BTEC

Pearson BTEC Level 3 National in Applied Science

Unit 3: Science Investigation Skills

Sample Assessment Materials (SAMs)

For use with Extended Certificate, Foundation Diploma, Diploma and Extended Diploma in Applied Science

First teaching from September 2016
First assessment from 2018

Issue 2

Pearson

Edexcel, BTEC and LCCI qualifications

Edexcel, BTEC and LCCI qualifications are awarded by Pearson, the UK's largest awarding body offering academic and vocational qualifications that are globally recognised and benchmarked. For further information, please visit our qualification websites at www.edexcel.com, www.btec.co.uk or www.lcci.org.uk. Alternatively, you can get in touch with us using the details on our contact us page at qualifications.pearson.com/contactus

About Pearson

Pearson is the world's leading learning company, with 40,000 employees in more than 70 countries working to help people of all ages to make measurable progress in their lives through learning. We put the learner at the centre of everything we do, because wherever learning flourishes, so do people. Find out more about how we can help you and your learners at qualifications.pearson.com

References to third-party material made in this specification are made in good faith. We do not endorse, approve or accept responsibility for the content of materials, which may be subject to change, or any opinions expressed therein. (Material may include textbooks, journals, magazines and other publications and websites.)

All information in this document is correct at time of publication.

BTEC

Pearson BTEC Level 3 Nationals

Applied Science

Unit 3: Science Investigation skills: Teacher/ technician notes and guidance – confidential

Extended Certificate/Foundation Diploma/ Diploma/Extended Diploma
Sample assessment material for first teaching September 2016

Level 3

This document contains confidential information for centres on the preparation and administration of the Part A practical investigation.

These teacher/technician notes and guidance are confidential and must be stored securely until the date advised by Pearson and must not be disclosed to learners.

Paper reference
XXXX/XX
S50630A

1/1/1/1/1/1/1

PEARSON

Guidance for Teachers/Technicians

Set task

The teacher/technicians notes provided in this document give information on the method for the practical investigation. It is the responsibility of centres to resource and trial the practical investigation prior to it being undertaken by learners in the assessment period.

Part A Practical investigation

Learners must not see the teacher/technician notes. A separate **Part A** will be available for the learners at the beginning of the assessment period. The **Part A** task brief provides all the necessary information for learners to conduct the practical investigation and includes a notes page for the learner to record their results/observations.

Centres must use the information in this booklet to make available appropriate resources for all learners taking the assessment in order to complete the practical assessment required for **Part A**. **Part B** is a written assessment that does not require specific resources.

The permitted period of eight days for **Part A** is to allow centres to schedule sessions for all learners. Each learner must have a single session of three hours. We encourage centres to schedule the practical session (Part A) as close to the **Part B** as possible.

Learners may work in pairs to conduct the practical investigation, however they must record their set of results/observations independently.

Learners will need to refer to their results/observations obtained from **Part A** when they complete **Part B**.

Teachers/Technician notes for the practical investigation

Learners must observe safe practice when carrying out practical scientific investigations.

It is the responsibility of centres to carry out risk assessments for all practical investigations.

List of equipment needed

If learners are working in pairs, then each pair will need the following:

- Separate labelled spirit burners with caps containing methanol, ethanol, propan-1-ol,
- butan-1-ol, pentan-1-ol
- Metal calorimeter or conical flask
- Thermometer
- Retort stand, boss and clamp
- 100 cm^3 measuring cylinder
- Glass stirring rod
- Ruler
- Heatproof mat
- Access to balance reading to at least two decimal places

Method

1. Use a measuring cylinder to measure out 100 cm^3 of water and transfer it to a calorimeter.
2. Find the mass of the spirit burner containing one of the alcohols, with the cap on.
3. Place the spirit burner on a heatproof mat under the calorimeter.
4. Clamp the calorimeter so that its base is about 1.5 cm above the wick of the spirit burner.
5. Record the initial temperature of the water in the calorimeter.
6. Light the wick.
7. Stir the water in the calorimeter at regular intervals.
8. When the temperature of the water has risen by 30°C extinguish the flame using the cap.
9. Find the new mass of the spirit burner and cap as quickly as possible.
10. Subtract this mass from the initial mass of the spirit burner and alcohol to find the mass of alcohol burnt.
11. Repeat steps 1 to 10 for the other four alcohols.

BTEC

Pearson BTEC Level 3 Nationals

Write your name here

Surname	Forename

Level 3

Applied Science

Unit 3: Science Investigation Skills

Part A

Supervised hours 3

Extended Certificate/Foundation Diploma/Diploma/ Extended Diploma

Sample assessment material for first teaching September 2016

Instructions

- **Part A** contains material for the completion of the preparatory work for the set task.
- **Part A** is taken under supervised conditions in one session of 3 hours within the period of eight days timetabled by Pearson.
- **Part A** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part B** materials for the set task will be issued prior to the start of the supervised assessment period according to the guidance in the specification.

Paper reference

XXXX/XX

S50139A

1/1/1/1/1/1/1/1

PEARSON

Instructions to Teachers/Tutors

This paper must be read in conjunction with the teacher/technician notes and guidance, the unit information in the specification and the BTEC Nationals Information for Conducting External Assessments (ICEA) document. See the Pearson website for details.

The centre must use the information booklet to prepare for **Part A** in the timescale given by Pearson. **Part A** must be taken by all learners within the period of 8 days timetabled by Pearson.

The permitted period of eight days for **Part A** is to allow centres to schedule sessions for all learners. Each learner must have a single session of three hours. We encourage centres to schedule the practical session (**Part A**) as close to the **Part B** as possible.

Part B is a written task and takes place in a single 1.5 hour session timetabled by Pearson on the day after the assessment period for **Part A**.

Learners will be expected to conduct a practical investigation and record their results/observations in this taskbook.

Teachers/tutors cannot give any support to learners during the practical investigation and recording of results/observations.

Learners can work in pairs for the practical investigation, however they must record their own results and observations independently.

Once learners have completed the practical investigation, teachers must keep the **Part A** taskbook containing learner results/observations secure. This must be returned to learners to complete **Part B**.

Refer carefully to the instructions in this taskbook and the Information for Conducting External Assessments (ICEA) document to ensure that the preparatory period is conducted correctly so that learners have completed their preparation validly and independently.

Instructions for Learners

Read the set task information carefully.

This is the information for **Part A** of the set task.

You will carry out a practical investigation over a period of up to three hours.

You may work in pairs, however you must record your set of results/ observations independently in the spaces provided.

Your teacher may give guidance on when you can complete the practical investigation.

You will use your results recorded in this taskbook, and they will be given back to you during the practical task.

Set Task Brief

Please read the following brief carefully before completing the practical investigation.

You must observe safe practice when carrying out the practical investigation.

You are a research scientist who works for a petrochemical company. You have been asked to investigate a series of alcohols in order to find out which one is the best fuel to use as an alternative to petrol in cars.

When an alcohol is placed in a spirit burner it can be used to heat a known volume of water. If we know the rise in temperature of the water and the mass of alcohol burnt we can find the heat energy in kJ/mol released by the combustion of the alcohol [NA1].

The alcohols that you are going to use are methanol, ethanol, propan-1-ol, butan-1-ol and pentan-1-ol.

When an alcohol burns in air carbon dioxide and water are produced.

The equation for the complete combustion of ethanol is:

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

Similar equations can be written for the combustion of the other alcohols.

Safety information

Alcohols are toxic and flammable. If they are spilt wash the area with water and keep naked flames away. Take care when handling hot spirit burners and calorimeters.

Follow this method to obtain a set of results.

1. Use a measuring cylinder to measure out 100 cm^3 of water and transfer it to a calorimeter.
2. Find the mass of the spirit burner containing one of the alcohols, with the cap on.
3. Place the spirit burner on a heatproof mat under the calorimeter.
4. Clamp the calorimeter so that its base is about 1.5 cm above the wick of the spirit burner.
5. Record the initial temperature of the water in the calorimeter.
6. Light the wick.
7. Stir the water in the calorimeter at regular intervals.
8. When the temperature of the water has risen by 30°C extinguish the flame using the cap.
9. Find the new mass of the spirit burner and cap as quickly as possible.
10. Subtract this mass from the initial mass of the spirit burner and alcohol to find the mass of alcohol burnt.
11. Repeat steps 1 to 10 for the other four alcohols.

Record your results/observations in the space provided.

BTEC

Pearson BTEC Level 3 Nationals

Write your name here

Surname	Forename

Level 3

Learner Registration Number | **Centre Number**

Applied Science

Unit 3: Science Investigation Skills

Part B

Marks

Supervised hours 1.5

Extended Certificate/Foundation Diploma/Diploma/ Extended Diploma
Sample assessment material for first teaching September 2016

Instructions

- **Part A** results/observations from the practical investigation will be required for completion of **Part B**.
- **Part B** must be undertaken in a single session of 1 hour and 30 minutes in the assessment session timetabled by Pearson.
- **Part B** contains material for the completion of the set task under supervised conditions.
- **Part B** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part B** should be kept securely until the start of the 1-hour and 30 minute supervised assessment session.

Information

- The total mark for this paper is 60.

Paper reference
XXXX/XX
S50140A

1/1/1/1/1/1/1/1/1/1

PEARSON

Instructions to Teachers/Tutors and/or Invigilators

This paper must be read in conjunction with the teacher/technician notes and guidance, unit information in the specification and the BTEC Nationals Information for Conducting External Assessments (ICEA) document. See the Pearson website for details.

Part B booklet must be retained securely until the start of the single session of 1.5 hours timetabled by Pearson.

Work must be completed in this taskbook.

Teachers/tutors must give learners their completed **Part A** taskbooks at the beginning of the supervised assessment period.

All learner work must be completed independently and authenticated by the teacher/tutor and/or invigilator before being submitted to Pearson.

Refer carefully to the instructions in this taskbook and the Information for Conducting External Assessments (ICEA) document to ensure that the assessment is supervised correctly. An authentication statement will be required confirming that learner work has been completed as directed.

Learners must not bring anything into the supervised environment or take anything out without your approval.

Centres are responsible for putting in place appropriate checks to ensure that only permitted material is introduced into the supervised environment.

Maintaining security:

- During supervised assessment sessions, the assessment areas must only be accessible to the individual learner and to named members of staff.
- Learners can only access their work under supervision.
- Any work learners produce under supervision must be kept secure.
- Learners are not permitted to have access to the internet or other resources during the supervised assessment period.

Outcomes for submission

One document will need to be submitted by each learner:

- a completed **Part B** taskbook.

Learner results/observations from **Part A** will be retained securely by the centre after **Part B** and may be requested by Pearson if there is suspected malpractice.

Instructions for Learners

Read the set task information carefully.

Complete all your work in this taskbook in the spaces provided.

This session is of 1.5 hours. Plan your time carefully.

You have prepared for the set task given in this **Part B** booklet. Use your results/observations from **Part A** if relevant. Attempt all of **Part B**.

Your results/obervation must be your own and will be retained by your centre until results are issued.

You must work independently throughout the supervised assessment period and should not share your work with other learners.

Outcomes for submission

You will need to submit one document on completion of the supervised assessment period:

- a completed **Part B** taskbook.

You must complete a declaration that you have produced independent results in **Part A** and that **Part B** is your own work.

Set Task

You must complete ALL activities in Section 1 and Section 2.

Section 1

1 (a) Record all your experimental results in a suitable table, using the space provided.

3 marks

The colour of the flame varies as the alcohol burns.

(b) State **one** other observation you made about the flame.

1 mark

.....

.....

Provided the temperature rise was 30°C for each experiment the heat energy will be the same for all five alcohols.

heat energy = mass of water x specific heat capacity of water x temperature rise

specific heat capacity of water = 4.2 $Jg^{-1}oC^{-1}$

100 cm^3 of water has a mass of 100 g

(c) Calculate the heat energy in joules supplied to the water by the burning alcohol using the equation.

2 marks

Show your working.

Heat energy = ... J

(d) The formulae of the five alcohols are given in the following table:

Name of alcohol	Formula of alcohol	Molar mass/g	Heat of combustion/ kJ mol $^{-1}$
methanol	CH_3OH		
ethanol	C_2H_5OH		
propan-1-ol	C_3H_7OH		
butan-1-ol	C_4H_9OH		
pentan-1-ol	$C_5H_{11}OH$		

For parts (i) and (ii) write your answers in the table provided.

(i) Calculate the molar masses of the five alcohols.

2 marks

Show your working.

(ii) Calculate the heat of combustion of the five alcohols in kJ mol^{-1}

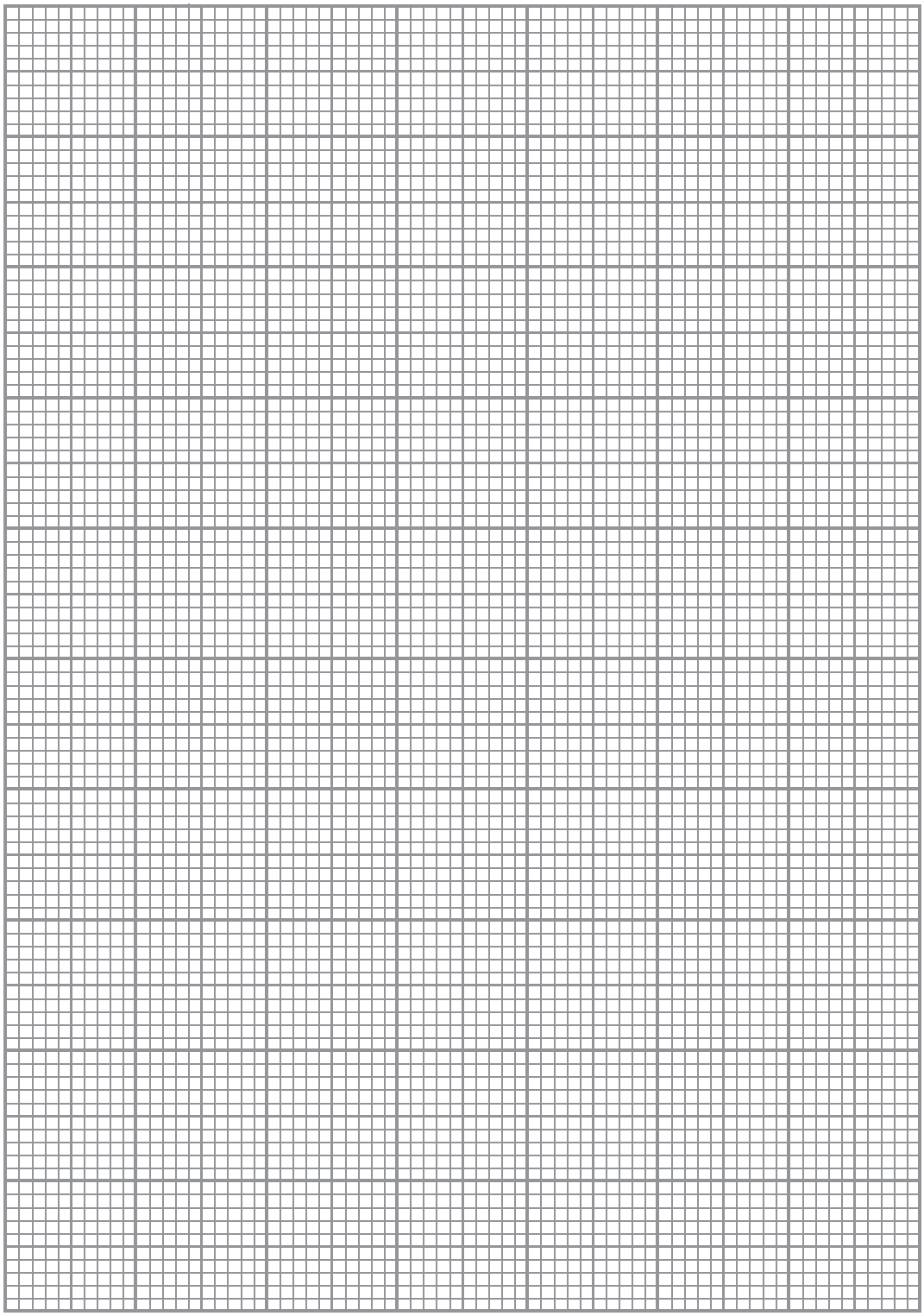
3 marks

heat of combustion (kJ mol^{-1}) = $\frac{\text{heat energy supplied to water x molar mass}}{\text{mass of alcohol burnt}}$

Show your working.

(e) Plot a graph of heat of combustion (kJ mol^{-1}) against number of carbon atoms per molecule for each of the alcohols, using the graph paper provided.

3 marks



(f) Use your graph to describe the relationship between the number of carbon atoms per molecule and the heat of combustion.

2 marks

(g) Calculate the percentage errors for the equipment you used for measuring:

(i) the volume of water

1 mark

(ii) the temperature

1 mark

(iii) the mass for the alcohol that gave the smallest change in mass.

2 marks

(h) (i) State which measurement would be most likely to affect the accuracy of the results.

1 mark

.....

.....

(ii) Write a balanced equation for the complete combustion of butan-1-ol, C_4H_9OH.

2 marks

Total for Question 1 = 23 marks

2 The actual data book values for the heats of combustion of the five alcohols are shown in the table.

The column headed increment in the table shows the differences in heat of combustion between one alcohol and the next (successive alcohols), for example 1367 kJ mol^{-1} – 726 kJ mol^{-1} = 641 kJ mol^{-1}

Name of alcohol	Formula of alcohol	Heat of combustion kJ mol^{-1}	Increment kJ mol^{-1}	Cost per litre / £
methanol	CH_3OH	726		3.90
ethanol	C_2H_5OH	1367	641	4.30
propan-1-ol	C_3H_7OH	2017		10.90
butan-1-ol	C_4H_9OH	2675		9.80
pentan-1-ol	$C_5H_{11}OH$	3323		59.60

(a) Calculate the next three increments and add them to the table.

1 mark

(b) Explain what these increments show about the relationship between the heat of combustion and the number of carbon atoms per molecule in the alcohols.

2 marks

The next alcohol in the series is hexan-1-ol, $C_6H_{13}OH$.

(c) Use the table to estimate a value for the heat of combustion of hexan-1-ol.

1 mark

.....

.....

(d) Give **two** reasons why there is a difference between your values for heats of combustion and the data book values.

2 marks

1 .....

.....

2 .....

.....

Your colleague thinks that ethanol is the best alcohol to us as an alternative fuel to petrol in cars.

(e) Comment on whether you think she is correct.

Use the secondary evidence to support your answer.

3 marks

Total for Question 2 = 9 marks

3 (a) (i) Explain why the water was stirred at regular intervals during the investigation.

2 marks

(ii) Identify **one** other variable in this investigation and give a reason why it was difficult to control.

2 marks

Variable

Reason why it was difficult to control

(b) Explain **two** ways in which you could extend this investigation, to improve the reliability of your conclusions.

4 marks

1 .....

.....

.....

.....

2 .....

.....

.....

.....

Total for Question 3 = 8 marks

END OF SECTION

TOTAL FOR SECTION 1 = 40 MARKS

Section 2

4 Effect of substrate concentration on enzyme activity.

Hydrogen peroxide is a waste substance produced in cells. Hydrogen peroxide is harmful in high concentrations, so cells must decompose it quickly. Catalase is an enzyme found in living organisms and helps to decompose hydrogen peroxide into water and oxygen.

You have been asked to write a plan for an investigation into the effect of different concentrations of hydrogen peroxide solution on the rate of catalase activity.

12 marks

Your plan should include the following details:

- A hypothesis
- Selection and justification of equipment, techniques or standard procedures
- Health and safety associated with the investigation
- Methods for data collection and analysis to test the hypothesis including:
  - the quantities to be measured
  - the number and range of measurements to be taken
  - how equipment may be used
  - control variables
  - brief method for data collection analysis.

Total for Question 4 = 12 marks

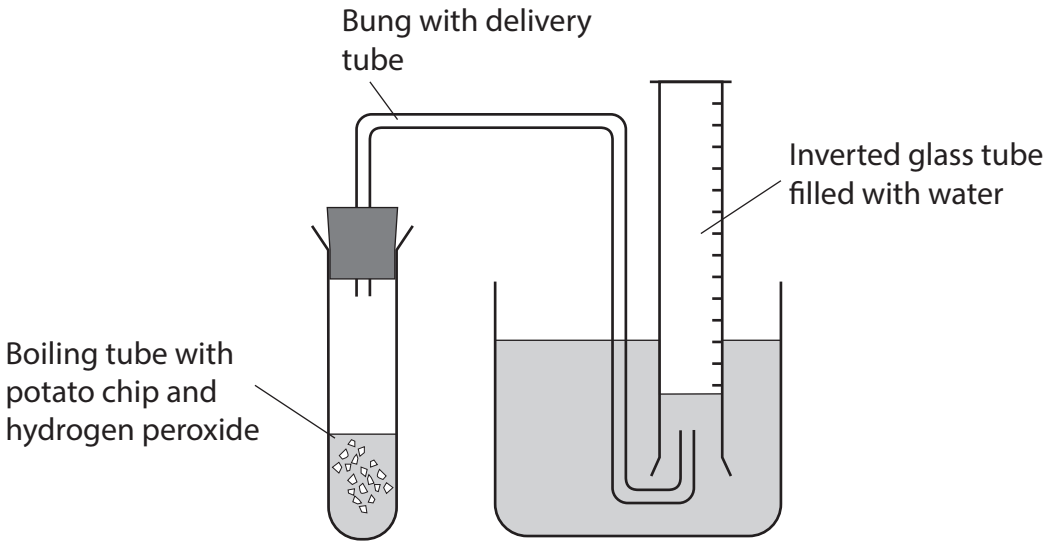
5 A learner investigates the effect of temperature on the activity of the enzyme catalase in potatoes.

The learner follows the following method:

- place a potato chip in a boiling tube and allow to stand for 10 minutes in a water bath at 2.5°C
- place a boiling tube containing hydrogen peroxide in the same water bath for 10 minutes
- after 10 minutes the potato chip is then added to the tube of hydrogen peroxide
- a bung, with a delivery tube attached, is quickly inserted into the boiling tube. The free end of the delivery tube is placed under an inverted graduated glass tube which is filled with water.

The learner repeats the steps in water baths at different temperatures.

The diagram shows the setup of the equipment.



The results of the learner's investigation are shown in the table.

temperature / °C	volume of oxygen produced /cm^3
2.5	2.3
20	4.65
41	5.45
51	4.5
59	0.2
69	0.0

The learner concludes that up to 41, a rise in temperature increases the rate of catalase activity. Above 41 the enzyme is denatured and its activity decreases.

Evaluate the learner's investigation.

Your answer should include reference to:

- the method of the experiment
- the results collected
- the conclusion made.

8 marks

Total for Question 5 = 8 marks

END OF TASK

TOTAL FOR SECTION 2 = 20 MARKS
TOTAL FOR TASK = 60 MARKS

Unit 3: Science Investigation skills

General Marking Guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the marking grid not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks if the learner's response is not rewardable according to the marking grid.
- Where judgment is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.
- You will not see 'owtte' (or words to that effect). Alternative correct wording should be credited in every answer unless the mark scheme has specified specific wording that must be present
- Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased"
- ecf indicates error carried forward means that a wrong answer given in an early part of a question is used correctly to a later part of a question
- / indicates that the response are alternatives and either answer should receive full credit
- Some question will be dependent upon learner's results and/or equipment used. The mark scheme will give clear guidance on how marks should be awarded, examiners need to check that answers are consistent with the learner's results

Specific Marking guidance

The marking grids have been designed to assess learner work holistically.
Rows within the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band depending on how they have evidenced each of the descriptor bullet points.

Section A

Question Number	Answer	Additional guidance	Mark
1(a)	• results table containing • suitable headings with units and measurements consistently recorded to the same precision **(1)** • masses of alcohols burnt calculated correctly **(1)** • indication of repeats and averages calculated **(1)**		**(3)**
1(b)	Any one from: • size of flame changes **(1)** • flame fluctuates **(1)**		**(1)**
1(c)	• correct use of equation **(1)** 100 x 4.2 x 30 • correct answer **(1)** 12 600 (J)	Allow 12.6 kJ units must be given	**(2)**
1(d)(i)	• 32, 46, 60, 74, 88 **(2)** • any 3 or 4 correct **(1)**		**(2)**
1(d) (ii)	• correct substitution and evaluation for all 5 **(2)** • correct substitution and evaluation for 3 or 4 **(1)** • all 5 correctly converted to $kJmol^{-1}$ **(1)**	Calculations will need to be based on students' results and need to be checked. Allow ecf on incorrect calculations in 1(d) or 1(e)(i)	**(3)**
1(e)	• labels and units for axes **(1)** • all points plotted correctly and suitable best fit line **(1)** • suitable scales **(1)**		**(3)**
1(f)	• the greater the number of carbon atoms the greater the heat of combustion **(1)** • comment on whether the number of carbon atoms and the heat of combustion are directly proportional or not **(1)**	Comment needs to be consistent with results and graph	**(2)**
1(g)(i)	• % error on volume measurement **(1)** ±0.5 x 100 / 100 = 0.5%		**(1)**

Question Number	Answer	Additional guidance	Mark
1(g)(ii)	• % error on temperature measurement **(1)** ± 1 x 100 / 30 = 3.3%	-10 to 100°C thermometer the uncertainty is ±0.5°C As initial and final temperature readings are taken the uncertainty on the thermometer is ±1°C If digital thermometers that measure to 1dp are used the error will be ±0.1x100/30 = 0.03%	**(1)**
1(g)(iii)	• correct % error calculation for lowest mass measurement **(2)**	For a balance reading to 2 d.p the uncertainty is ±0.005g As two mass measurements are taken total uncertainty is ±0.01g If the percentage error of a mass measurement other than the lowest one has been calculated correctly (1)	**(2)**
1(h)	• measurement which gives highest % error from their calculations **(1)**		**(1)**
1(i)	$C_4H_9OH + 6O_2 \rightarrow 4CO_2 + 5H_2O$ • all formulae correct **(1)** • balancing of correct formulae **(1)**	Allow multiples	**(2)**

Question Number	Answer	Additional guidance	Mark
2(a)	• 650, 658, 648 **(1)**	All 3 need to be correct	**(1)**
2(b)	• the differences are approximately the same each time **(1)** • (this shows) heat of combustion is directly proportional to the number of carbon atoms per molecule **(1)**		**(2)**
2(c)	• answer in the range 3960 to 3990 **(1)**		**(1)**
2(d)	Any two from: • thermal energy/heat is transferred to air / surroundings **(1)** • thermal energy/heat absorbed by the calorimeter **(1)** • incomplete combustion **(1)**		**(2)**
2(e)	Any three from : • methanol is cheaper than ethanol but the heat of combustion is a lot less **(1)** • propan-1-ol, butan-1-ol and pentan-1-ol have greater heat of combustion but are more expensive than ethanol **(1)** • correct manipulation of data **(1)** • there would be more moles in a litre for ethanol than propan-1-ol, butan-1-ol and pentan-1-ol as the molecules are smaller **(1)**	Accept more energy e.g. ethanol gives 318 $kJmol^{-1}$ per £	**(3)**

Question Number	Answer	Additional guidance	Mark
3(a) (i)	An explanation that makes reference to: • to ensure that the temperature of water was uniform throughout **(1)** • so that the temperature rise could be measured more accurately **(1)**		**(2)**
3(a) (ii)	• temperature rise **(1)** • because it is difficult to stop at exactly 30°C temperature rise **(1)** Or • distance of flame **(1)** • because the flame size changes during the experiment **(1)**		**(2)**
3(b)	Any two linked pairs from: • repeat the experiment more times to obtain concordant results for each alcohol **(1)** • in order to eliminate any anomalous results **(1)** • repeat the experiment for alcohols with more carbon atoms (1) • in order to extend the range of results **(1)** • repeat the experiment using liquid hydrocarbons **(1)** • in order to see whether these follow the same pattern **(1)**	Or other suitable named fuels	**(4)**

Section B

<table>
<tr><th>Question Number</th><th colspan="2">Indicative content</th></tr>
<tr><td>4</td><td colspan="2">Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers.
A plan, that makes reference to:
• a hypothesis
• equipment, techniques and/or procedures
• risks
• control variables
• dependent variables – how it will be measured, units and the precision of measurements to be taken
• independent variable - the range of measurements/categories to be used and how they will be measured, the intervals to take measurements.
• data analysis</td></tr>
<tr><td colspan="3">Mark scheme (Award up to 12 marks) Refer to the general marking guidance found in this document on how to apply Levels Based Mark Schemes*.</td></tr>
<tr><td>Level</td><td>Mark</td><td>Descriptor</td></tr>
<tr><td>Level 0</td><td>0</td><td>No rewardable material</td></tr>
<tr><td>Level 1</td><td>1-4</td><td>• limited attempt at a hypothesis is made
• demonstrates limited knowledge and understanding of scientific concepts, procedures, processes and techniques with a basic description of the plan to investigate the scientific scenario given
• provides a rationale for the method suggested and generic statements may be presented rather than linkages being made so that lines of scientific reasoning are unsupported or unclear
• the plan will not be logically ordered with significant gaps that will not lead to reliable results being collected</td></tr>
<tr><td>Level 2</td><td>4-6</td><td>• an explanation for the hypothesis is given which is partially supported by scientific understanding.
• demonstrates adequate knowledge and understanding of scientific concepts, procedures, processes and techniques with a partial description of the plan to investigate the scientific scenario given
• provides a rationale for the method which has occasional linkages present so that lines of scientific reasoning are partially supported
• the plan will generally be in a logical sequence and will yield some results</td></tr>
</table>

Level 3	7-9	• an explanation for the hypothesis is given which is supported by scientific understanding • demonstrates good knowledge and understanding of scientific concepts, procedures, processes and techniques with a clear description of the plan to investigate the scientific scenario given • provides a rationale for the method which has linkages present so that lines of scientific reasoning are supported • the plan will be in a logical sequence but with minor omissions of steps and will yield reliable results
Level 4	10-12	• an explanation for the hypothesis is given which is fully supported by scientific understanding • demonstrates comprehensive knowledge and understanding of scientific concepts, procedures, processes and techniques with a step by step description of the plan to investigate the scientific scenario given • provides a rationale for the method which has consistent linkages present so that lines of scientific reasoning are fully supported • the plan will in a logical sequence and will lead to a reliable set of results being collected

Question Number	Indicative content
5	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some / all of the indicative content but should be rewarded for other relevant answers. • chips may have been different sizes / shapes / skin on / surface area • chips may have been from different potatoes, so different amounts of catalase present • readings not repeated • measurements not recorded to same degree of accuracy • volume and concentration of hydrogen peroxide used isn't stated – this could affect volume of oxygen produced and should be the same • no reference to when readings were taken, e.g. when bubbling stopped / after 2 minutes • gas escaped when delivery tube inserted into boiling tube / delivery tube placed under graduated tube, so volume measurements may be inaccurate • non-uniform temperature range • data supports conclusion (refers to data) • but insufficient data around 41 °C to make a firm conclusion – need more information at finer intervals, e.g. every 2°C • also need more data between 51 – 59 °C as volume of oxygen decreases dramatically

Mark scheme (Award up to 8 marks) Refer to the general marking guidance found in this document on how to apply Levels Based Mark Schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material
Level 1	1-2	• adequate interpretation and analysis of the scientific information • generic evaluative comments made with little linkage to supporting evidence/reference to context • a conclusion may be presented, but will lack focus and be superficial and underdeveloped
Level 2	3-5	• good analysis and interpretation of the scientific information • evaluative comments with supporting evidence/reference to context and a partially developed chain of reasoning • conclusion will be mostly focussed and developed and draw upon some of the information
Level 3	6-8	• comprehensive analysis and interpretation of all pieces of scientific information • evaluative comments supported by relevant reasoning and appropriate reference to context • conclusion will be clear and concise and well developed drawing upon the most relevant information presented before

For more information about Edexcel, BTEC or LCCI qualifications visit qualifications.pearson.com

Pearson Education Limited. Registered in England and Wales No. 872828
Registered Office: 80 Strand, London WC2R 0RL
VAT Reg No GB 278 537121

ISBN 978-1-4469-4530-8