Edexcel GCE

Edexcel Advanced Subsidiary GCE in Engineering (8731)

Edexcel Advanced GCE in Engineering (9731)

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Sample assessment material

Edexcel GCE in Engineering

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Acknowledgements

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Authorised by Jim Dobson
Prepared by Parul Patel

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Contents

Unit 1: Engineering Materials, Processes and Techniques

Question paper 1

General guidance on marking 15

Mark scheme 17

Unit 4: Applied Engineering Systems

Brief 27

Assessment criteria 34

Paper Reference (complete below)									Centre No.					
									Candidate No.					

Surname	Initial(s)
Signature	

Paper Reference(s)

6931/01

Edexcel GCE

Engineering

Advanced Subsidiary

Unit 1: Engineering Materials, Processes and Techniques

Thursday 16 June 2005 — Morning

Time: 1 hour 30 minutes

30 Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your Centre Number and Candidate Number, your surname, initial(s) and signature.
The Paper Reference is shown at the top of this page. Check that you have the correct question paper and write the Paper Reference for which you have been entered.
Answer **ALL** the questions in the spaces provided in this question paper.

Information for Candidates

There are 14 pages in this question paper. All blank pages are indicated.
The total mark for this paper is 90. The marks for the various parts of questions are shown in round brackets, e.g.: **(2)**.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.
Include diagrams in your answers where these are helpful.

Turn over

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Answer ALL questions

Some of the questions in this paper relate to a petrol driven scooter, shown in figure 1.

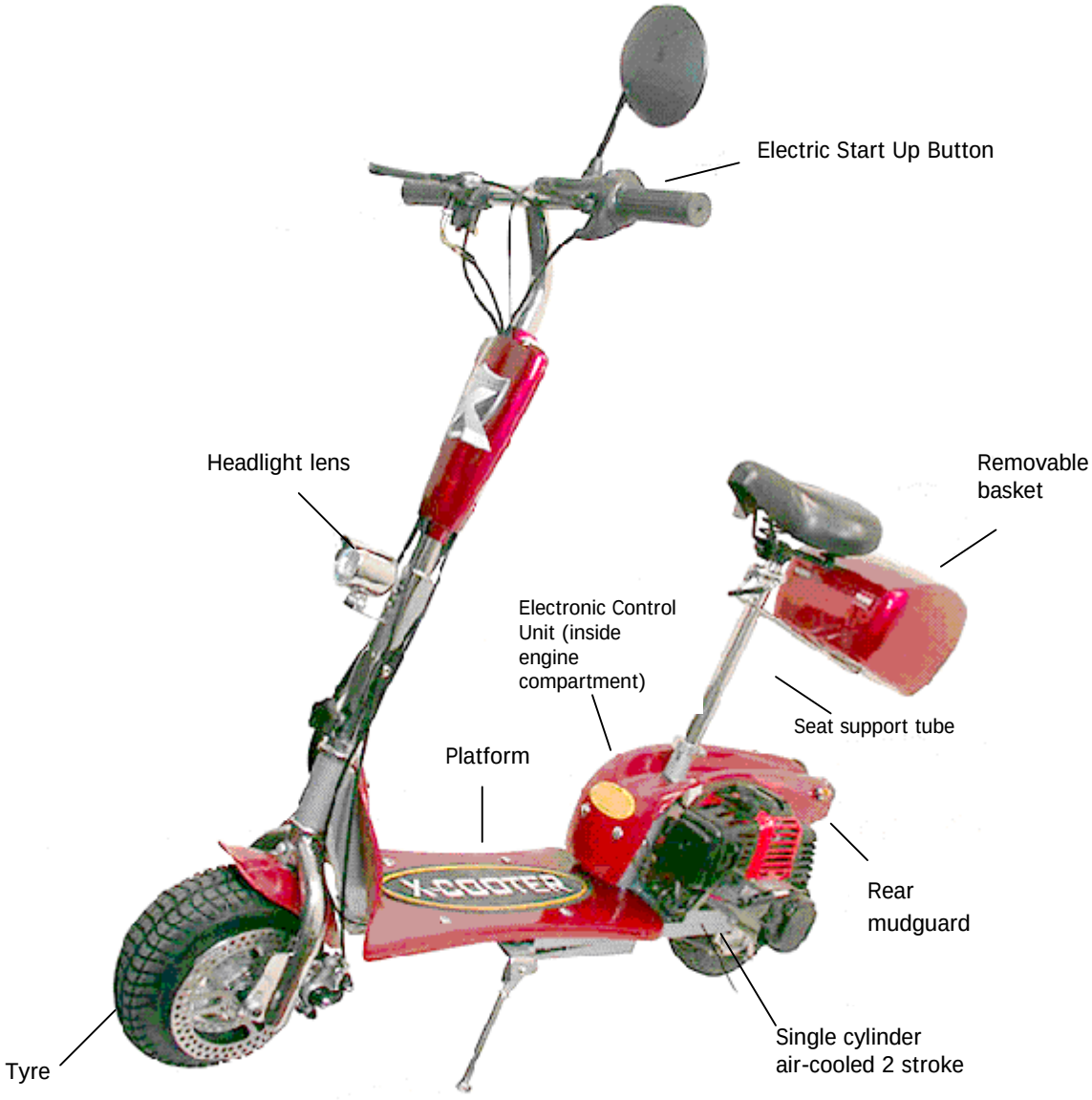

Figure 1

Leave blank

1. A number of different processes may be used to manufacture the scooter. These processes must all be conducted safely.

Complete the following table, to give **one** risk for each process listed, and **one** precaution/control measure which will prevent this risk resulting in an injury.

Process	**Risk**	**Precaution/Control Measure**
Drilling		
Arc welding		
Soldering electronic circuits		
Etching a printed circuit board (PCB)		

Q1

(Total 8 marks)

2. The materials used on the scooter can be grouped into classes of materials.

Complete the following table, by giving **one** example of a specific material for each class of material, and state **one** important property of that material.

Class of material	**Specific material**	**Important property**
Ferrous metal		
Thermoplastic polymer		
Ceramic		
Elastomer		

Q2

(Total 8 marks)

Turn over

Leave blank

3. The platform on the scooter is made from low carbon steel and can be protected by galvanising it.

Explain the following main stages of galvanising:

(i) pickling

.....

.....

(2)

(ii) pre-heating

.....

.....

(2)

(iii) dipping

.....

.....

(2)

Q3

(Total 6 marks)

Leave blank

4. (a) The exhaust pipe on the scooter takes away hot gases from the engine.

Identify **two** alternative materials for making the exhaust pipe and state **one** advantage of using each material.

Material 1 .....

Advantage 1 .....

Material 2 .....

Advantage 2.....

(4)

(b) The headlight lens on the scooter can be made from different materials.

Identify **two** materials that could be used in the headlight lens and compare the properties of these materials.

Material 1.....

Material 2.....

Comparison.....

.....

.....

(4)

(c) The tyres on the scooter are made from a composite material.

Explain how the material used in the composite contributes to the properties of the tyres.

.....

.....

.....

.....

(4)

Q4

(Total 12 marks)

Turn over

Leave blank

5. Describe **one** application of heat shrink material and explain how it is an improvement on previous materials used for that application.

.....

.....

.....

.....

.....

(Total 5 marks)

Q5

6. The control unit casing, inside the engine compartment, is made using injection moulding from ABS.

(a) Give **one** advantage and **one** disadvantage of using ABS in this application.

.....

.....

(2)

(b) Briefly describe the injection moulding process.

.....

.....

(2)

(c) Explain how the start up button can be made from a thermosetting polymer.

.....

.....

.....

(3)

Q6

(Total 7 marks)

Leave blank

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TURN OVER FOR QUESTION 7

Turn over

Leave blank

7. To protect the rider's legs from wind and rain, a prototype 'fairing' is needed. This will be attached to the front of the scooter, with a hole to let the headlight through. This is as shown in figure 2.

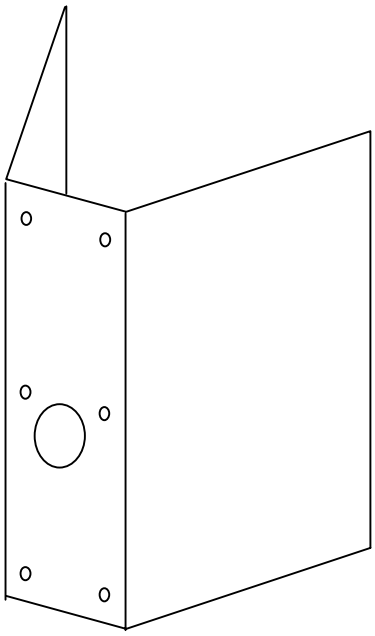

Figure 2

The fairing is going to be made from a sheet of metal 1mm thick, as marked out in figure 3.

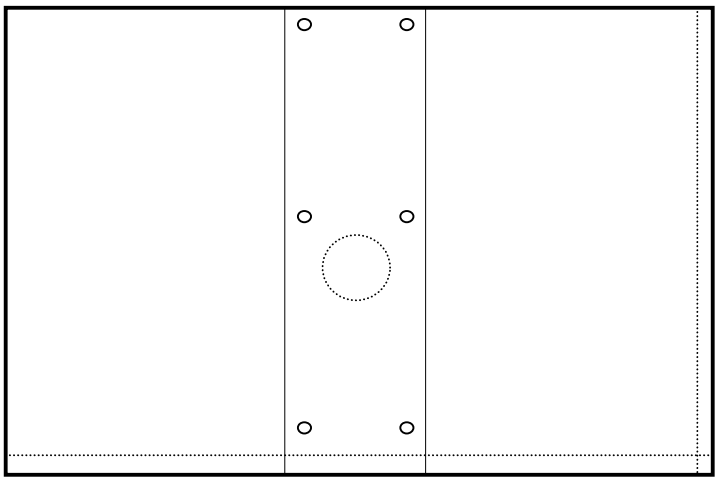

Figure 3

The fairing has six small holes and a larger hole for the headlight.

..... this type of line indicates where the material is to be cut.

Leave blank

(a) Describe the four main stages of how a prototype of the fairing could be made in the school workshop. Include details of any tools and equipment used.

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(4)

(b) Large numbers of the fairings are required to be manufactured in an industrial workshop.

(i) Describe how the fairings would be manufactured.

.....

.....

.....

(2)

(ii) Give **two** advantages of manufacturing the fairings in an industrial workshop.

.....

.....

.....

(2)

(c) Two identical fairings have been made, one of low carbon steel, and the other of aluminium. Explain **two** simple tests that can be done to decide which one is made of aluminium. Indicate which property of the material is being tested.

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.....

.....

.....

(4)

Q7

(Total 12 marks)

Turn over

Leave blank

8. The removable basket, shown in figure 1 is attached to the seat support tube by a bracket.

Design a bracket which will connect the removable basket to the seat support tube using the following information:

- diameter of the seat support tube is 25mm O.D.
- dimensions of the basket are 300mm wide, 180mm high and 180mm deep.

Your annotated design must indicate principle dimensions and methods of attaching the bracket to the basket and the seat support tube.

Q8

(Total 10 marks)

Leave blank

9. Inside the headlamp an insulated electrical wire is to be joined onto a terminal.

(a) Describe **two** suitable methods of connecting the wire and terminal so that it will conduct electricity.

.....

.....

.....

.....

(4)

(b) Compare the **two** methods against each other and justify the most appropriate method.

.....

.....

.....

.....

.....

.....

(6)

Q9

(Total 10 marks)

Turn over

Leave blank

10. The following table lists some properties of materials.

Material	**Density kg m-3**	**Electrical resistivity Ω m**	**Tensile strength MN m^{-2}**	**Thermal conductivity W m^{-1} K^{-1}**	**Material cost, relative to aluminium alloy**
Aluminium alloy	2800	2.85×10^{-8}	500	180	1.0
Copper	8960	1.68×10^{-8}	215	385	0.95
Low carbon steel	7860	10.6×10^{-8}	690	63	0.2
Stainless steel	7790	8.4×10^{-8}	630	32	1.2
ABS	1060	$>10^{11}$	60	0.19	0.5
Polystyrene	1030	$>10^{11}$	30	0.13	0.2

By analysing the relevant data in the table **and** using your own knowledge of these materials compare and contrast these materials for making the seat support tube and justify your selection of the most appropriate material.

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Leave blank

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Q10

(Total 12 marks)

OVERALL TOTAL: 90 MARKS

END

General guidance on marking

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing learners to be rewarded for answers showing correct application of principles and knowledge, and for critical and imaginative thinking. Examiners should therefore read carefully and consider every response; even if it is not what is expected it may be worthy of credit. The Principal Examiner or Team Leader should be consulted as necessary.

Applying the Mark scheme

1 In the first column the question is identified.

2 The second column identifies the expected answers to the question. The expected answers are not necessarily exhaustive and so professional judgement should be applied by the marker.

3 For some of the expected answers, example answers have been supplied to give additional guidance, particularly where the question allows for a wide range of response from the learner.

4 The third column identifies how the marks should be awarded.

5 **(1)** identifies the award of each mark.

6 1 × 4 **(4)** indicates that the mark (sub total) for that part of the question is made up of **four** one-mark answers or parts.

7 The **(6)** or similar mark in the third column is the sub total allocated to that part of the question and is the same as the sub total which appears on the question paper.

8 The total mark for each question is in **Bold** at the bottom of each full question.

9 Information in **Bold** which appears in the bottom of the second column for that question gives guidance on how to award a range of marks and must be followed for that specific question eg **low response (1) or detailed explanation (2)**.

10 The third column for straightforward responses basic information has been provided with the total mark available for the question enclosed in brackets. Where more extended answers are required from the learner, levels of response style instructions have been provided.

Unit 1: Engineering Materials, Processes and Techniques

Mark scheme

Question			Expected answers			Marks awarded
1.			**Process**	**Risk**	**Precaution/control measure**	**8 × 1 (8)**
			Drilling	small pieces flying off (**1**) work-piece rotating with drill (**1**) hair or clothes entrapment (**1**)	guard and/or goggles (**1**) clamp work-piece (**1**) tie back hair or wear overalls (**1**)	
			Arc welding	risks of burns (**1**) UV eye damage (**1**)	wear gauntlets (**1**) protective clothing (**1**) UV visor (**1**) welding mask (**1**)	
			Electronic soldering	fumes into lungs (**1**) burns (**1**) contact with lead (**1**)	fume extractor (**1**) use stand/clamp (**1**) wash hand (**1**)	
			Etching a PCB	chemical burns (**1**) fumes into lungs (**1**)	wear rubber gloves, apron, goggles (**1**) fume extractor (**1**)	
			1 mark for each correct answer — there are multiple answers for each process but maximum 1 for each risk and precaution			
					Total marks for Question 1	**8 marks**

Question			Expected answers			Marks awarded
2.			**Class of material**	**Specific material**	**Important property**	**8 × 1 (8)**
			Ferrous metal	low carbon steel **(1)** (accept steel, iron SS, etc)	high melting point **(1)** hardness **(1)** high compressive **(1)** high tensile **(1)** high torsional strength **(1)**	
			Thermo-plastic polymer	PVC **(1)** ABS **(1)** nylon **(1)**	insulator **(1)** easy to mould **(1)** low melting point **(1)**	
			Ceramic	porcelain **(1)** alumina **(1)**	good electrical **(1)** thermal insulator **(1)** suitable for high temperature use **(1)**	
			Elastomer	rubber **(1)** neoprene **(1)**	high elasticity **(1)** low melting point **(1)** high friction **(1)** shock absorbing **(1)**	
			1 mark for each correct answer — there are multiple answers for each class of material but maximum 1 for each specific material and important property			
					Total marks for Question 2	**8 marks**

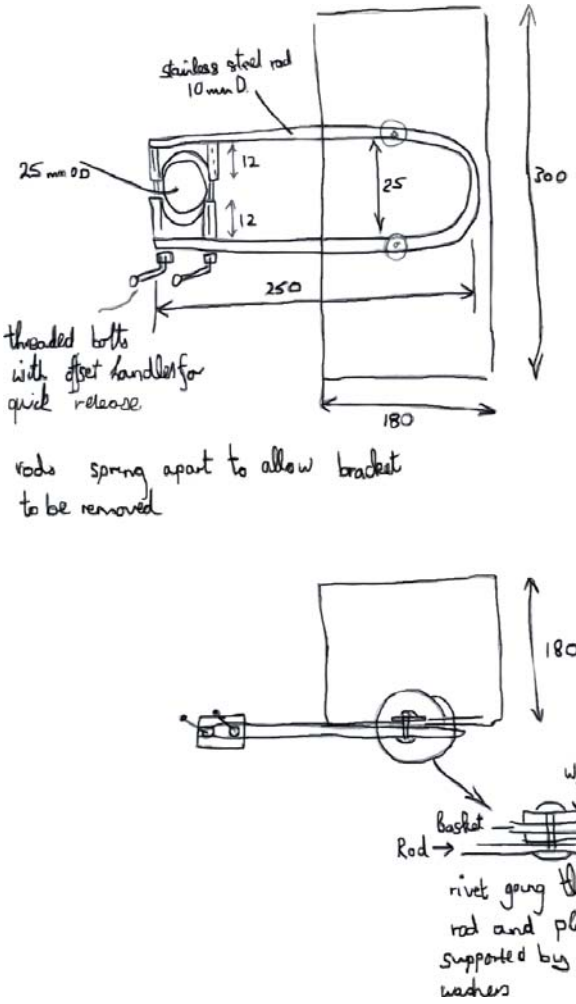
3.		**(i)**	Use acid (**1**) to clean or degrease the surface (**1**) **or** acid etching surface to improve adhesion (**2**)	**2 × 1 (2)**
			Maximum 2 marks available	
		(ii)	Heating the platform before dipping to make sure the zinc does not freeze on contact with the metal (**1**) **or** ensures good bonding (**1**) between the zinc and the metal (**1**)	**2 × 1 (2)**
			Maximum 2 marks available	
		(iii)	immersing the product into molten zinc (**1**) to provide an even coating (**1**)	**2 × 1 (2)**
			Maximum 2 marks available	
			Total marks for Question 3	**6 marks**

Question			Expected answers	Marks awarded
4.	**(a)**		Two suitable metals with an advantage for each metal eg material: stainless steel (**1**) advantage: as it has a long life (**1**) Material: low carbon steel (**1**) advantage: as it is cheap (**1**) Material: aluminium alloy (**1**) advantage: as it is light weight (**1**) **Maximum 4 marks available, 2 for two materials identified and 2 for advantages of the materials identified**	**2 × 2 (4)**
			Maximum 4 marks available	
	(b)		Material 1: glass (**1**), material 2: polycarbonate/acrylic (**1**) Comparison should pull out the following points: glass is likely to shatter compared to polycarbonate/acrylic (**1**) UV resistance is higher for the glass (**1**) glass is scratch resistant compared to polycarbonate/acrylic (**1**) **1 mark for each material stated and maximum 2 marks available for a comparison**	**4 × 1 (4)**
			Maximum 4 marks available	
	(c)		An explanation should include the following marking points: rubber (**1**) as it acts as a binder (**1**), provides compressive strength (**1**), high friction (**1**) **2 marks available but only 1 for an appropriate reason plus any one of the following materials** nylon (**1**), steel (**1**), cotton reinforcement (**1**), plus one mark for saying they provide tensile strength (**1**)	**2 × 2 (4)**
			Maximum 4 marks available	
			Total marks for Question 4	**12 marks**

Question			Expected answers	Marks awarded
5.			Answers could include an electrical sleeving or commercial packaging solution. Marks may be allocated for: used to insulate **(1)** and or mechanically support **(1)** and or protect from dust and moister **(1)** Improvement maybe: reduce cost **(1)** good aesthetics **(1)** improve protection **(1)** ease of application without force **(1)** readily conforms to awkward shapes **(1)** **Maximum 5 marks available, 2 marks for use and 3 marks for any points identified for improvements**	
			Total marks for Question 5	**5 marks**

6.	**(a)**		**Advantage**: ABS can be moulded **(1)**, needs no surface finishing **(1)**, is insulating **(1)**, tough **(1)** **Disadvantage**: ABS may not be able to handle the high temperatures inside the engine compartment **(1)** **Maximum 1 mark for an advantage and 1 mark for a disadvantage**	**2 × 1 (2)**
			Maximum 2 marks available	
	(b)		Description should include granules of ABS heated **(1)** forced into mould **(1)**, cooled and ejected **(1)** **1 mark for each process identified, maximum 2 marks available**	**2 × 1 (2)**
			Maximum 2 marks available	
	(c)		Explanation to include the following points: liquid polymer/resin poured into a mould **(1)**, mould pressurised **(1)** and heat applied **(1)**, until polymer/resin is cured **(1)**, mould opened and component ejected **(1)** **1 mark for each stage identified, maximum 3 marks available**	**3 × 1 (3)**
			Maximum 3 marks available	
			Total marks for Question 6	**7 marks**

Question			Expected answers	Marks awarded
7.	(a)		A description to include use of tools (for marking out, drill or drill bit, punch, tin snips/bench shears, guillotine, file, emery paper, line bender), priming and painting (if steel) **1 mark for any four appropriate comments**	**4 × 1 (4)**
			Maximum 4 marks available	
	(b)	(i)	The metal sheet would be cut with power guillotines **(1)**, there would be a standard jig to hold the sheet while the holes were punched out **(1)**, and to allow the sheet to be bent to the required angles **(1)** **1 mark for each point identified, maximum 2 marks available**	**2 × 1 (2)**
			Maximum 2 marks available	
		(ii)	Each fairing is produced much faster **(1)** cost of each fairing/labour costs are reduced **(1)** **1 mark for each point identified**	**2 × 1 (2)**
			Maximum 2 marks available	
	(c)		Comparison of weight **(1)** indicates density **(1)** effects of applying a magnet **(1)** will show whether ferrous magnetic or not **(1)** scratching/bending **(1)** will indicate comparable hardness **(1)** if it is uncoated **(1)** colour will indicate material **(1)** **1 mark for each test and 1 mark for the property being tested, maximum two tests identified**	**4 × 1 (4)**
			Maximum 4 marks available	
			Total marks for Question 7	**12 marks**

Question			Expected answers	Marks awarded
8.			 Marks will be allocated in accordance with the five areas identified below as (i)–(v) that address marks available for feasibility and communication, using sketches and annotation — an example of one possible design is shown above.	**4 × 1 (4)**
		(i)	Dimensions: **feasibility** N/A, **communication (2)**, some major dimensions **(1)**, most major dimensions **(2)**	
		(ii)	Fixing basket: **feasibility (1)**, **communication (1)**	
		(iii)	Attaching the seat to the support tube: **feasibility (1)**, **communication (1)**	
		(iv)	Annotation: **feasibility** N/A, **communication (2)** some **(1)** — full **(2)**	
		(v)	Removability of basket: **feasibility (1)**, **communication (1)**	
			Total marks for Question 8	**10 marks**

<table>
<tr><th colspan="3">Question</th><th colspan="4">Expected answers</th><th>Marks awarded</th></tr>
<tr><td>9.</td><td>(a)</td><td></td><td colspan="4">The wire can be stripped of its insulation (1)
and then soldered (1) or spot welded (1) or screwed (1)
or it can be mechanically crimped (1)
onto a connector and then pushed onto the terminal (1)
Maximum 4 marks available for two suitable methods</td><td>4 × 1 (4)</td></tr>
<tr><td></td><td></td><td></td><td colspan="4">Maximum 4 marks available</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td colspan="4">Give 1 mark for each appropriate comparison against each method, and justification for selecting crimping</td><td>6× 1 (6)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Advantage</td><td>Disadvantage</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Soldering</td><td>Good connection</td><td>Permanent/must be stripped first/ surface must be cleaned/fume extractor needed</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Crimping</td><td>Stripping not necessary/no heat or fume extractor needed/ fast/can be disassembled</td><td>Extra connector needed</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Using a screw</td><td>Can be dissembled</td><td>Expensive</td><td></td></tr>
<tr><td></td><td></td><td></td><td colspan="4">Maximum 6 marks available</td><td></td></tr>
<tr><td colspan="6">Total marks for Question 9</td><td>10 marks</td></tr>
</table>

Question			Expected answers	Marks awarded
10.			Marks should be awarded for four areas identified below as (i)–(iv):	
		(i)	Identification of the requirements (application) of the seat support tube — needs high tensile strength **(1)**, bending **(1)**, compressive strength **(1)** **Maximum 2 marks available**	**2 × 1 (2)**
		(ii)	Identification of three potential suitable materials with description of its property in relation to requirements of the seat support tube — ABS or polystyrene as low tensile strength **(1)** and lack of rigidity **(1)** and copper as limited strength **(1)**, high ductility **(1)**, cost **(1)**, malleability **(1)** **Maximum 4 marks available overall but marks on description on why that material is suitable must be evident in response**	**4× 1 (4)**
		(iii)	Analysing these materials with data in the table and comparing against each other — low carbon steel is suitable as it has the highest strength, and is low cost. However it will need surface coating and is susceptible to corrosion Stainless steel — similar strength to low carbon steel, self-finish, scratch resistant, but the most expensive Aluminium alloy is suitable as it has sufficient strength for application and needs no surface coating. It is light weight, but expensive **Maximum 4 marks available for points identified above as part of their comparison**	**4× 1 (4)**
		(iv)	Sound justification for the final recommendation **Maximum 2 marks available**	**2× 1 (2)**
			Total marks for Question 10	**12 marks**
			OVERALL TOTAL	**90 marks**

Unit 4: Applied Engineering Systems — Brief

Instructions for the conduct of Unit 4 assessment

1 This brief is the **only** vehicle for the assessment of this unit.

2 Apart from this document there will be **no examination paper** for this unit

3 The learner work must be carried out individually in a suitable environment, such as the workshop, and under strictly controlled/managed conditions.

4 The three practical activities may be started at anytime after the brief has been published on the Edexcel website, at centre discretion.

5 Learners should spend no more than a total of 10 hours in completing the three practical activities.

6 The evidence to be submitted for assessment must demonstrate compliance with the requirements of the Assessment criteria grid.

7 Assessment will be carried out by centre assessors, whose decisions will be subject to moderation by Edexcel's external moderators. For this purpose, Edexcel will require a sample of the learners' work and moderation will take place during the June examination series.

8 The learners' work must be completed, assessed and submitted to the designated moderator by the end of the published deadline.

9 The learners' mark must be entered on the appropriate OPTEMS forms and returned to Edexcel by the published deadline.

10 **Centres should note that the marks and learner work can only be submitted in the June examination series**.

Practical activity brief

Activity 1

It is important for engineers to know the forces acting in the members of load bearing structures and the strength of the materials from which they are made. In this activity you will be asked to carry out a destructive tensile test on a structural material to determine its load bearing properties. You will also be asked to analyse a loaded framed structure to determine how its members react and whether it is in a safe condition.

You are required to complete the following tasks and submit evidence of your work.

Task 1:

Measure and record the behaviour of samples of low carbon steel when subjected to a destructive tensile test.

Task 2:

Plot a graph of stress v strain and from it determine:

(a) the ultimate tensile strength of the material

(b) the modulus of elasticity of the material.

The members of the structure in figure 1 are made from tubular section low carbon steel of the same composition as the material that you have tested. The outer diameter of the members is 50 mm and the wall thickness is 5 mm. You may assume that they are pin-jointed at their ends.

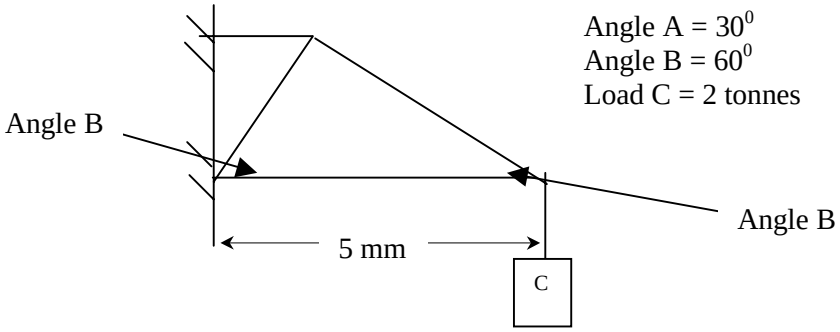


Figure 1

Task 3:

Determine the magnitude and nature of the forces present in the above structure.

Task 4:

Determine the factor of safety in operation.

Task 5:

Determine the dimensional changes that occur in the members as a result of the loading.

You may assume that the modulus of elasticity of the material is the same in tension and compression.

Activity 2

Electro-mechanical systems are to be found in everyday life. They include domestic appliances, power tools and some items of laboratory and office equipment. In this activity you will be asked to explain the function and investigate the design of a given electro-mechanical system.

You are required to complete the following tasks and submit evidence of your work.

Figure 2

Task 1:

Explain the overall purpose and function of the oscillating fan shown in figure 2.

Task 2:

Investigate the construction and operation of the fan and explain with the aid of a labelled block diagram how its sub-systems and components are interconnected.

Your diagram should clearly show the connecting pathways, the input and output of each block and any energy transfer/conversion that takes place.

Task 3:

Provide a detailed example of an alternative design solution that might fulfil the same basic function and compare fitness for purpose.

Activity 3

Process variables such as temperature, pressure, speed, light intensity etc often need to be monitored and controlled. In this activity you have to design a suitable monitoring or control system which fulfils the requirements of the given design brief.

Design brief

You are required to design an engineering system for the monitoring and control of temperature. The range that it must cover is 20–100^{0}C. The degree of accuracy required is ±2.0^{0}C.

You are required to complete the following tasks and submit evidence of your work.

Task 1:

Produce a feasible design solution for the system. This should include appropriate block diagrams showing the system elements, signal pathways, inputs and outputs. It should also include a detailed explanation of how your system functions, meets the requirements of the design brief and takes into account health and safety considerations.

Task 2:

Select suitable materials and components for your design which take into account possible production constraints, cost constraints and safety considerations.

Assessment

The work of learners will be assessed by centre assessor(s), using the Assessment criteria grids on pages 36–37 and will be subject a postal external moderation.

Learners' marks must be recorded on the Unit 4 Mark Record Sheet, which must be attached to the learners' work when submitted to Edexcel for moderation.

The Unit 4 Mark Record Sheet can be found in the Edexcel GCE in Engineering — Teachers' Guide.

Assessment evidence

The learner will need to submit evidence of their work for each of the following practical activities, based on the brief given to them.

Activity 1

(a) Measure and record the behaviour of a structural material when subjected to a destructive tensile test. Process the data and determine the tensile strength and modulus of elasticity of the material. Determine the internal forces present in a loaded-framed structure. Calculate the factor of safety in operation and the dimensional changes caused by the loading.

Activity 2

(b) Explain the function of a given electro-mechanical system.

(c) Investigate the sub-systems and elements that comprise the given electro-mechanical system. Describe using a block diagram, their function, relationships and the transfer or conversion of energy that might occur.

(d) Provide an alternative design solution that fulfils the basic functions of the system.

Activity 3

(e) Respond to a design specification for a monitoring or control system by producing an appropriate and feasible design solution that takes account of its operational requirements and health and safety considerations.

(f) Select suitable materials and components for the design solution taking into account possible production and cost constraints and health and safety considerations.

Unit 4: Applied Engineering Systems

Assessment criteria

Assessment criteria

	Mark Band 1		Mark Band 2	Mark Band 3	Mark awarded
(a) **(AO1)** **(AO2)**	• A limited understanding of using the equipment. Data is inaccurate and cannot determine tensile strength **and** modulus of elasticity. • Some aspect of structural loading determined but analysis is weak and incomplete. **(0-4)**	• Successful use of the equipment with reliable data extraction but with little understanding of processing the data to determine either tensile strength **or** modulus of elasticity. • Some structural loading correctly determined. **(5-8)**	• Successful use of the equipment with reliable data extraction to determine accurate tensile strength **or** modulus of elasticity. • All the main materials properties and effects of structural loading determined. **(9-12)**	• Successful use of the equipment with reliable data extraction to determine accurate tensile strength **and** modulus of elasticity. • Fully determines and evaluates the relevant materials and determines the full effects of the structural loading. **(13-16)**	**16**
(b) **(AO1)**	• A limited understanding of the electro-mechanical system. **(0-2)**		• Some understanding of the electro-mechanical system, with some aspects of the key functions explained. **(3-4)**	• Most aspects of the function of the electro-mechanical system understood and explained in detail. **(5-6)**	**6**
(c) **(AO2)**	• Block diagram contains only basic and general information and identifies some of the internal workings of the system. **(0-4)**		• Block diagram contains some relevant information with a broad explanation of the internal workings of the system. Some consideration of energy transfer. **(5-7)**	• Block diagram contains most relevant information with a detailed explanation of the internal workings and energy transfer within the system. **(8-10)**	**10**

	Mark Band 1		Mark Band 2	Mark Band 3	Mark awarded
(d) **(AO3)**	• Alternative design solution that partially meets the operational requirements, where the outcome is unlikely to function. **(0-2)**		• Alternative design solution is appropriate and meets some of the operational requirements, where the outcome could broadly functions. **(3-4)**	• A workable alternative design solution that meets most of the operational requirements and is likely to function. **(5-6)**	**6**
(e) **(AO3)**	• Design solution is superficial and contains only a few specified requirements. A health and safety aspect is considered. **(0-4)**	• Design solution is feasible and takes into account some of the specified requirements. Some health and safety aspects considered. **(5-9)**	• Design solution is feasible and takes into account most of the specified system requirements. Some relevant health and safety aspects are considered and explained. **(10-14)**	• Detailed workable design solution that takes into account most of the specified system requirements. Most relevant health and safety aspects are considered and explained. **(15-18)**	**18**
(f) **(AO1)**	• Materials and components identified and selected without consideration of production constraints, cost and health and safety issues. **(0-2)**		• Some appropriate materials and components selected, with some consideration of production constraints, cost and health and safety issues. **(3)**	• Most materials and components selected, with justification that includes a consideration of production constraints, costs and health and safety issues. **(4)**	**4**
				Total marks	**60**

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