learner, the assessor is required to question the learner regarding their information or resources until the assessor is sufficiently satisfied with the authentication. Whilst the interview is in progress the learner should not have access to the information or resources unless the individual unit specifies otherwise. It can be either a group or individual interview.

If the assessor decides to test the learner, the assessor is required to follow the usual testing format, with learners working in silence, and placed in a manner so that they do not see other learners' responses. The questions are at the discretion of the assessor, as is the length and timing of the test. Learners are not permitted to view the questions prior to the test and should not have access to their work during the test unless the individual unit specifies otherwise.

The documented outcome could be either notes following an interview with one or a group of learners and signed by the assessor, or marked test papers.

Each candidate is required to sign a declaration before submitting their coursework to their subject tutors/assessors for final assessment, to confirm that the work is their own and that any assistance given and/or sources used have been acknowledged. Ensuring that they do so is the responsibility of the candidate's centre.

It is also a requirement that tutors/assessors confirm to the awarding body that all of the work submitted for assessment was completed under the required conditions and that they are satisfied that the work is solely that of the individual candidate concerned. If they are unable to do so, the work should not be accepted for assessment. Centres should record marks of zero if candidates cannot confirm the authenticity of work submitted for assessment.

All tutors/assessors who have assessed the work of any candidate entered for each component must sign the declaration of authentication.

More guidance may be found in the JCQ Internal Conduct of Examinations (ICE) booklet for coursework and portfolios.

Re-sits

There may be occasions when a learner needs to retake a task or assignment. This is acceptable at the discretion of the tutor, but the assignment should normally be set in a different context so that the learner is not repeating exactly the same tasks which they have had the chance to practise beforehand. Individual units will have further guidance where appropriate.

Artefact — additional guidance

Due to the nature of producing an artefact, its production will often be dictated by the availability of materials, equipment etc, therefore it may well be produced outside of the centre. However, the assessor must be confident that the work is that of the learner. In order to be confident, Edexcel requires one of the following situations to apply:

- The work is carried out under the direct supervision of the teaching centre assessor. This is the most desirable option.
- The learner demonstrates to the teaching centre assessor equivalent levels of skill in each of the processes included in the final artefact. Ideally this would be in the course of the regular teaching/learning programme, but exceptionally, if the assessor feels a skill has been assessed at a level beyond expectations, the assessor may require the learner to repeat that skill before authenticating the work.
- If the artefact can be produced remotely only, for example during work experience, the assessor must have enough reliable information to allow them to both accurately assess the outcome and have a signed witness statement from an appropriate person who directly observed the learner producing the artefact.

It is not permissible for artefacts to be produced in the learner's home environment without the direct supervision of their assessor.

Performance evidence, including presentations and workshop skills — additional guidance

If a learner is being assessed on a presentation or a performance it is likely that some written evidence will also be available to assess, whether in hard copy or electronic format. This may be in the form of production notes, PowerPoint presentation, work logs etc. This section covers only the performance or presentation delivery skills. Likewise, in many cases a learner being assessed on workshop skills may also submit an artefact that has been produced or worked on that could form part of the evidence.

Formative assessment is to be particularly encouraged to help learners prepare for their tasks. As with other forms of assessment, direct help during the assessed performance is not permitted unless explicitly stated as being acceptable in the guidance section for the relevant unit. Assessment must be based only on the performance put forward for assessment. This should be recorded using the most suitable format, which is at the centre's discretion unless stipulated in the relevant unit.

Where witness statements and practical activity logs are required Edexcel will provide exemplar pro formas. Centres may choose to develop their own documentation, but they must record at least the information contained within the exemplar pro formas.

Other evidence that will support assessment decisions includes audio and visual recordings and photographs, particularly if they have been annotated.

Annexe B: Guidance for adaptation of exemplar assignments

Level 1 Unit 2: Practical Engineering and Communication Skills	
Task: Learners will need to plan and produce an engineered product and produce sketches of engineered products.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. Include witness statements/observation records and annotated photographs showing safe use of tools and equipment.	Amend tasks to accommodate the local needs of centres. The following indicates where this flexibility exists: Tasks 1.1, 2.1 and 3.1 These may be related to the learners' work experience Also: Task 4 Drawings of other products or assemblies can be used

Level 1 Unit 3: Introduction to Computer Aided Engineering	
Task: Learners will need to produce drawings of an engineering component using CAD, import the drawing geometry into a CAM system and convert into a machine tool cutter path. They will then execute the program to produce a component.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band.	Amend tasks to accommodate the local needs of centres. Tasks 1 and 2 A different component of similar complexity can be used This may be related to the learners' work experience

Level 1 Unit 4: Developing Routine Maintenance Skills	
Task: Learners will investigate and carry out routine maintenance procedures and assess likely failure rates of equipment.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band.	Amend tasks to accommodate the local needs of centres. The following indicates where this flexibility exists: Tasks 2 and 3 A different piece of equipment can be used for the maintenance tasks.

Level 1 Unit 5: Introduction to Engineering Materials	
Task: Learners will need to investigate different materials and carry out tests to determine their properties.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band.	Centres may wish to link the materials used for Task 3 with those used in Unit 2.

Level 1 Unit 6: Electronic Circuit Construction and Testing	
Task: Learners will read electronic diagrams, use symbols to prepare diagrams that represent a given circuit, build circuits and test them.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band.	Amend tasks to accommodate the local needs of centres. The following indicates where this flexibility exists: Tasks 1.1, 2.1 and 3.1 The circuit diagram given could have different components. Tasks 1.2 and 1.3 The actual components given for each learner could be varied. Also Task 3.5 If the learner has not produced any circuit of a suitable standard for this task, a simple circuit of similar nature should be given.

Level 1 Unit 7: Engineering the Future	
Task: Learners will demonstrate what they know about engineering technology and its impact, how products are recycled or safely disposed of, and the use of renewable energy.	
Centres must	**Centres may**
Take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.	Task 1.1 Centres may wish to focus learners on specific materials that are used by local industry or that they are familiar with through class exercises and work placements. The areas of space exploration, underwater research and building construction can be changed to more relevant areas as appropriate. Task 1.2 The research of engineering technologies could be more focused on specific areas of engineering that relate to centres' industrial links and individual student interest. Task 1.3 Centres may wish to focus this task on alternative energy resources that reflect local investment in green technology. This may include initiatives by local industry or investments from power companies. Centres should make the most of any green initiatives by engineering companies that they have links with.

Level 2 Unit 1: Exploring the Engineering World	
Task: Learners will produce either a report or a presentation, which will demonstrate what they know about the different engineering sectors and their products and services, and the job opportunities available within engineering.	
Centres must	**Centres may**
Take a holistic approach when designing assessment instruments in order to minimise the number of tasks required.	Task 1.1 Centres may wish to focus learners on the specific sectors of engineering that reflect local industry trends or that are relevant to work placements or existing links with employers. Task 2.1 Centres may wish to utilise links with local and/or national engineering companies to support learners in identifying opportunities and progression routes within engineering organisations. Site visits and guest speakers would be a valuable aid to this task. Task 2.2 Centres may wish to identify engineering institutions that represent sectors of local engineering establishments. Task 3.1 Learners should be encouraged to focus on engineering achievements that have significant local impact or that are directly relevant to engineering sectors of interest. This may include a local birthplace of an inspirational engineer, the site of specific research or development or a reflection of local commercial infrastructure.

<table>
<tr><th colspan="2">Level 2 Unit 2: Investigating Engineering Design</th></tr>
<tr><td colspan="2">Task: Learners will investigate engineered products and turn a design brief into a design specification and a design specification into a design solution.</td></tr>
<tr><th>Centres must</th><th>Centres may</th></tr>
<tr><td>Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band.

Provide a realistic design brief and specification.</td><td>Task 2

Use products other than those given in the unit content providing they are of similar complexity.

Task 3

Can be a continuation of Task 2 using the specification that has been produced.</td></tr>
</table>

Level 2 Unit 3: Engineering Applications of Computers	
Task: Learners will use a computer-based system to solve an engineering problem and research how computers are used in industry.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. Provide a realistic activity for Task 2 which can be solved using the available equipment. Include witness statements/observation records and photographic evidence to demonstrate authenticity.	Link Tasks 1 and 4 to learners' work experience.

Level 2 Unit 4: Producing Engineering Solutions	
Task: Learners will plan, produce and test an engineered product observing all health and safety requirements.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. Provide an engineering activity which is within the centre's resources for the learners to carry out. Include witness statements/observation records and annotated photographs showing safe use of tools and equipment.	Link this unit with Unit 6. Task 2 Use a centre devised worksheet for the activity plan.

Level 2 Unit 5: Electrical and Electronic Circuits and Systems	
Task: Learners will identify electronic components, build working electronic circuits safely, test working circuits and find faults on faulty circuits.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. Provide components and equipment for learners to construct working electronic circuits. Provide working electronic circuits with all necessary test equipment. Provide faulted electronic circuits.	Use circuits other than those listed in the unit content, as long as they are of a similar complexity.

Level 2 Unit 6: Applications of Manufacturing Techniques in Engineering	
Task: Learners will work in a team to plan and produce a batch of components using a CNC lathe and test the quality of the finished product.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. Include witness statements/observation records and annotated photographs showing safe use of tools and equipment. Ensure learners identify evidence from group work.	Use a different component for batch production, which should be similar in complexity. Link this Unit with Unit 4.

Level 2 Unit 7: Application of Maintenance Techniques in Engineering	
Task: Learners will describe different types of maintenance and carry out a routine maintenance procedure and then carry out a risk assessment and produce their own maintenance procedure.	
Centres must	**Centres may**
Allow the appropriate work to be carried out to meet the requirement of the assessment focus and mark band. Provide a maintenance strategy for a system that the learners can then design and carry out a maintenance procedure.	Link the maintenance operation to the learners' work experience.

Level 3 Unit 2: Applications of Computer Aided Designing	
Task: Learners will need to focus on CAD hardware and software to produce 2D drawings, 3D models and simulations to carry out testing and analysis.	
Centres must	**Centres may**
Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.	Amend tasks to accommodate the local needs of the centre using these assessment instruments. The following indicates where this flexibility exists: Task 2.1 The examples of engineering drawings given could be different. This would also enable tasks 2.2, 3.1 and 3.2 to be different. Task 3.3 The drawing file given for each learner could be varied. Task 4.1 The component and functional requirements along with the material to be used could be varied for each learner. This would also enable tasks 4.2 and 4.3 to be different.

Level 3 Unit 3: Selection and Application of Engineering Materials	
Task: Learners will investigate the properties of materials and test whether they will fail.	
Centres must	**Centres may**
Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.	Use work experience to carry out Task 4 if the required equipment is not available.

Level 3 Unit 4: Instrumentation and Control Engineering	
Task: Learners will produce a report describing signals and sensors in open and closed loop systems and use PLCs in an engineering context.	
Centres must	**Centres may**
Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.	Link Tasks 4 and 5 to learners work experience.

<table>
<tr><th colspan="2">Level 3 Unit 5: Maintaining Engineering Plant, Equipment and Systems</th></tr>
<tr><td colspan="2">Task: Learners will investigate the need for maintenance procedures and plan and carry out a risk assessment and maintenance procedure.</td></tr>
<tr><th>Centres must</th><th>Centres may</th></tr>
<tr><td>Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.</td><td>Link the maintenance activity to the learners' work experience.</td></tr>
</table>

<table>
<tr><th colspan="2">Level 3 Unit 6: Investigating Modern Manufacturing Techniques Used in Engineering</th></tr>
<tr><td colspan="2">Task: Learners will investigate how traditional and modern techniques are used in manufacturing, plan how to produce a product, and work in a team to apply quality control.</td></tr>
<tr><th>Centres must</th><th>Centres may</th></tr>
<tr><td>Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.

Task 4 will require witness statements/observation records to determine individual contributions.</td><td>Task 3 could be linked to learners’ work experience.</td></tr>
</table>

Level 3 Unit 7: Innovative Design and Enterprise	
Task: Learners will research existing products and see how they evolved from an initial idea into a commercial reality. They will investigate the people who made this happen, and the wider implications of the effect of the products on society and the environment. Learners will then attempt to design a product yourself.	
Centres must	**Centres may**
Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.	Link Task 2 to learners' work experience or, if possible, invite a local entrepreneur to address the group.

Level 3 Unit 9: Principles and Applications of Engineering Science	
Task: Learners will carry out a series of laboratory experiments which will enable them to gather data and use the data to solve engineering problems.	
Centres must	**Centres may**
Give learners support to ensure the opportunities for meeting the assessment focus and mark band requirements are facilitated.	Use a variety of laboratory and workshop experiments which enable learners to collect data.

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