CAMBRIDGE TECHNICALS

Oxford Cambridge and RSA

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 3 Summer 2023 series

Version 1

ocr.org.uk/cambridgetechnicals

Contents

Introduction 4
Unit 3 series overview 5
- Question 1 (b) 6
- Question 1 (c) 7
- Question 1 (d) (i) 7
- Question 1 (d) (ii) 8
- Question 1 (e) 8
- Question 2 (a) (i) 9
- Question 2 (a) (ii) 10
- Question 2 (a) (iii) 11
- Question 2 (b) (i) 11
- Question 2 (b) (ii) 12
- Question 2 (c) (i) 12
- Question 2 (c) (ii) 12
- Question 3 (a) 13
- Question 3 (b) 14
- Question 3 (c) (i) 14
- Question 3 (c) (ii) 15
- Question 3 (d) (i) 16
- Question 3 (d) (ii) 16
- Question 3 (e) 17
- Question 4 (a) 18
- Question 4 (b) (i) 20
- Question 4 (b) (ii) 20
- Question 4 (c) 20
- Question 4 (d) 21
- Question 4 (e) 21
- Question 4 (f) (i) 22
- Question 4 (f) (ii) 22
- Question 4 (f) (iii) 23
- Question 4 (g) (i) 24
- Question 4 (g) (ii) 25
- Question 5 (a) (i) 25
- Question 5 (a) (ii) 26

Question 5 (b) 26
Question 5 (c) 26
Question 5 (d) (i) 27
Question 5 (d) (ii) 27
Question 5 (d) (iii) 28
Question 6 (a) (i) 29
Question 6 (a) (iii) 30
Question 6 (b) 30
Question 6 (c) (i) 31
Question 6 (c) (ii) 32
Question 6 (d) (i) 33
Question 6 (d) (ii) 34
Question 7 (a) 35
Question 7 (b) (i) 36
Question 7 (b) (ii) 37
Question 7 (b) (iii) 37
Question 7 (c) 37
Copyright information 38

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Unit 3 series overview

Unit 3 (Scientific analysis and reporting) is a mandatory unit for the Level 3 Cambridge Technical Foundation Diploma, Diploma, and Extended Diploma in Applied Science. All Learning Outcomes within the specification are assessed in every series through a paper worth a maximum of 100 marks and of two hours duration.

This unit assesses:

- the ability to use mathematical techniques to analyse data
- the ability to use graphical techniques to analyse data
- the ability to use keys to classify organisms
- the ability to critically analyse and evaluate the quality of data
- the ability to draw justified conclusions from data
- the ability to record, report on, and review scientific analyses
- knowledge of the use of modified, extended, or combined laboratory techniques in analytical procedures – building on Unit 2 (Scientific techniques).

Questions are presented to candidates using a range of styles, including short answer, calculation, fill-the-blanks, matching pairs, true/false, and a longer six mark level-of-response question. Questions are presented in a scientific context, which may, however, be a context with which candidates are unfamiliar.

Centres must provide candidates with extensive opportunities for practising those skills detailed in the unit specification as well as exposure to the required experimental techniques and apparatus – this will allow candidates to answer questions in this paper with greater confidence.

Some of the questions in this paper required candidates to answer precisely, applying their knowledge tightly to the context given, and using stimulus material to work out the answer, using skills of observation, analysis, and evaluation. Careful reading of the question, and care in answering the question precisely and in depth was important to gain maximum credit.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• understood and applied the conventions to be followed when constructing line graphs and pie charts	• did not understand nor apply the conventions to be followed when constructing line graphs and pie charts
• were able to construct a tangent to a line-of-best-fit and show how the gradient was calculated	• were unable to construct a tangent to a line-of-best-fit and were unable to determine the gradient
• showed working when carrying out calculations and were confident in the use of standard form, significant figures, and unit	• did not show working when carrying out calculations and were not confident in the use of standard form, significant figures or units
• were able to use knowledge gained from having undertaken practical activities to answer Question 6	• were unable to draw on first-hand experience of practical activities to help with answering Question 6
• answered questions precisely and succinctly within the context given, demonstrating both an appropriate breadth and depth of knowledge	• provided vague responses to questions, that were not framed within the context given, and did not demonstrate the required breadth of depth of knowledge
• were confident in the application, analysis, and evaluation of information and data presented in unfamiliar contexts (Questions 1 (d), (e), 2 (a) (ii) and 7).	• experienced difficulties in the application, analysis, and evaluation of information and data presented in unfamiliar context (Questions 1 (d), (e), 2 (a) (ii) and 7).

Question 1 (b)

(b) Calculate the variance $\mathbf{s^2}$ and standard deviation **s** of the mass values shown in the table.

Use the equation:

$$s^2 = \frac{\Sigma(X-\overline{X})^2}{N-1}$$

where N is the number of samples, X is the mass of each pellet and $\overline{X}$ is the mean mass calculated in **(a)(i)**.

Show your working.

Give **both** your answers to **3** significant figures.

$\mathbf{s^2}$ = ...

s = ...

[6]

This question addressed LO1. A majority of candidates understood how to use the equation provided to calculate the variance in mass of the ten pellets and took the square root of the variance to calculate standard deviation – they were able to demonstrate their working at each stage, and correctly gave both answers to three significant figures.

A significant number of candidates, however, had difficulty using the equation given and applying it step-by-step. The majority of candidates did persevere and were able to pick up some marks at some point of the process, either at the beginning, as subsequent correct manipulation of previous errors for apply, or for giving otherwise incorrect answers to three significant figures.

Question 1 (c)

(c) Use your answers in **(a)(i)** and **(b)** to determine the percentage of Alex's sample of pellets shown in the table whose mass is within one standard deviation above and below the mean.

Percentage of sample = ... % **[2]**

This question addressed LO1 and LO4. It proved challenging for a number of candidates. Some candidates appeared not to understand how to calculate the appropriate range, other candidates were unable to calculate the number of pellets within the range calculated – generally speaking, the majority of candidates who came up with a value for the number of pellets were then able to express that value correctly as a percentage.

Question 1 (d) (i)

(d) Alex suggests that:

"Pellet 1, pellet 6 and pellet 9 in the table could contain the same species of prey."

(i) Explain how the mass of these pellets can be used to support her suggestion.

....

.... **[1]**

This question addressed LO5. A majority of candidates appreciated that the masses of pellets 1, 6, and 9 were multiples of ~25g although this was expressed in a number of ways, often without reference to 25g. Some candidates appeared not to have read the question fully and answered in terms of examining the pellets for bones/teeth/fur/DNA, which caused problems when they came to answer Question 1 (d) (ii) unless they repeated the same information (candidates who did that did not, however, appear to reread this question in order to revise their answers).

Question 1 (d) (ii)

(ii) What **two** further pieces of information should Alex record in her table to make her suggestion more secure?

1 ....

2 ....
[2]

This question addressed LO5. The majority of candidates provided at least one valid piece of information that would support the suggestion that pellets 1, 6, and 9 contain the same species of prey – references to "DNA analysis" were surprisingly rare. A number of candidates appeared to misunderstand the question, and offered "location of sample"/"time of sampling"/"name of investigator"/etc.

Question 1 (e)

(e) Alex finds the remains of only four different species in the ten pellets sampled.

Almost half of the animal remains come from one species.

Alex also obtains data about the percentage of these species in the habitat.

She finds that the percentage of a prey species found in the pellets is **not** the same as the percentage of this prey species in the habitat.

Suggest **two** reasons, relating to owl hunting behaviour, that would explain why the two values are **not** the same.

1 ....

....

2 ....

....
[2]

This question addressed LO5. It proved challenging for a significant number of candidates. The novel nature of the content proving difficult for many candidates, who appeared unfamiliar with predator behaviour. Many candidates referred to predators or prey migrating outside the habitat, which was not relevant in the context of the question. The most commonly seen response was the idea that owls are nocturnal, when certain of the species in the habitat might not be active .

Question 2 (a) (i)

2 There are about 2000 species of firefly.

Fireflies are nocturnal members of the family *Lampyridae*.

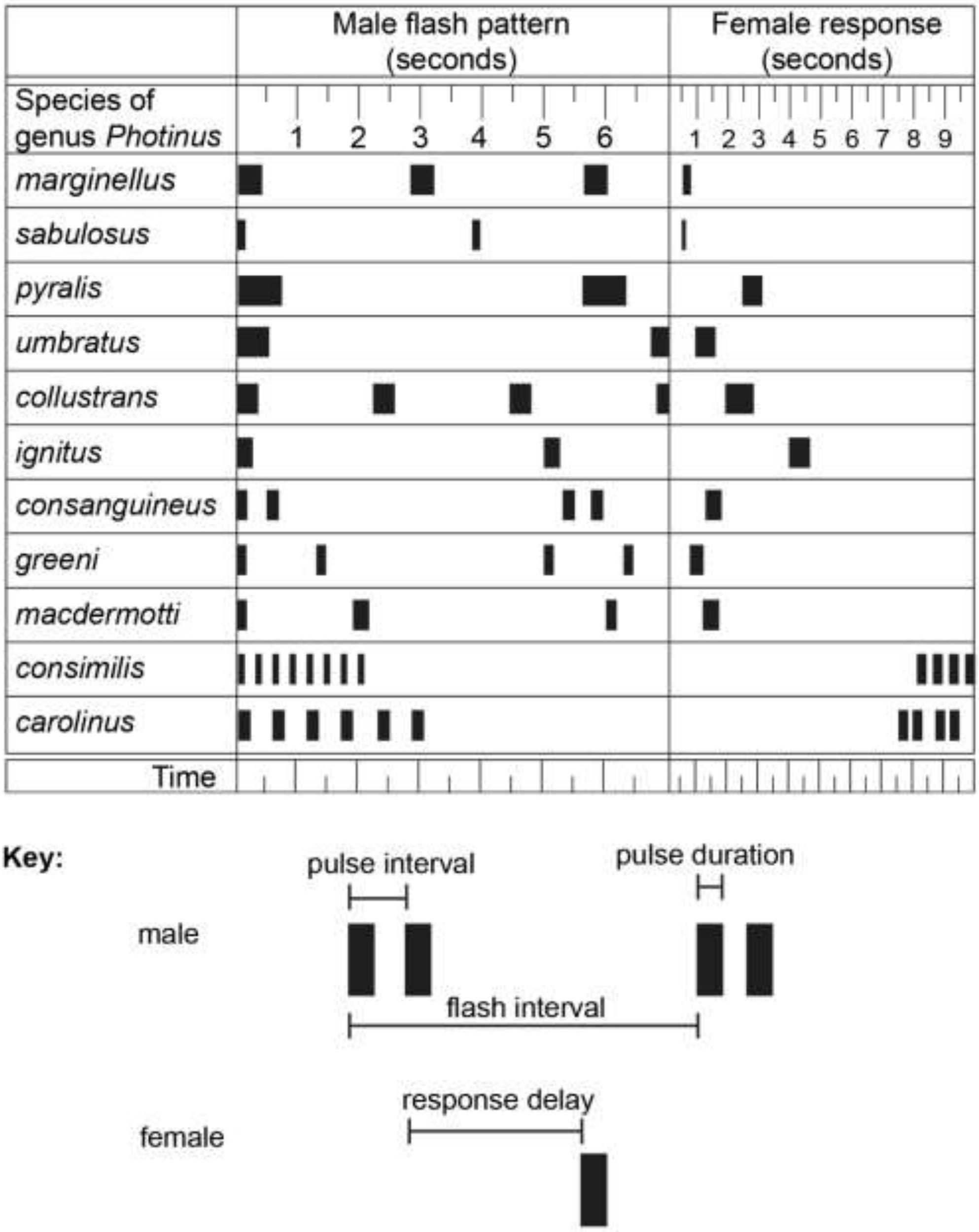
This means that they are active at night and, as the name suggests, they produce flashes of light.

The patterns of flashing light produced by male fireflies and the response patterns shown by the females are unique to each species.

Each pattern is a signal that helps fireflies find potential mates.

Fig. 2.1 shows the male flash patterns and the female response patterns for some of the species of the firefly genus, *Photinus*.

Fig. 2.1



(a) (i) Use the information in **Fig. 2.1** to identify the firefly species with the following **male** flash patterns:

- a 0.75 s pulse duration and 5 s flash interval.

Species = ...

- a 0.30 s pulse interval.

Species = ...
[2]

This question addressed LO3 at pass demand. Nearly all candidates correctly identified the first flash pattern as *P. pyralis*. The second flash pattern proved harder for candidates to identify, with a significant number of candidates suggesting *P. consanguineous*, and a handful suggesting *P. carolinus*.

Question 2 (a) (ii)

(ii) In terms of the pulse interval, pulse duration and flash interval shown in **Fig. 2.1**, describe the flash pattern of **male** *consanguineus*.

....

....

.... **[3]**

This question addressed LO3. Some candidates had problems interpreting the flash pattern and a wide range of suggestions for pulse duration, pulse interval, and flash interval were seen – in many cases it was clear that candidates did not understand the points between which the components of the flash pattern should be measured. Some candidates had the lengths of the components in the correct relative proportions but provided incorrect figures. Those candidates who opted to provide a description of the flash pattern generally provided descriptions that were accurate in terms of lengths – but because no figures were provided, and so there was no evidence of being able to read times correctly from the recording in Fig. 2.1 these candidates were limited to a maximum of 2 marks.

Question 2 (a) (iii)

(iii) Identify the firefly species with the following **female** response patterns:

- a response delay of 7.5 seconds.

Species = ...

- a response that mimics the male of the species.

Species = ...
[2]

This question addressed LO3. Nearly all candidates correctly identified both the first and second response patterns, with an overwhelming majority choosing *P. consimilis* as the second response pattern.

Question 2 (b) (i)

(b) **(i)** Explain why Latin and Ancient Greek are often used in the classification of living things.

....

....

.... **[2]**

This question addressed LO3. A surprisingly high number of candidates provided only one suggestion in response to this question, but a large number of valid answers were nevertheless provided. A common misconception was that Latin and Ancient Greek were the languages in everyday use when the majority of organisms were classified. The ideas of a universally recognised language and a language which would not change over time were the most commonly seen suggestions, the idea that a using dead language avoids the problems of international dispute when a living language is chosen as a common language was not often seen.

Question 2 (b) (ii)

(ii) Give **one** advantage of binomial nomenclature.

....

.... **[1]**

This question addressed LO3. A significant number of candidates appeared to have misunderstood the question as being about the advantages of using Latin or Ancient Greek as the language of binomial nomenclature, rather than the advantage of the binomial system itself. Where the question was correctly understood, most candidates were able to suggest a response framed around precision of classification and/or communication between scientists.

Question 2 (c) (i)

(c) **Fig. 2.1** is an example of secondary data.

(i) Give **one** example of primary data.

.... **[1]**

This question addressed LO3. It was intended to be answered within the context of the question, so the types of primary data suggested would have been those used in this investigation or similar fieldwork investigations. Many candidates answered more generically and suggested drawings/surveys/interviews. Newspapers are not an appropriate example of primary data, unless it is qualified that the information under consideration is obtained first hand by the reporter/columnist, as they can also be sources of secondary data – similarly "journals" or "diaries" also require clarification as to the first-hand nature of the relevant material. Where fieldwork, including surveys and interviews, and experimental investigations are suggested, clarification is required that the work has been carried out by the investigator and not being referred to by the investigator.

Question 2 (c) (ii)

(ii) Some female fireflies have been observed mimicking the response pattern of the females of **other** firefly species.

Explain how scientists should use this observation and the data in **Fig. 2.1** to determine more accurately which species of firefly are present in a habitat.

....

.... **[1]**

This question addressed LO3. It proved challenging to a significant number. A common suggestion was to remove the female fireflies from the area to prevent mimicking. Few candidates suggested that only the male flashes should be counted.

Question 3 (a)

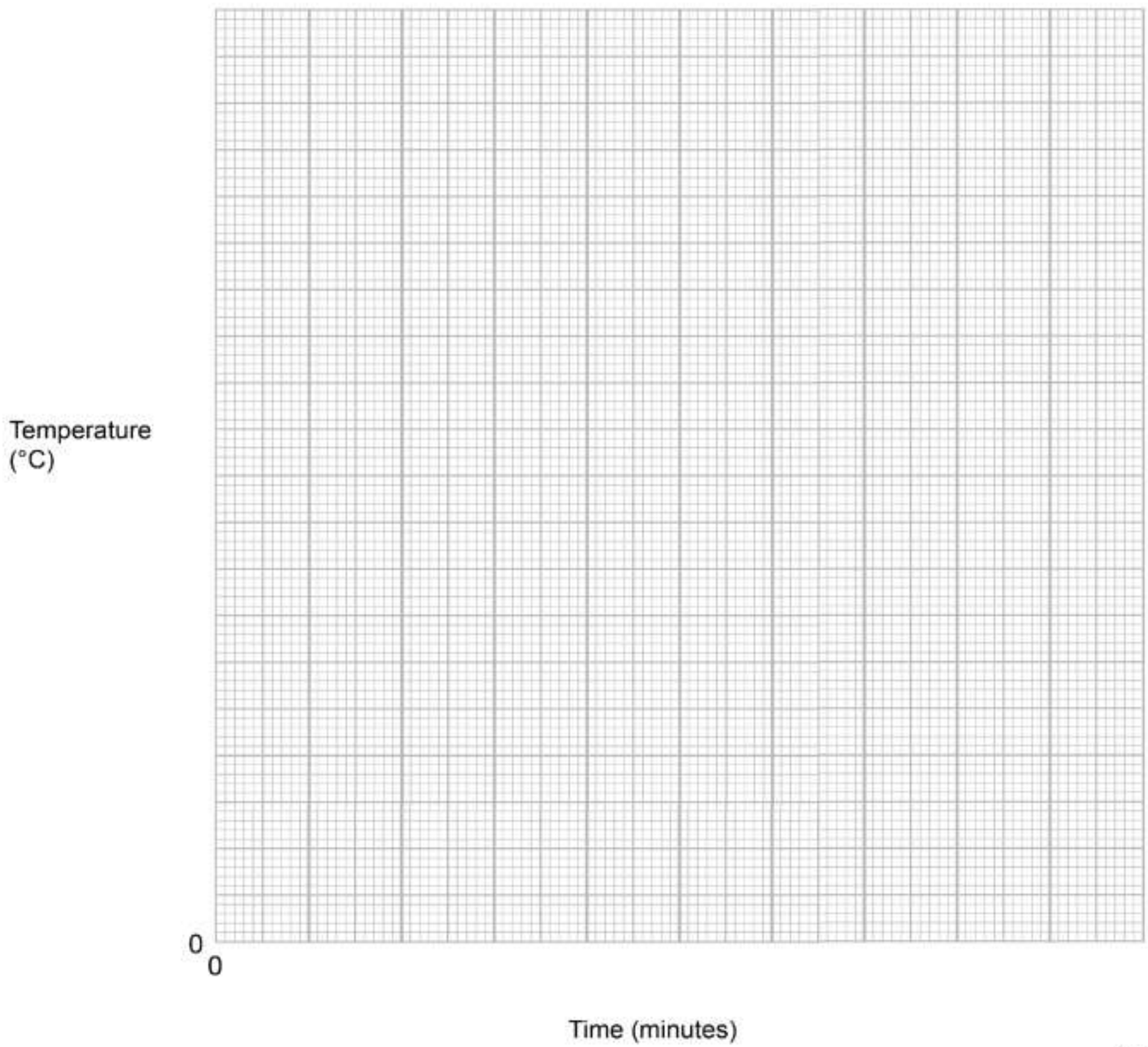
3 Jamal is investigating how the temperature of oil changes when it is heated by a candle flame.

He records the temperature of the oil every minute during his investigation.

His results are shown in the table below.

Time (min)	1	2	3	4	5	6	7	8
Temperature (°C)	25	31	41	52	62	71	78	83

(a) On the grid below plot a line graph of temperature on the y-axis against time on the x-axis and draw the curved line of best fit.



[3]

This question addressed LO2.

Nearly all candidates selected scales for the y- and x- axes that were appropriate for the size of grid and ranges of values, but in some cases the scales selected were awkward or impractical when it came to the plotting of points and reading-off of values – in such cases candidates will inevitably penalise themselves through the consequential loss of subsequent marks.

Nearly all candidates managed to plot points correctly to the nearest small square, although candidates who had selected inappropriate scales for the y- and x- axes struggled. Some candidates made careless errors when plotting points.

The majority of candidates attempted to draw smooth, continuous, and thin lines –of best fit – there, were however, a number of candidates who drew a straight line through the points, and there were too many lines of best fit that were feathered/discontinuous/too thick.

Question 3 (b)

(b) Jamal did **not** record the **initial** temperature of the oil at the start of his investigation.

On the grid show how Jamal should use the curved line of best fit to estimate a value for the initial temperature of the oil.

Record this temperature.

Initial temperature of the oil = ... °C **[2]**

This question addressed LO2. Candidates understood that the line-of-best-fit should be extended to intercept the temperature axis. However, not all lines were extended appropriately by naturally extending the line of best fit – some candidates used a straight line to extend the line – of best fit, others forced the line through 0,0 (not-with-standing the awkward shape of curve resulting). Whatever the intercept, only a handful of candidates made errors in reading off the intercept value – these were generally candidates who had selected an awkward scale for the y-axis.

Question 3 (c) (i)

(c) **(i)** Suggest a numerical value for the level of uncertainty in the initial temperature of the oil recorded in **(b)**.

.... **[1]**

This question addressed LO4. Very few correct answers were seen – the determination of uncertainty in scientific measurements remains problematical for very many candidates.

OCR support

Links to resources on the meaning and correct use of scientific terminology can be found in the OCR publication Resource links: Scientific analysis and reporting (Unit 03) which has been produced to support the teaching of Level 3 Cambridge Technicals in Applied Science.

Question 3 (c) (ii)

(ii) Calculate the percentage uncertainty in the initial temperature of the oil.

Percentage uncertainty = ... **[1]**

This question addressed LO1. It proved challenging for many candidates. Only a small number of candidates knew that they needed to divide the uncertainty calculated in Question 3 (c) (i) by the initial temperature of the oil determined in Question 3 (b) and express the answer as a percentage. A significant number of candidates selected the correct values but then applied an incorrect manipulation. It was evident, from the wide range of values selected for substitution and the manipulations performed, that many candidates had no real idea how to determine percentage uncertainty.

Question 3 (d) (i)

(d) (i) Draw a tangent to the curve when the time is 6 minutes and determine the gradient of your tangent.

Gradient = ... °C min^{-1} **[3]**

This question addressed LO1 and LO2.

A significant number of candidates were unable to draw a tangent to the line of best fit – many of those that were drawn were too small, or otherwise inaccurate, and consequently only a handful of candidates were able to provide an answer within the appropriate range.

In the vast majority of cases where tangents had been constructed candidates were able to read off the relevant dy and dx values and substitute them into dy/dx accordingly – there were, however, a number of candidates who instead of reading off dy and dx values as change in temperature and change in time read them off in terms of number of small/large squares.

Question 3 (d) (ii)

(ii) Jamil decides to convert his value of the gradient into SI units.

State the SI units of the gradient and explain how he would convert his value to SI units.

Units ....

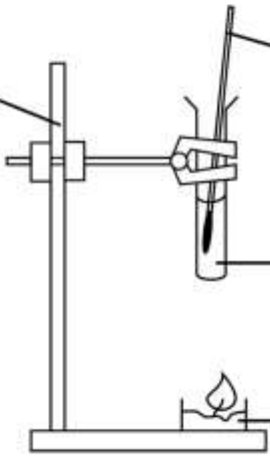
Explanation ....

....
[3]

This question addressed LO1. Only one or two candidates gained all 3 marks on this question. In general, the question proved challenging to candidates. A significant number of candidates gave the correct SI unit of K s^{-1}, and most were then able to explain that to make the conversion they would divide the gradient calculated in Question 3 (d) (i) by 60. Only one or two were then able to expand their explanation in terms of the change in temperature in Kelvin and the change of time in seconds – the overwhelming majority of candidates seemed to have no awareness of the relationship between the Kelvin and Celsius temperature scales.

Question 3 (e)

(e) Jamal draws a diagram of his apparatus.



Jamal needs to provide more details about his method and results so that his investigation is **repeatable** and **reproducible**.

Discuss the difference between repeatability and reproducibility and describe what further information Jamal should provide.

....

....

....

....

....

.... **[6]**

This question addressed LO4.

A majority of candidates provided descriptions of both repeatability and reproducibility which highlighted the differences between them. Unfortunately, there were a number of candidates whose descriptions were confused and lacked clarity (or were, in a very small number of cases, wrong – having confused the two terms). In general, descriptions often lacked breadth, being limited to one or two indicative content points.

Only a handful of candidates distinguished between the information required from Jamal to conduct the experiment under repeatable and reproducible conditions – in nearly all cases a combined list was provided for both repeatability and reproducibility, which limited the maximum awardable level to level-2.

Question 4 (a)

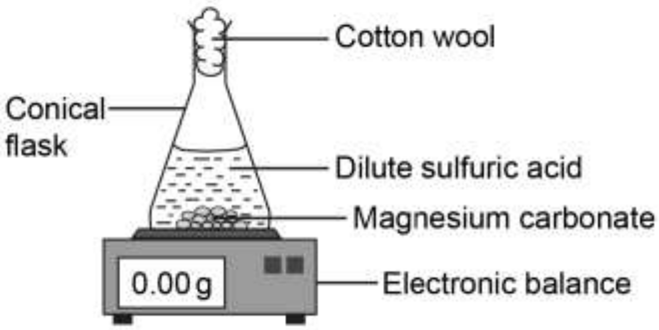
4 Leo is a chemistry student investigating the rate of reaction between magnesium carbonate, $MgCO_3$, and sulfuric acid, H_2SO_4.

$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l) + CO_2(g)$

As the reaction proceeds, carbon dioxide gas is released, causing the mass of the reaction mixture to decrease.

Leo decides to monitor the rate of reaction by measuring the loss in mass at 10 second intervals.

He sets up the apparatus as shown and follows the method outlined below.



Method

- Pour 25 cm^3 of 1.0 mol dm^{-3} sulfuric acid into the conical flask and stand it on the electronic balance.
- Add 1.25 g of magnesium carbonate and immediately start the timer.
- Record the reading on the balance every 10 seconds.
- Calculate the loss in mass by subtracting each reading from the initial mass.
- Repeat the experiment twice more using the same mass of magnesium carbonate and the same volume of 1.0 mol dm^{-3} sulfuric acid.

The table shows Leo's results.

Time (s)	Loss in mass (g)			Mean loss in mass (g)
	Experiment 1	Experiment 2	Experiment 3	
0	0.00	0.00	0.00	0.00
10	0.18	0.19	0.18	0.187
20	0.41	0.36	0.42	0.415
30	0.54	0.55	0.53	0.540
40	0.57	0.63	0.58	0.575
50	0.61	0.61	0.62	0.613
60	0.62	0.63	0.63	0.627
70	0.63	0.63	0.63	0.630
80	0.63	0.63	0.63	0.630

(a) Explain why Leo stops recording his measurements after 80 s.

....

.... **[1]**

This question addressed LO4. Nearly all candidates seemed to have understood that the reaction had stopped by 80 s. A common error was to refer the reaction having reached "end point", which is a term specific to titrations. A number of candidates referred to no further loss in mass at 70 s, but this would not be known until 80 s – candidates had to make it clear that any decision was based on the data available at 80 s. Although it was not specifically mentioned in the question and no data was provided, a small number of candidates worked out that production of carbon dioxide would cease once the reaction had stopped and that the earliest this could have been determined was between 70 s and 80 s.

Question 4 (b) (i)

(b) **(i)** Suggest why Leo carries out repeat measurements.

Put a (ring) around the correct answer.

To increase accuracy **To reduce the effect of random error**

To reduce the effect of systematic error

[1]

This question addressed LO4. A selection of responses was seen for this question. Understanding the difference between, causes of, and limitation of random and systematic error continues to be a problem for a significant number of candidates.

Question 4 (b) (ii)

(ii) Leo thinks that his results are precise.

Explain what **precise** means in relation to Leo's results.

....

.... **[1]**

This question addressed LO4. An overwhelming majority of candidates were able to define the term precision, although very few did so in the context of the question which the precision in terms of loss of mass.

Question 4 (c)

(c) Explain why the mean mass Leo calculates at 40 s is **not** the mean of all three mass readings.

....

.... **[1]**

This question addressed LO4. Nearly all candidates identified that the value for experiment 2 was an outlier/anomalous, but not all went on to state that it would then not have been included when calculating the mean.

Question 4 (d)

(d) Leo uses a two decimal place balance for his mass readings.

What is the uncertainty in each mass reading?

Put a (ring) around the correct answer.

±0.01 g **±0.005 g** **±0.10 g**

[1]

This question addressed LO4. The majority of candidates correctly selected +/-0.005 g.

Question 4 (e)

(e) Leo decides to assess the accuracy of his experiment.

He uses the reaction quantities and the balanced equation to calculate that the loss in mass should be 0.650 g.

Leo compares this calculated value with his experimental value.

His experimental value is the mean loss in mass, 0.630 g, recorded after 80 s (as shown in the table).

Calculate the percentage difference between the calculated value and his experimental value using the following equation.

$$\% \text{ difference} = \frac{(\text{calculated value} - \text{experimental value}) \times 100}{\text{calculated value}}$$

[2]

This question addressed LO4. In general, this question presented few problems to the majority of candidates – until the answer had to be correctly rounded for the chosen number of significant figures. A high number of candidates offered 3.076, instead of 3.077.

Question 4 (f) (i)

(f) Kareem is another chemistry student investigating the rate of reaction between magnesium carbonate, $MgCO_3$, and sulphuric acid, H_2SO_4.

$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l) + CO_2(g)$

He decides to measure the reaction rate by timing how long it takes for the reaction to stop.

(i) Suggest **two** observations he could make which indicate that the reaction has finished.

....

....

.... **[2]**

This question addressed LO4. Most candidates managed to suggest one valid answer, although a high number did only suggest one answer. The most common error was to suggest that Kareem could observe "no more gas being given off". This is not an observation – the observation that could be made being no more bubbles/fizzing.

Question 4 (f) (ii)

(ii) Kareem carries out the reaction three times, keeping the mass of magnesium carbonate and the volume of sulphuric acid the same each time, but changing the concentration of the acid.

His results are shown in the table below.

Experiment	**Concentration of acid ($mol\ dm^{-3}$)**	**Time taken for reaction to stop (s)**	$\frac{1}{time}$ **(s^{-1})**
1	0.5 $mol\ dm^{-3}$	135	
2	1.00 $mol\ dm^{-3}$	70	
3	2.00 $mol\ dm^{-3}$	36	

Complete the table by calculating $\frac{1}{time}$ for each experiment.

Give your answers to **3** decimal places.

[2]

This question addressed LO1. It caused candidates few problems – other than incorrect rounding and careless placing of decimal points, both of which were rare.

Question 4 (f) (iii)

(iii) $\frac{1}{\text{time}}$ is a measure of the rate of reaction.

State what Kareem's results show about the effect of acid concentration on the rate of reaction.

....

....

.... **[2]**

This question addressed LO4. Nearly all candidates identified that that reaction rate increased as concentration of acid increased – but only one or two candidates identified the doubling of reaction rate with doubling of concentration.

Question 4 (g) (i)

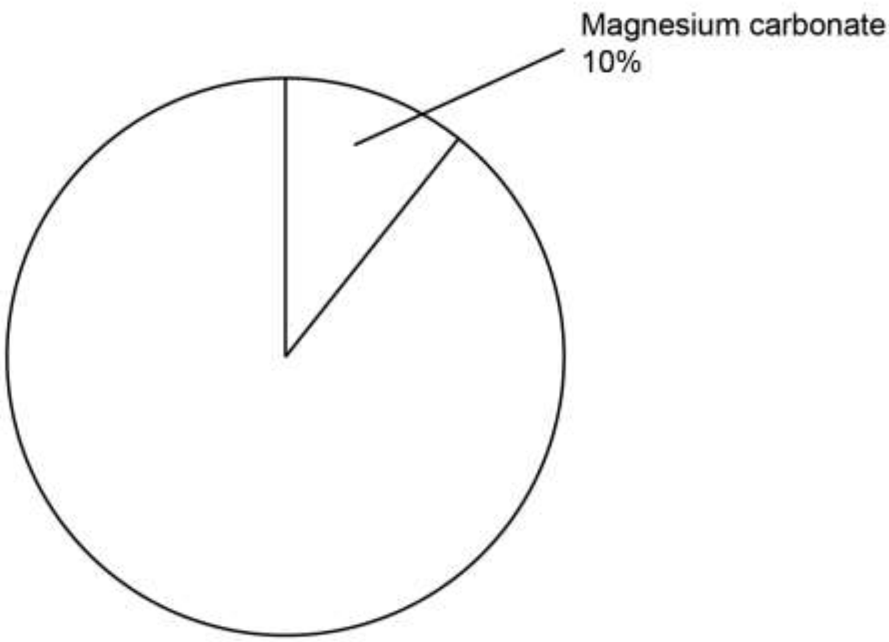
(g) Magnesium carbonate is an ingredient in many common indigestion tablets.

A typical indigestion tablet contains several components.

The table shows the % by mass of each component found in one type of indigestion tablet.

Substance	Percentage by mass
Magnesium carbonate	10%
Alginic acid	15%
Glucose	45%
Calcium carbonate	30%

The pie chart below shows the percentage by mass of magnesium carbonate in the tablets.



(i) Explain how the size of the slice of the pie chart labelled magnesium carbonate has been calculated.

....

.... **[1]**

This question addressed LO2. It was apparent that whilst the overwhelming majority of candidates knew how to calculate the size of a sector of a pie chart (this was evident also from completing the pie chart for Question 4 (g) (ii)), they struggled to explain clearly and concisely how they would do so.

Question 4 (g) (ii)

(ii) Complete the pie chart to show the slices of the pie chart that represent the other three substances.

Label each of the three segments.

[2]

This question addressed LO2. Nearly all candidates produced pie charts with the correctly labelled sectors in the correct proportions, but the majority did not follow the convention that unless there is an inherent ordering of the data in the sectors (by age, time of year, size of population, etc) then the sectors should be ordered in increasing size – the majority of candidates simply placed the components in the order in which they were listed in the table, so forfeiting the mark). A significant number of candidates also drew the first radius at >90^o.

Question 5 (a) (i)

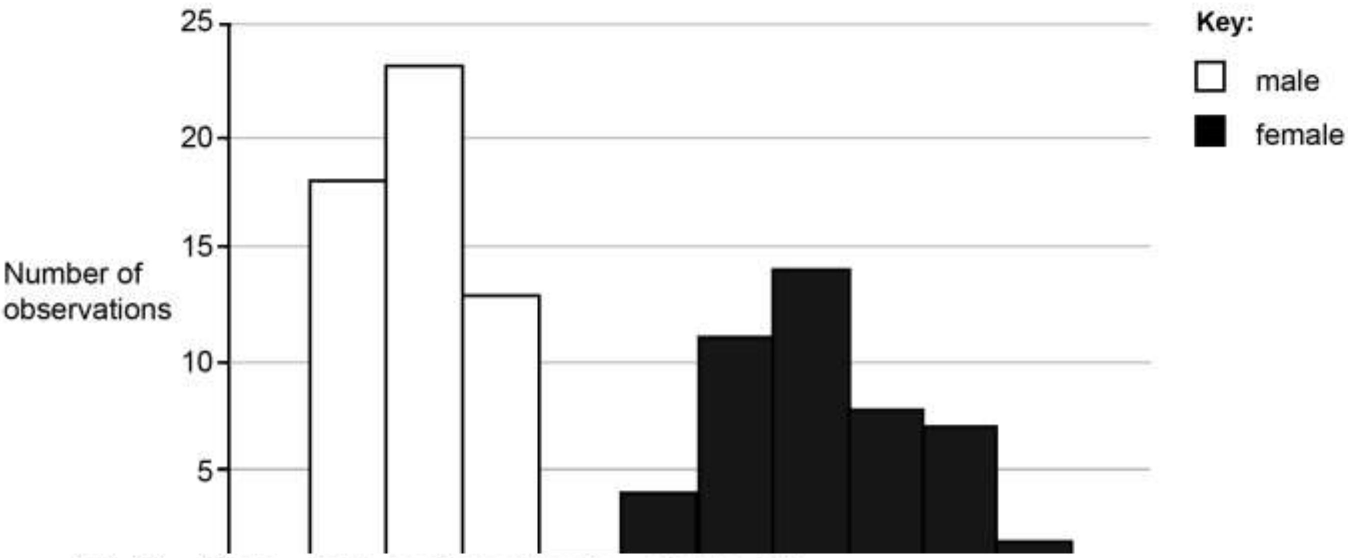
5 Jane is investigating a species of shrimp that is found in mountain streams.

She gathers a sample of the shrimps.

For each shrimp in the sample Jane measures its body length and determines whether it is male or female.

Jane presents her data in a chart as shown in **Fig. 5.1**.

Fig. 5.1



(a) (i) State what type of chart is shown in **Fig. 5.1**.

Give **two** reasons for your answer.

Type of chart ....

Reason 1 ....

Reason 2 ....

[3]

This question addressed LO2. Although in a small minority, a high number of candidates identified that chart as a bar graph – these were the only alternatives offered.

Question 5 (a) (ii)

(ii) Use **Fig. 5.1** to estimate the number of male shrimps collected by Jane.

....

.... **[1]**

This question addressed LO2. Some unexpected values were offered, but nearly all candidates suggested a value within the allowable range.

Question 5 (b)

(b) Describe the distribution in the body length of female shrimps.

....

.... **[1]**

This question addressed LO4. A significant number of candidates identified the correct range (although some candidates stated ranges that made no sense) but only one or two candidates identified that there was a normal distribution within that range,

Question 5 (c)

(c) Suggest **three** conclusions Jane can make using the data in **Fig. 5.1**.

1 ....

2 ....

3 ....

[3]

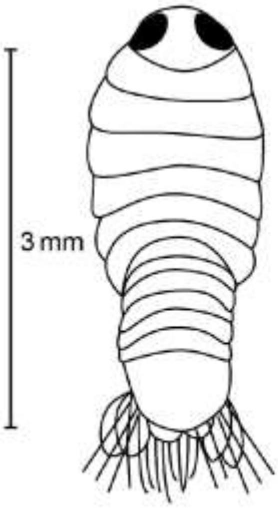
This question addressed LO5. Few candidates were awarded more than 2 marks here, simply because general statements about the data, rather than specific conclusions which could be drawn from it, were offered.

Question 5 (d) (i)

(d) Jane finds a diagram of the shrimp species in an online academic journal.

Fig. 5.2 shows the dorsal side of the shrimp, when viewed from above.

Fig. 5.2



(i) What types of information sources (primary or secondary) are shown in **Fig. 5.1** and **Fig. 5.2**?

Fig. 5.1 ....

Fig. 5.2 ....
[1]

This question addressed LO5. A range of combinations of primary and secondary sources for Fig. 5,1 and 5.2 were offered – it is clear that candidates do not have a clear understanding of the distinction between primary and secondary sources.

Question 5 (d) (ii)

(ii) The online journal identifies the image in **Fig. 5.2** as a female.

Use the measurements shown in **Fig. 5.1** and **Fig. 5.2** to suggest why this is an example of conflicting evidence.

....

.... **[2]**

This question addressed LO5. A majority of candidates identified that the shrimp in Fig. 5.2 is too small to be a female, but candidates either did not support this assertion with a supporting measurement or selected incorrect measurements – many candidates referred to the size of males, which was not relevant.

Question 5 (d) (iii)

(iii) Suggest what further information is needed to make the identification in **(d)(ii)** more secure.

....

.... **[1]**

This question addressed LO5. A large number of candidates framed their answers to this question in terms of the size of males, overlooking the fact that the question was about the size of females. Of those who responded correctly, in terms of size of females, a significant number did not qualify their answers in terms of the minimum expected size of females and so limited themselves to 1 mark.

Question 6 (a) (i)

6 Beth is a technician working in a hospital pathology laboratory.

She tests patient samples to determine whether they have a bacterial infection and if so, what types of bacteria are present.

(a) Her initial investigations involve gram staining to determine whether the bacteria are gram-positive or gram-negative.

(i) Gram staining involves the use of different stains.

Tick (✓) the boxes next to **two** of the stains used for the gram staining process.

Crystal violet	☐
Leishman's stain	☐
Methylene blue	☐
Safranin	☐
Sudan III	☐
Toluidine blue	☐

[2]

This question addressed LO6. The overwhelming majority of candidates correctly identified crystal violet and safranin as two of the stains used in gram staining – crystal violet was almost always correctly identified, but Sudan III and methylene blue were sometimes suggested instead of safranin.

Assessment for learning

Centres should provide candidates with as many opportunities as possible to gain experience with the practical techniques specified within the Unit specifications for both this unit and Unit 2 (Laboratory Techniques).

Centres should ensure that the correct equipment is used and the correct procedures are followed when conducting investigations, and that candidates understand why particular equipment is used and specific procedures followed.

Question 6 (a) (iii)

(iii) Suggest **one** reason why bacteria in a blood sample are grown on an agar medium before carrying out the gram staining process.

....

.... **[1]**

This question addressed LO6. A high number of candidates did not appreciate that the first stage in performing microbiological analysis is to culture sufficient individuals to work on. A variety of incorrect answers were suggested, many of which did not make sense within the context of the question.

Question 6 (b)

(b) Beth uses different media for growing and identifying bacteria.

Draw lines to connect each type of growth medium with its correct use.

Growth medium	**Use**
Differential media	Contain dyes or specific substrates so that different bacteria can be recognised on the basis of their colony colour.
Enriched media	Contain specific antibiotics to prevent the growth of some bacteria while promoting the growth of others.
Selective media	Contain specific nutrients to increase the relative concentration of certain bacteria in the culture.

[3]

This question addressed LO6. Nearly all candidates selected the correct pairs; the most common error was to confuse the uses of differential and selective media.

Question 6 (c) (i)

(c) Some bacteria can ferment lactose and others cannot.

MacConkey agar (MAC) is a type of medium that helps microbiologists to identify lactose fermenting bacteria.

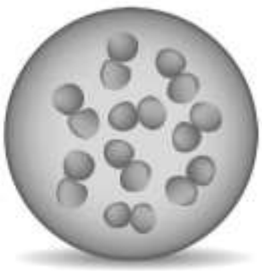
Lactose fermenting bacteria produce pink colonies on MAC but non-lactose fermenting bacteria appear as colourless colonies on the growth medium.

Beth believes that a sample taken from one her patients contains one of the bacteria listed in **Table 6.1**.

Table 6.1

Name of bacteria	Cell shape of bacteria	Gram-negative?	Lactose Fermenter?
Escherichia coli	rods	Yes	Yes
Salmonella enterica	rods	Yes	No
Neisseria lactamica	cocci (round)	Yes	Yes
Moraxella catarrhalis	cocci (round)	Yes	No

The results of Beth's tests are shown below.

Collection of bacterial cells seen under light microscope	Appearance of bacterial colonies when grown in MacConkey agar
	Pink colonies

(i) State the name of the bacteria in **Table 6.1** that could be the bacteria in her sample.

Explain your answer.

Name of bacteria ....

Explanation ....

....

....

[3]

Question 6 (c) (ii)

(ii) Explain why Beth cannot be 100% confident that the type of bacteria identified in **(c)(i)** is correct.

....

.... **[1]**

This question addressed LO6. Many candidates referred to other bacteria having similar characteristics without explaining how they would have come to have been on the plate – "contamination" was the idea being looked for, and that was addressed by only a minority of candidates.

Question 6 (d) (i)

(d) Beth is told that one of the patients has a wound, which has been in contact with soil.

She is concerned that the patient may have been infected with a type of soil-borne bacterium.

Beth decides to test a sample of the soil.

She grows her sample on a nutrient agar plate.

The appearance of the colony is shown below.

Item removed due to third party copyright restrictions

Beth concludes that the type of bacteria is *Bacillus subtilis* because of the colony shape.

(i) Tick (✓) **one** box that describes the colony shape shown.

Circular ☐

Filamentous ☐

Rhizoid ☐

Spindle ☐

[1]

This question addressed LO6. A variety of responses was suggested, none more common than any other. Identification of colony morphology proved problematic for candidates; candidates would benefit from spending time developing the ability to identify colony shapes using diagrams, drawings, and photographs.

Question 6 (d) (ii)

(ii) Beth takes a sample of the bacteria growing on her agar plate to prepare a permanent slide.

She has already stained the bacterial cell contents but must follow three further steps before completing the process.

The steps are shown in the table below but are **not** in the correct order.

Put the numbers **1 to 3** in the boxes to indicate the correct order of steps.

Step	**Order**
Clearing	
Dehydration	
Mounting	

[1]

This question addressed LO6. The majority of candidates placed the stages in the correct order, suggesting some practical knowledge – but a significate number had no idea of how to sequence the stages; suggesting practical knowledge is lacking in this area.

Question 7 (a)

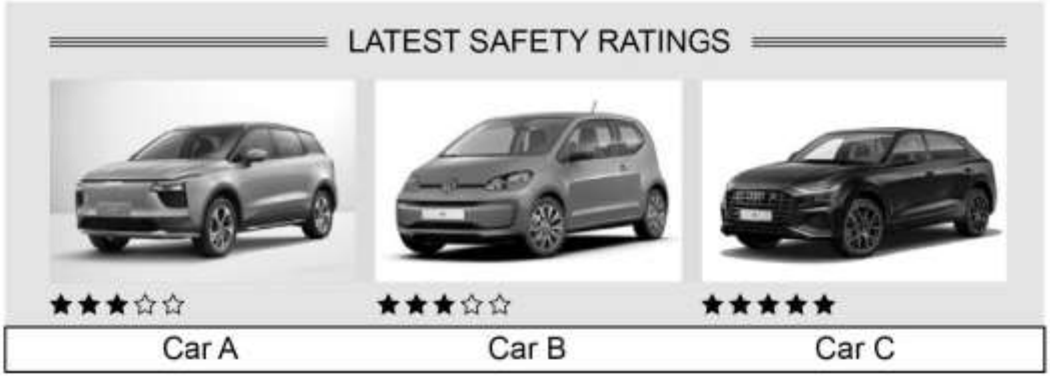
7 The European New Car Assessment Programme (EuroNCAP) uses crash-test dummies to investigate the safety of new cars.

(a) **Fig. 7.1** shows crash-test data presented on the EuroNCAP website.

The star system indicates how well the car performed in the crash-tests.

Cars awarded five stars are the safest.

Fig. 7.1



Give **two** advantages of presenting data in this way on a website.

1 ....

2 ....

[2]

This question addressed LO7. Nearly all candidates provided at least one correct suggestion, and the majority two.

Question 7 (b) (i)

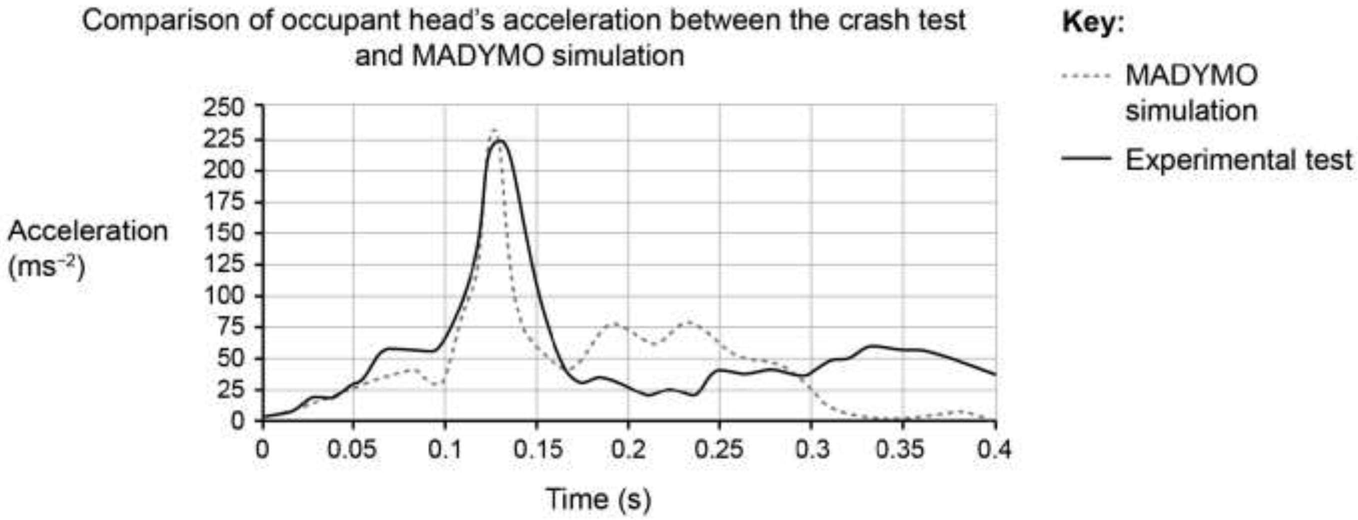
(b) The crash-test dummies are fitted with over 200 sensors that measure acceleration on different parts of the dummy's body during a simulated crash.

The data are stored in the dummy and then downloaded onto a computer programme after the crash. Each crash is filmed using a high-resolution, high-speed video camera.

In addition to the data measured in crash-test experiments, data can also be obtained by mathematical modelling.

Fig. 7.2 shows a graph comparing crash-test data and mathematical modelling (MADYMO) data.

Fig. 7.2



(i) Suggest **two** advantages of using mathematical modelling to collect data.

1 ....

2 ....

[2]

This question addressed LO7. The advantages of using mathematical data were not apparent to many candidates, a number who fell back on "ease [sic] of collecting data" – in general, ease is too vague to be creditworthy.

Question 7 (b) (ii)

(ii) Describe **two** ways that the crash-test data in **Fig. 7.2** validates the mathematical modelling data.

1 ....

2 ....
[2]

This question addressed LO7. Candidates did not match the two traces in Fig. 7.2 with the magnitudes/times of the recorded accelerations.

Question 7 (b) (iii)

(iii) Suggest **two** advantages of recording crash-test data on video.

1 ....

2 ....
[2]

This question addressed LO7. Few candidates scored maximum marks on this question, and a number did not score any marks. The most common mark points scored were those relating to re-watching or freezing/re-playing/fast-forwarding – features which candidates might use first-hand.

Question 7 (c)

(c) The target audiences for the information shown in **Fig. 7.1** and **Fig. 7.2** are different.

Suggest what the target audiences might be.

Fig. 7.1 ....

Fig. 7.2 ....
[2]

This question addressed LO7. Nearly all candidates were able to make a correct distinction between the target audiences for Fig. 7.1 and Fig. 7.2, although some suggestions – "directors", "parents", etc – were rather too vague.

Copyright information

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit

- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **facebook.com/ocrexams**
- **twitter.com/ocrexams**
- **instagram.com/ocrexaminations**
- **linkedin.com/company/ocr**
- **youtube.com/ocrexams**

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT