CAMBRIDGE TECHNICALS

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CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 3 Summer 2022 series

Version 1

Contents

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.

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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 2 hours in 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 for analysis
- the ability to 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.

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

In general candidates demonstrated good examination technique. All candidates appeared to have allowed themselves sufficient time to attempt all questions on the paper. Where candidates were required to match pairs, select multiple choice responses, or provide a specific number of suggestions, nearly all candidates completed or provided the correct number of responses.

OCR support

Links to resources to support the teaching of unit content assessed in this examination are contained in the OCR resource: Unit 3 – Scientific analysis and reporting: resource links

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• understood the conventions to be followed when constructing charts and graphs • took care when performing calculations and carried through calculated values between part questions • answered questions precisely within the context given, demonstrating depth of knowledge • used knowledge gained when carrying out practical activities to answer Question 6(e) • were confident in the use, analysis, and evaluation of data presented in unfamiliar contexts.	• demonstrated a lack of care and attention when constructing charts and graphs • made mistakes when performing calculations and did not carry through calculated values between part questions • provided vague answers to questions that were not specific to the context given and did not demonstrate depth of knowledge • were unable to draw on first-hand practical experience to answer Question 6(e) • experienced problems when presented with information and data in unfamiliar contexts.

Question 1 (a) (i)

1 Jamila is investigating the movement of a mass on the end of a chain of springs.

She attaches one end of the chain of springs to a hook on the ceiling and the other end to the hook of a mass hanger.

The arrangement of the apparatus is shown in **Fig. 1.1**.

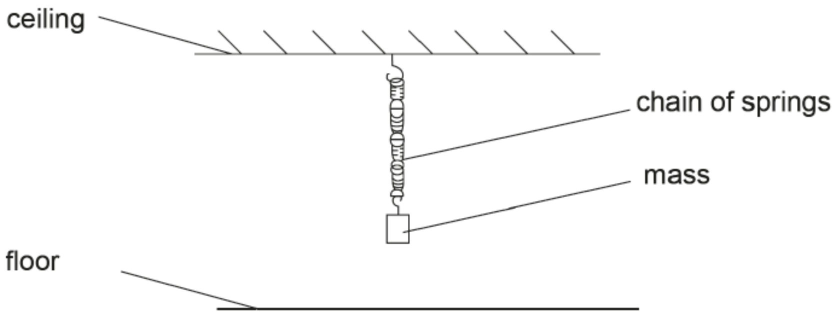


Fig. 1.1

- Jamila pulls the mass down to the floor.
- She then releases the mass and starts a stopwatch.
- She stops the stopwatch when the mass returns to its starting position.

(a) In her first experiment, she uses a 600 g mass and carries out a total of nine repeats.

Her results are shown in **Table 1.1**.

Repeats	1	2	3	4	5	6	7	8	9
Time (s)	2.45	2.43	2.22	2.62	2.58	2.69	2.54	2.45	2.64

Table 1.1

(i) Jamila analyses her data using some calculations.

Draw straight lines to link each type of **analysis** to the correct **result** of the analysis.

There is one **result** you do not need to use.

Analysis	**Result**
mean	2.54
median	2.51
mode	0.235
range	2.45
	2.22 to 2.69

[4]

This question presented few problems, with nearly all candidates able to obtain maximum marks for matching the correct result of each mathematical analysis.

Question 1 (a) (ii)

(ii) The stopwatch can be read to the nearest ± 0.10 s. Jamila estimates that her reaction time between starting and stopping the stopwatch is about 0.2 s.

Identify:

- the type of error in the stopwatch reading

....

- the type of error due to Jamila's reaction time.

....

[2]

This question proved problematical for candidates, many of whom can correctly identify systemic error and random error but were unfamiliar with the specific types of error leading to systematic and random errors.

Assessment for learning

When carrying out practical activities centres should teach candidates about the specific types of experimental error and how they can lead to systematic and random errors – candidates could be encouraged to identify possible causes of error when conducting practical investigations.

Question 1 (a) (iii)

(iii) Calculate the total error in Jamila's readings and use this value to estimate the percentage uncertainty in Jamila's lowest reading from **Table 1.1**.

Total error = ...

Percentage uncertainty = ...

[2]

This question proved challenging to all but the higher performing candidates. Those candidates were able to calculate both total error and percentage uncertainty.

OCR support

Guidance on the calculation of error and uncertainty can be found in the OCR resource Mathematical Skills Handbook for GCE A Level physics.

Question 1 (b) (i)

(b) Jamila then repeats the experiment. She keeps the number of springs in the chain constant and varies the mass. Her results are shown in **Table 1.2**.

Mass (g)	550	350
Average time (s)	2.27	2.15

Table 1.2

One of Jamila's friends suggests that the time, t, might be directly proportional to the mass, m.

This would mean that t = *k* m where *k* is a constant.

Jamila decides to test out her friend's theory using the data in **Table 1.2**.

(i) Use the data in **Table 1.2** to calculate two values of *k*. Give your answers to a suitable number of significant figures

Value of *k* when m is 550 g = ...

Value of *k* when m is 350 g = ...

[2]

A significant number of candidates did not identify that the equation t = km required to calculate k was provided in the stem of the question, and consequently calculated incorrect values. Where correct values for k were offered these were invariably stated correctly to either two or three significant figures.

Question 1 (b) (ii)

(ii) Explain the number of significant figures you have given in your values of *k*.

....

.... **[1]**

A small number of candidates were able to correctly justify their choice of number of significant figures in Question 1(b)(i) with reference to the number of significant figures for m and t in Table 1.2. Those who did so appeared to understand that the answer cannot be stated to a greater number of significant figures than the smallest number for any value used in the calculation.

Seen in isolation, it is impossible to know whether the final zeros in the stated masses of 350g and 550g are significant (and the values stated to three significant figures) or insignificant (and the values stated to two significant figures). This was taken into account in the mark-scheme, and either interpretation by candidates was allowed.

OCR support

Guidance on the use of significant figures can be found in the OCR resource Mathematical Skills Handbook for GCE A Level physics.

Question 1 (b) (iii)

(iii) Determine the percentage difference in the two values of *k* calculated in **(b)(i)**.

Use the equation:

$$\text{percentage difference} = \frac{(k_2 - k_1) \times 100}{k_{ave}}$$

where k_2 is the value of *k* when m is 350 g and k_1 is the value of *k* when m is 550 g. k_{ave} is the average of these two *k* values.

Show your working.

Percentage difference = ... % **[2]**

The majority of candidates managed to calculate a correct percentage difference, where necessary involving an e.c.f for k_1 and k_2 from 1(b)(i).

Question 1 (c)

(c) Jamila writes a conclusion in her laboratory notebook.

The suggested relationship t = *k*m is **not** supported by the evidence.

Discuss whether Jamila's conclusion is correct by comparing your answers to **(a)(iii)** and **(b)(iii)**.

....

....

....

.... **[2]**

Nearly all candidates correctly stated that the conclusion was correct/relationship not supported for MP2, but only a small number of candidates were able to correctly support their conclusion with reference to the difference in the calculated values of k.

Question 1 (d)

(d) Jamila repeats her analysis. She uses a different value from **Table 1.1** for her calculation in **(a)(iii)** to compare with her calculation in **(b)(iii)**.

Explain why using any other value from **Table 1.1** means that Jamila can be even more confident that her conclusion in **(c)** is correct.

....

....

.... **[2]**

This question proved challenging for the majority of candidates; very few candidates obtained more than 1 mark, those candidates who did obtain a mark invariably did so by referring to the elimination or identification of anomalous data.

Question 2 (a)

2 Leo is a science student.

He is studying the rate of reaction between nitric acid and sodium thiosulfate solution.

Leo wants to find out how the concentration of sodium thiosulfate affects the rate of reaction.

- He marks an **'X'** on a piece of paper and places a flask containing 10 cm^3 of nitric acid on top of the **'X'**.
- He adds 10 cm^3 of sodium thiosulfate solution, swirls the flask and immediately starts a stopwatch. Sulfur is produced causing the mixture to become cloudy.
- Leo stops the stopwatch when he can no longer see the cross.

The experiment is shown in **Fig. 2.1**.

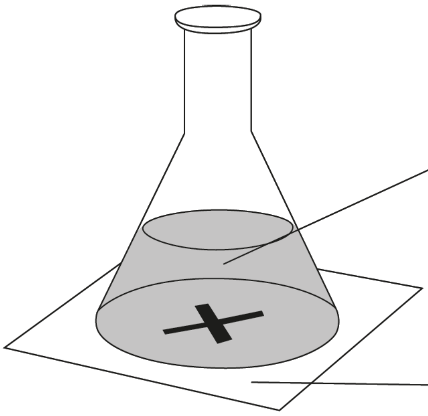


Fig. 2.1

- Leo repeats the experiment using different concentrations of sodium thiosulfate.
- For each concentration he times how long it takes for the cross to be obscured.

His results are shown in **Table 2.1**.

Experiment	**Concentration of sodium thiosulfate (%)**	**Time taken to obscure the cross, t (s)**	**Relative rate, 1/t (s^{-1})**
A	50	16	
B	40	21	
C	30	33	
D	20	39	
E	10	91	

Table 2.1

(a) The relative rate is equal to 1/t.

Complete **Table 2.1** by calculating the relative rates of reaction for each of the experiments.

Give your answers to **2** significant figures.

[2]

A significant number of candidates calculated the relative rate incorrectly, despite the required manipulation being stated both in Table 2.1 and in the question. However, nearly all candidates correctly expressed whatever relative rate they had calculated to two significant figures – a number of candidates were uncertain of how treat trailing zeros when handling significant figures.

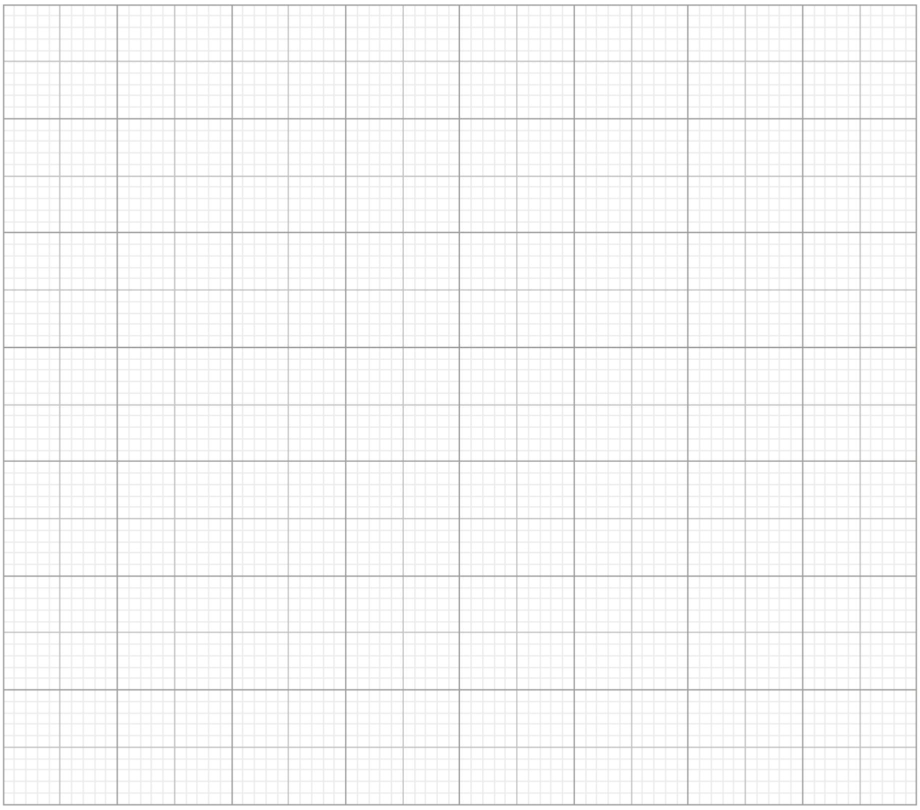
OCR support

Guidance on the use of significant figures can be found in the OCR resource Mathematical Skills Handbook for GCE A Level chemistry.

Question 2 (b) (i)

(b) (i) On the grid below plot a graph of relative rate (vertical axis) against % concentration (horizontal axis).

- Start your graph at the origin on both axes and label the axes.
- Draw the straight line of best fit.



[2]

Some candidates produced very good graphs which scored full marks. However, many candidates lost 1 or 2 marks for omitting units, drawing inappropriate scales, careless plotting of points and in a few cases transposition of the x- and y-axes. The line of best fit was often not well drawn (being thick and/or broken/sketched/not ruled), did not allow for an even spread of points above and below, and a significant number of candidates did not draw the line of best fit through 0, despite this being implicit in the context of the question.

OCR support

Guidance on drawing graphs can be found in the OCR resource Practical Skills Handbook for GCE A Level chemistry.

Question 2 (b) (ii)

(ii) Draw a circle around the anomalous result. **[1]**

This question presented few problems to candidates, who were able to correctly identify the anomalous result from their graph plotted in 2(b)(i). Although an e.c.f was often allowed from an incorrect graph.

Question 2 (b) (iii)

(iii) Determine the gradient of the line of best fit.

Show your working.

Gradient = ... **[2]**

Only the higher performing candidates were able to calculate the gradient of the graph using dy/dx; whilst some candidates attempted to calculate the gradient using dx/dy, many candidates had no idea how to attempt this question, and of those candidates who correctly use dy/dx a significant number incorrectly read y and/or x values from their graph.

OCR support

Guidance on determining the gradients of graphs, and other mathematical skills related to the use of graphs, can be found in the OCR resource Practical Skills Handbook for GCE A Level chemistry.

Question 2 (c) (i)

(c) Leo repeats the experiment using a serial dilution of sodium thiosulfate.

He puts 27 cm^3 of water in four test-tubes. He adds 3 cm^3 of the original sodium thiosulfate solution to test-tube A.

He then takes 3 cm^3 of the solution from test-tube A , adds it to test-tube B and mixes the solution. Then, he takes 3 cm^3 of the solution from B, adds it to test-tube C and mixes the solution. He repeats this procedure from C to D.

The serial dilution is shown in **Fig. 2.2**.

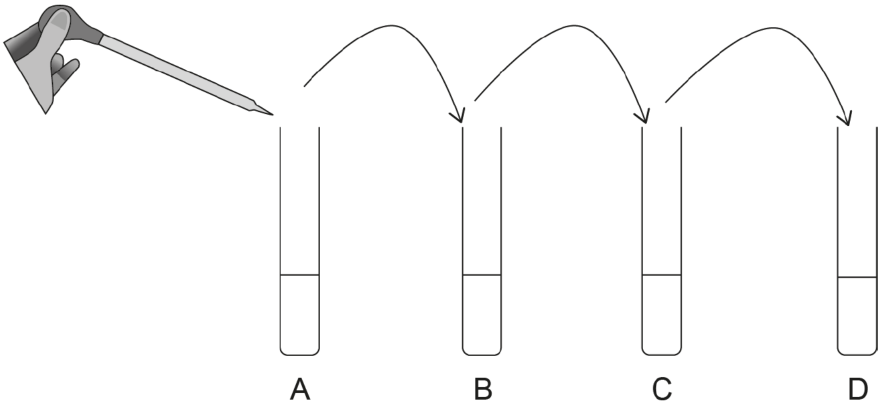


Fig. 2.2

(i) Calculate the dilution factor of the sodium thiosulfate in test-tube A.

Give your answer as a fraction.

Dilution factor = ……………..……………................. **[1]**

This question was found challenging by a number of candidates. Many candidates had not read the question and presented their answers as decimal numbers, as ratios etc, or in standard form. Where the answer was presented as a fraction, a significant number of candidates stated the dilution factor to be 1/9.

Misconception

A significant number of candidates displayed a misconception concerning dilution factors, stating a dilution factor of 1/10 to be 1/9. Centres should make sure that candidates are secure in their understanding of dilution factors, and able to express them in different formats.

Question 2 (c) (ii)

(ii) The initial concentration of the sodium thiosulfate solution is $0.15\,g\,cm^{-3}$.

Calculate the concentration of sodium thiosulfate in test-tube D.

Give your answer in standard form.

Concentration = ……………………………………… $g\,cm^{-3}$ **[2]**

Candidates coped well with this question, being able both to use the initial dilution factor calculated in Question 2(c)(i) to calculate the final dilution factor, and then to use that value to calculate the final concentration of sodium thiosulfate, which was correctly-expressed in standard form. In general, candidates appear to be confident in the use of standard form and in converting to and from standard form.

Question 2 (d) (i)

(d) (i) The equation for the reaction between sodium thiosulfate, $Na_2S_2O_3$, and nitric acid, HNO_3 is shown below.

$$Na_2S_2O_3 + 2HNO_3 \rightarrow Na_2SO_4 + S + 2NO_2 + H_2O$$

The relative molecular mass of sodium thiosulfate is 158.2, and the relative atomic mass of sulfur is 32.1.

Calculate the expected mass of sulfur produced when 3.17 g of sodium thiosulfate reacts with nitric acid.

Expected mass of sulfur = ……………………………………… g **[2]**

A significant number of candidates appeared to be unfamiliar with how to calculate the expected number of moles of sulfur produced from the stated mass of sodium thiosulfate and/or how to calculate the expected mass of sulfur produced from the calculated number of moles produced. This led to a wide range of answers being suggested.

Question 2 (d) (ii)

(ii) The actual mass of sulfur produced was 0.463 g.

Calculate the % yield of sulfur using the equation:

$$\% \text{ yield} = \frac{\text{actual mass of product} \times 100}{\text{expected amount of product}}$$

% yield of sulfur = ... % **[1]**

Nearly all candidates were able to use the value for the expected mass of sulfur calculated in Question 2(d)(i) to calculate the percentage yield of sulfur, where necessary involving an e.c.f from Question 2(d)(i).

OCR support

Guidance on amount of substance calculations and the calculation of percentage yield can be found in the OCR resource Mathematical Skills Handbook for GCE A Level chemistry.

Question 3 (a)

3 Emma is trying to find ways of reducing air pollution around schools and shops in the city where she lives.

- She gathers data on the amount of time that the engine of a bus spends at different engine speeds on its route around the city. Engine speed is not the same as the speed of the bus.
- When the bus is stationary, with the engine on, the engine speed is at 15 % of its maximum speed and it is said to be idling.
- Idling is bad for the environment because although it does not use much fuel, the fuel that it uses does not combust completely and this causes air pollution.
- Emma's aim is to recommend 'no idling zones' around schools and busy shopping areas.

Emma presents her data for bus route **1** in the chart shown in **Fig. 3.1**.

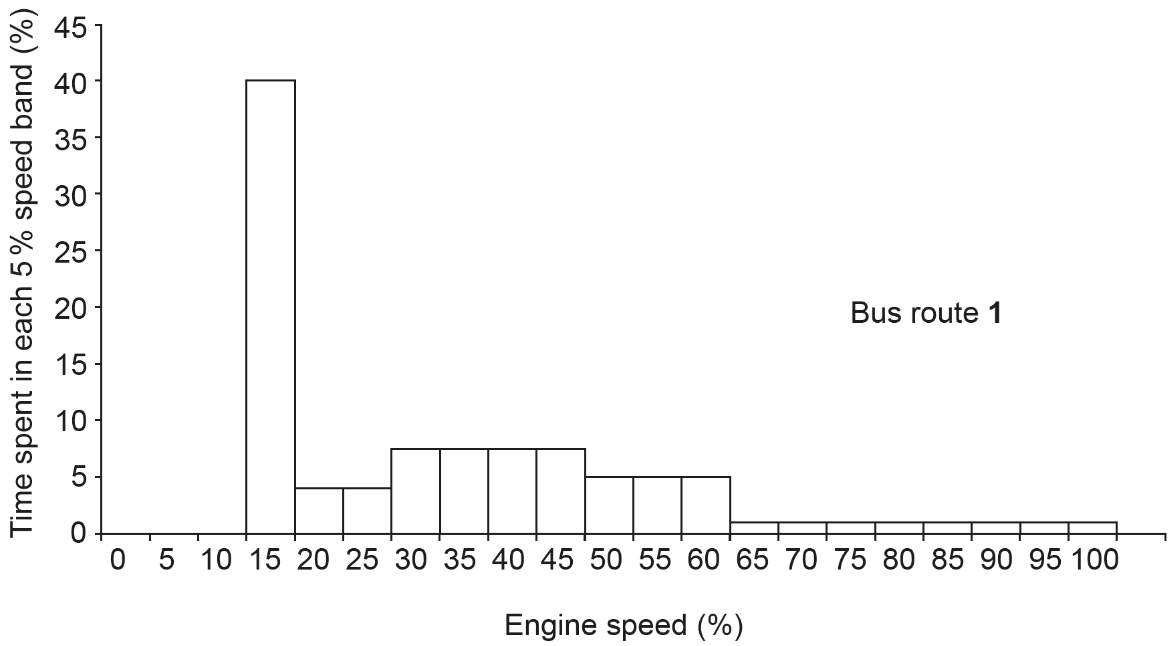


Fig. 3.1

(a) Complete the following sentences using the % values or words/phrases from the list.

Each % value or word/phrase may be used once, more than once, or not at all.

5% **15%** **20%** **30%** **40%** **45%** **60%** **100%**

bar graph **continuous** **discontinuous** **histogram**

The type of chart shown is a ……………………….................. .

The data is ……………………….................. and has a bin width of

……………………….................. .

The percentage of time spent idling is ……………………….................. .

For approximately 30% of the time the speed of the engine is between

……………………….................. and ……………………….................. .

[5]

In general, candidates correctly identified the type chart and the type of data, although some confusion over the distinction between a histogram and a bar graph was evident (see also Question 5(c)(i)) but were much less secure when interpreting the chart to identify the percentage of time spent idling and, particularly, the range of engine speeds that accounted for 30% of the time.

Question 3 (b)

(b) Emma repeats her investigation on a different bus route, bus route **2**.

She presents her data in a new chart shown in **Fig. 3.2**.

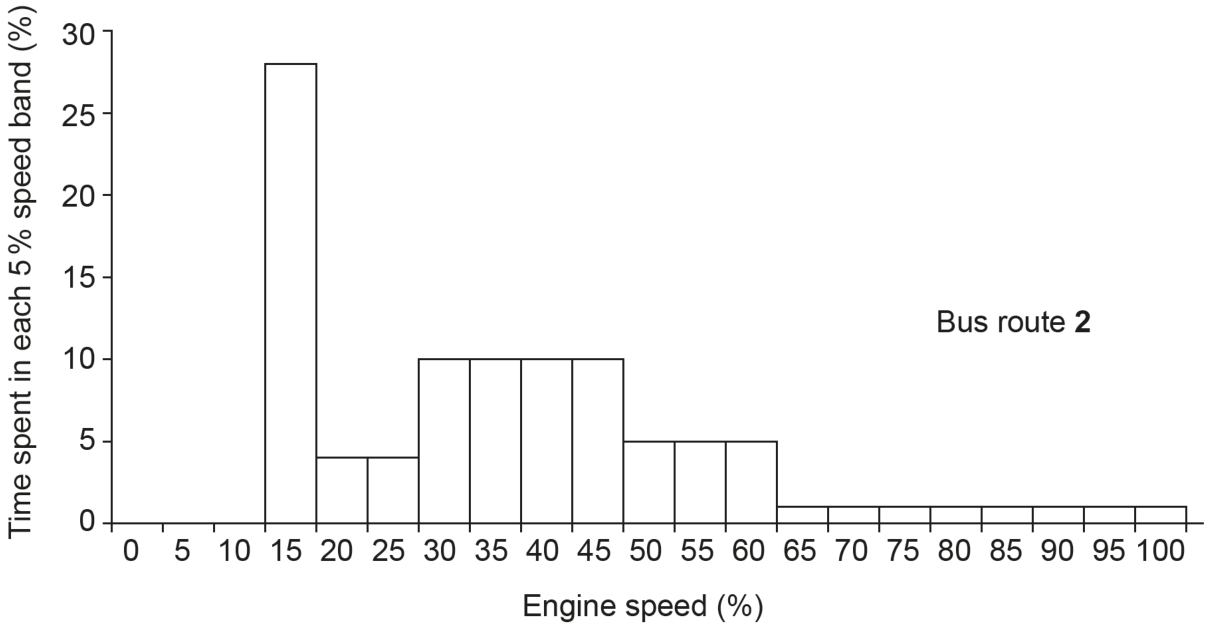


Fig. 3.2

Emma compares both charts and writes a conclusion in her report

'Bus route 1 creates greater pollution than bus route 2.'

Discuss why the data in **Figs 3.1** and **3.2** does **not** support Emma's conclusion and suggest further evidence that would make her conclusion more secure.

....

....

....

....

....

.... **[6]**

This question proved very challenging for candidates. Candidates were expected to demonstrate an understanding of what was (idling/stationary time, time at higher speeds), and what was not (journey time, distance, locations), shown on the histograms. They were then expected to identify additional evidence that would need to be collected to support any conclusions that could be drawn from the histograms. Few candidates got much beyond identifying the amount of time spent idling/at higher speeds in routes 1 and 2; the higher performing candidates linked these points to the type of pollution emitted and/or the use of fuel. A small amount of candidates crept into Level 3, a number manged to enter Level 2, with a handful entering Level 1. The overwhelming majority of candidates remained within Level 0. This question generated a significant number of zero responses.

Question 3 (c) (i)

(c) The engine speed is shown by the tachometer or rev counter on the dashboard of a bus. When the engine is switched off the rev counter should be zero.

Fig. 3.3 shows the rev counter from a bus on route **3** when the engine is switched off.

Emma reads this value as 250 RPM.

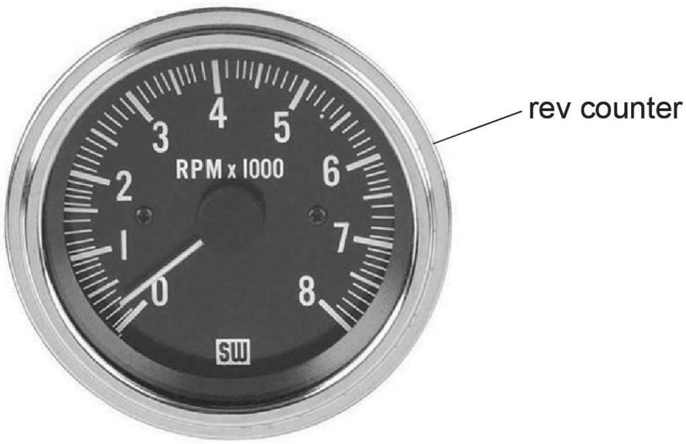


Fig. 3.3

(i) Identify the type of error shown in **Fig. 3.3**.

.... **[1]**

The majority of correct answers identified the type of error as systematic error; few candidates were able to identify the specific type of systematic error. Instrument error was frequently offered but was too vague to specify either systematic error or a type of error leading to systematic error.

Question 3 (c) (ii)

(ii) The rev counter should be 1200 RPM when the bus is idling. This is 15 % of the maximum engine speed of 8000 RPM.

Discuss how the error indicated in **Fig. 3.3** might affect Emma's conclusions about bus route **3** when the data is presented in a graph.

You may use a calculation to support your answer.

....

....

....

....

.... **[2]**

Candidates seemed to struggle with bringing forward the reading from Fig. 3.3 to answer this question, many candidates seemed to ignore that part of the question and toyed with comparing 15% of 1200 RPM and 15% of 8000 RPM. Many candidates attempted to do some form of calculation, but this seemed to be at the expense of answering the question. A minority of candidates identified that the reading on the rev counter would be higher than it should be, but only a handful then used that knowledge to develop the idea that, within the context of the question, this would mean that the amount of time recorded spent idling would be incorrect.

Question 3 (d)

(d) Emma needs to determine which elements of her data collecting were repeatable and which were reproducible.

Complete **Table 3.1** by placing **one** tick (✓) in each row.

	Repeatable	**Reproducible**
Same observer		
Different routes		
Same measuring instrument		
Same measurement procedure		
Different buses		

Table 3.1

[5]

Nearly all candidates scored full marks on this question. Clearly candidates now have a secure understanding of the components of/differences between repeatability and reproducibility. The most common error was to transpose the components of repeatability and reproducibility.

Question 4 (a) (i)

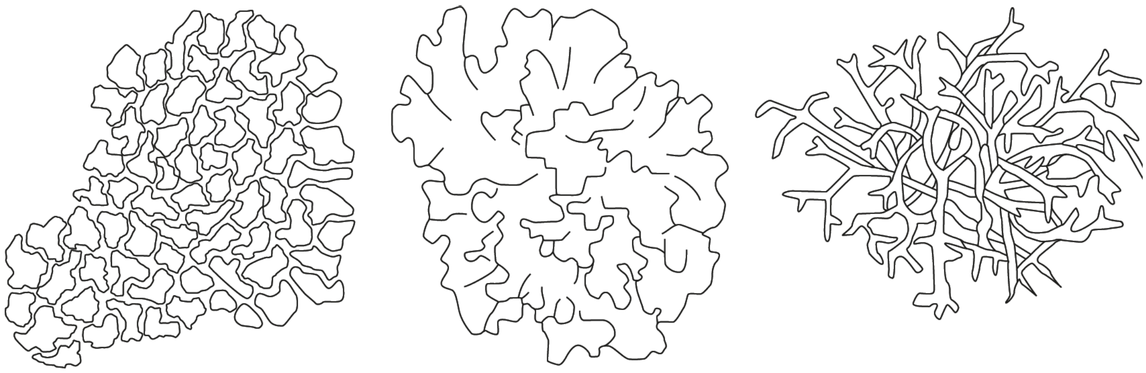
4 Kareem is examining the distribution of lichens in an ecosystem.

- Lichens can often look like plants, growing on bricks, rocks and tree trunks.
- However, they are a complex association between an algae and a fungus.
- The main body of the lichen is called the thallus.
- Lichens are especially sensitive to air polluted with sulfur dioxide (SO_2).
- They die if SO_2 levels in air are too high.

Kareem wants to find out if reductions in SO_2 levels in air have led to a recovery in lichen populations.

There are three main kinds of lichen, characterised by their general habit of growth as shown in the drawings in **Fig. 4.1**.

Lichens are also characterised by the way they are attached to the object on which they grow.



A **B** **C**

Fig. 4.1

(a) Identify lichens **A**, **B** and **C** from the following descriptions:

(i) Fruticose: thallus (body) is either erect and bushy or pendent (hanging down) and tassel-like.

Lichen .... **[1]**

Question 4 (a) (ii)

(ii) Foliose: thallus creeps horizontally and is like a leaf or scale, or more usually a system of numerous leaves and scales.

Lichen .... **[1]**

Question 4 (a) (iii)

(iii) Crustose: thallus is like a crust and lacks distinct lobes but is divided up into tiny, irregular-shaped areas.

Lichen .... **[1]**

Nearly all candidates were able to correctly match the appearance of the thallus for each of the lichens in Fig. 4.1 with the correct description in Questions 4(a)(i), (ii) and (iii).

Question 4 (b) (i)

(b) Kareem takes a photograph of a grey reindeer lichen as shown in **Fig. 4.2**.

Fig. 4.2

(i) State the type of data shown in **Figs 4.1** and **4.2**.

Fig. 4.1 ....

Fig. 4.2 ....
[1]

A number of candidates misinterpreted this question and offered "drawing" and "photograph" as their answers, but the overwhelming majority correctly understood that Fig 4.1 as a drawing is secondary data and Fig 4.2 as a photograph is primary data.

Question 4 (b) (ii)

(ii) Give **three** pieces of evidence in **Fig. 4.2** which show that Kareem's photograph is fit for purpose.

1 ....

....

2 ....

....

3 ....

....

[3]

The question proved to be challenging for candidates, many finding it difficult to make suggestions for the three pieces of evidence required. Many answers were framed around a vague idea of "clarity", but this was not unpicked sufficiently to identify resolution, focus, contrast, composition, or illumination as factors which made Fig. 4.2 fit for purpose. Common suggestions were that the photograph closely resembled the specimen, the photograph was large, or that the photograph was black-and-white.

Assessment for learning

Centres should make sure for learning outcome 7 that, for each of the methods of recording data specified in the teaching content, candidates have a sound understanding of the advantages and disadvantages of different types of data records and the factors that can influence the fitness-for-purpose of different types of records.

Question 4 (c) (i)

(c) Kareem investigates the possibility of designing a dichotomous key to identify lichen species.

He starts by reading the descriptions of three lichen species.

> **Species 1** … is common on hard siliceous rocks in upland areas. It has rather a thick, yellowish grey, warted and cracked thallus.The chemical reaction test with potassium hydroxide solution is positive with a yellow result.
>
> **Species 2** … is an eastern and lowland species. It grows on the bark of old trees. The thallus does not creep close to the substratum but has an ascending sometimes arching habit. When dried it varies in colour from whitish to brownish grey; when wet it is greenish. Increasingly rare due to atmospheric pollution.
>
> **Species 3** … grows in a variety of habitats from moorlands to logs and tree bases in damp woods. The chemical reaction tests with potassium hydroxide and para-phenylenediamine (PD) are negative but in one subspecies the potassium hydroxide test is positive with a yellow result and the PD test is also positive with an orange result.

(i) Use these descriptions to identify the features that Kareem could use to design his key.

Complete the table.

The first feature has been done for you.

Number	Feature
1	The type of substratum it grows on (such as rocks, trees or logs).
2	
3	
4	
5	
6	
7	

[6]

Higher performing candidates performed well on this question, but nearly all candidates were able to identify at least two or three features that could be used in the design of the dichotomous key; reaction to chemical tests was invariably identified. Marks were frequently lost because candidates were insufficiently specific in their suggestions, such as referring to "where it grows" without reference to altitude/habitat/geographical location, referring to "colour" without differentiating between colour when wet or dry, or "appearance of thallus" without specifying shape.

Question 4 (c) (ii)

(ii) Explain **one** advantage and **one** disadvantage of using species 2 as an indicator species.

Advantage ....

....

Disadvantage ....

....

[2]

This question was challenging to candidates; many candidates were unable to suggest both an advantage and a disadvantage. Many candidates suggested that the advantage of using species 2 was because it "stood-out" or was easily identifiable. Very few candidates appeared to understand that it is the sensitivity to a particular environmental factor that provides the advantage to an organism in terms of its use as an indicator species. Most candidates suggested that the disadvantage of using species 2 was because of its rarity but did not explain why this might be a disadvantage. The alternatives of unsuitable geographical location or lack of trees to support growth was very rarely seen.

Question 5 (a) (i)

5 Sara is a food scientist working in a nutrition laboratory.

She is researching the impact of recent legislation to reduce the amount of sugar in processed food.

Sara studies the chart shown in **Fig. 5.1** to understand how glucose in the blood varies in normal, pre-diabetic and diabetic patients after they have eaten a meal.

'Normal' means blood glucose levels are within normal range.

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Fig. 5.1

(a) Thirty minutes after the meal the blood glucose level of the diabetic patient is in the range 210 to 270 mg 100 cm^{-3}

On **Fig. 5.1**:

(i) Draw the range bar of the blood sugar level for diabetic patients at 30 minutes. **[1]**

A significant number of candidates did not attempt to draw the range bar. Where the range bar was drawn it was correctly placed on the graph.

Question 5 (a) (ii)

(ii) Show how to determine the y-intercept of the diabetic patient graph and record the value.

y-intercept = ………..…………….................... **[2]**

A significant number of candidates did not attempt to extrapolate the diabetic patient graph to determine the blood glucose level at 0 minutes. Where the graph was extrapolated this was frequently done without the aid of a ruler, leading to some very inaccurate determinations of the y-intercept.

Question 5 (b)

(b) Describe **four** trends shown in **Fig. 5.1**.

1 ....

....

2 ....

....

3 ....

....

4 ....

.... **[4]**

A common error made was to simply quote data to describe the shape of each graph, without drawing conclusions from the graphs of comparing the graphs to identify trends and patterns in the data. In general, those candidates who were able to identify trends and patterns in the three graphs performed very well.

Question 5 (c) (i)

(c) Sara studies a Public Health England report on a sugar reduction programme which aimed to reduce the average sugar content of food products and individual food categories by 20 % by the year 2020.

The chart in **Fig. 5.2** shows the change in sugar content over the period from 2015 to 2018 by category of food.

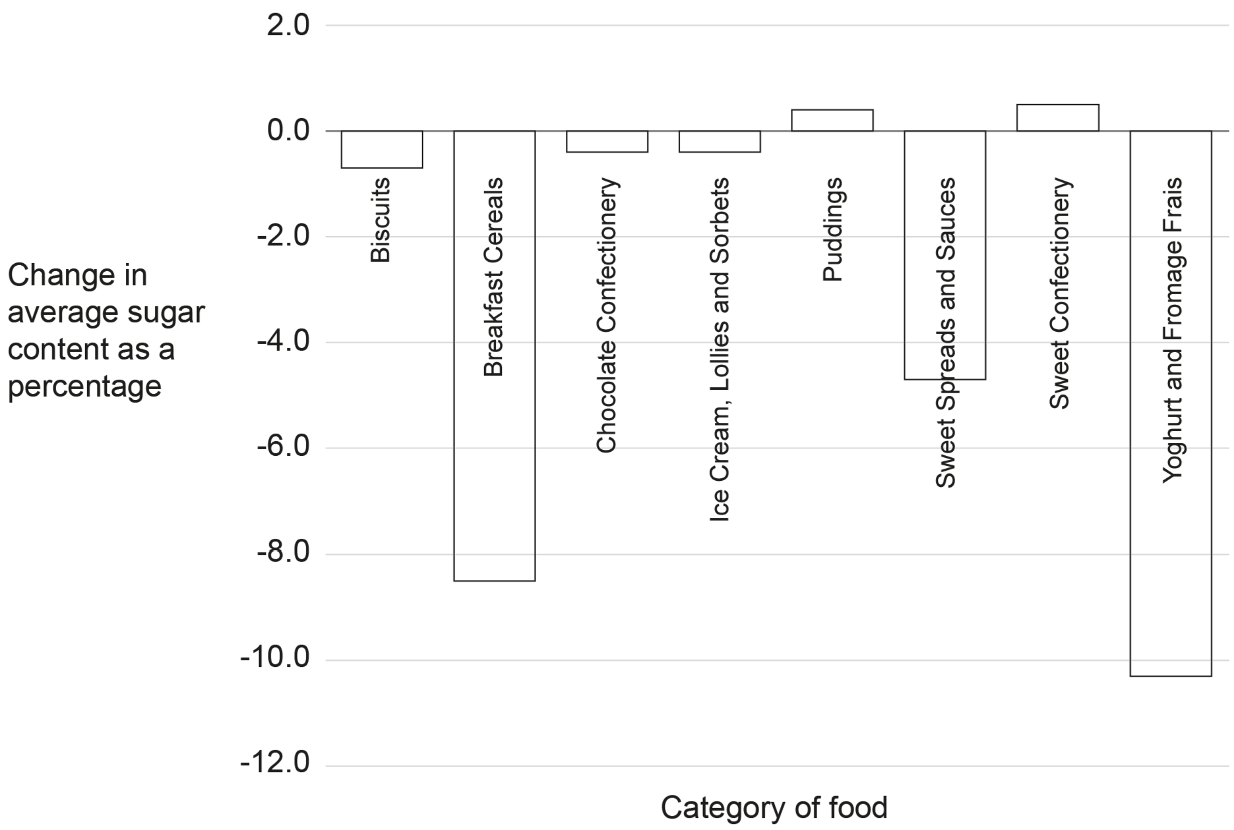

Fig. 5.2

(i) State and explain the type of data presentation in **Fig. 5.2**.

....

....

.... **[2]**

In general candidates correctly identified that a bar chart was being used to present discontinuous data, but a disappointing number of candidates were unable to distinguish between a bar chart and a histogram (see also Question 3(a)). Some candidates made the same suggestion for the different graphs in both Questions 3(a) and 5(c)(i).

Question 5 (c) (ii)

(ii) **Fig. 5.2** shows that the recipes used to make many food products have been changed to **reduce** the amount of sugar they contain.

Sara reads a section of the sugar reduction programme report which summarises the main findings.

One paragraph in the report states:

'Overall, the total tonnes of sugar sold in food included in the programme has increased by 2.6 % between 2015 and 2018.'

Which of the following conclusions might explain this conflicting evidence?

Tick (✓) **two** boxes.

- biscuit sales have fallen ☐
- people are eating less suger ☐
- puddings contain large amounts of sugar ☐
- some products are more easily reformulated to contain less sugar ☐
- some product ranges are not included in the report ☐
- yoghurt is sold as a health food ☐

[2]

This question generated a variety of responses. A significant number of candidates identified the correct two conclusions, with the majority of candidates identifying that some product ranges not being included in the report was a valid conclusion. People eating less sugar or products being reformulated to contain less sugar were the most common incorrect responses. Very few candidates selected either falling biscuit sales or yoghurt being sold as a health food as valid conclusions.

Question 6 (a) (i)

6 A sequence of seven steps is often required to make permanent microscope slides.

Fig. 6.1 shows the first four steps in order.

(a) (i) Draw straight lines to link each step to its correct function.

Step	Function
1. Killing	Removes all traces of water to allow further processing
2. Fixing and hardening	Colours parts of the specimen for clear differentiation of structures
3. Staining	Makes the tissue ready for subsequent processing and able to take up stains
4. Dehydration	Instantaneous stoppage of processes to stop post-mortem changes

Fig. 6.1

[3]

This question was answered very well by nearly all candidates, who correctly matched each step with its function. The most common error was to transpose the functions of killing and fixing and hardening.

Question 6 (a) (ii)

(ii) Describe **one other** step involved in the preparation of permanent microscope slides.

.... **[1]**

Candidates were much less secure in their knowledge when asked to suggest one of the three steps not included in Fig. 6.1 (obtaining the specimen/tissue was also allowed). The most common correct suggestion was a reference to adding the cover slip. The other stages were rarely seen, if at all.

Question 6 (b)

(b) The process of staining can be used in many different ways.

Complete the sentences using the correct words or phrases from this list:

fluorescence **emittance** **viability** **transparency** **dead**
living **fully repaired** **colour** **frozen**

1. Some stains can absorb light of one wavelength and then emit light of a longer wavelength. The stained cells and tissues are seen to be much brighter and appear to glow. This is feature is known as ……………………..................... .
2. Stains that are actively transported out of cells can be used to show cell ……………………..................... .
3. Fixed cells are ……………………………… .

[3]

Very few candidates scored full marks on this question, with nearly all candidates completing at least one sentence incorrectly, although the majority of candidates gained 2 marks. No one statement seemed to cause candidates more trouble than the others, and a variety incorrect selections was made for each statement.

Question 6 (c)

(c) List **three** disadvantages of preparing permanent microscope slides.

1 ....

2 ....

3 ....

[3]

Candidates tended to offer one or more of time-consuming, expensive, or difficult (which was accepted as the reason for requiring specialist/highly-trained technicians), but a significant number of candidates were unable to provide three suggestions. The need for differential stains was rarely suggested, whilst those candidates that suggested only dead specimens could be observed did not link this to the inability to see living processes.

Question 6 (d) (i)

(d) (i) Stains can also be used in culture media to identify colonies of bacteria.

Put a tick (✓) in the box next to the correct term for this kind of media.

Selective media	
Nutrient agar	
Differential media	
Minimal media	

[1]

The majority of candidates correctly selected differential media, but a significant number selected selective media. Very few candidates selected either nutrient agar or minimal media.

Question 6 (d) (ii)

(ii) Another technique used to identify bacteria and other microorganisms is colony morphology.

Fig. 6.2 shows an agar plate which has been used to culture bacteria collected from the surface of human skin.

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Fig. 6.2

State how many different types of microorganism are growing on the plate in **Fig. 6.2**.

.... **[1]**

Question 6 (e) (i)

(e) Some images of common colony morphologies are shown below.

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(i) Fungi often form colonies that are filamentous with a filiform margin.

State how many different kinds of fungi are seen on the plate in **Fig. 6.2**.

.... **[1]**

Question 6 (e) (ii)

(ii) Suggest why it is not possible to identify the elevations of the different colonies of fungi seen in **Fig. 6.2**.

.... **[1]**

Question 6 (e) (iii)

(iii) Suggest why it is not possible to identify the margin morphology of the bacterial colonies seen in **Fig. 6.2**.

.... **[1]**

Answers to Question 6(d)(ii), e(i), e(ii), and e(iii) clearly differentiated between those candidates who had carried out techniques for identification of microorganisms and had observed colonies growing on nutrient media and those candidates who were trying to visualise 3-D colonies from Fig. 6.2 without previous practical experience.

Assessment for learning

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

Centres should ensure that the correct equipment and processes are followed when conducting investigations, and that candidates understand why particular items of equipment are used and why certain processes are followed.

Question 7 (a)

7 Scientists often use photographs to record data and monitor changes on the surface of the earth over time.

Some photographs are taken from satellites.

Fig. 7.1 is a satellite photograph taken of the Larsen ice shelf in Antarctica.

Fig. 7.2 is a photograph taken of the same area several months later.

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Fig. 7.1

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Fig. 7.2

(a) Use the scale bar in **Fig. 7.2** to estimate the area of the iceberg that has broken off the ice shelf.

Area = ……………………………………..km^2 **[1]**

A small number of candidates were able to correctly calculate the area of the iceberg that had broken off the ice shelf. In nearly all cases the response to Question 7(e) was correct, so it evident that candidates were incorrectly measuring the size of the iceberg.

Question 7 (b)

(b) Suggest **two** other pieces of information (in addition to the area of the iceberg) that should be collected with the satellite photographs to confirm what has happened.

1 ....

2 ....

[2]

Many responses stated "temperature," but without realising that this would need to be at ground level and would not be able to be captured by the satellite.

Question 7 (c)

(c) Suggest **two** advantages that photographs taken from satellites have compared to photographs taken from the Earth.

1 ....

2 ....

[2]

The idea of satellites having a large field of view was not apparent to candidates, who frequently suggested that satellite images had greater clarity/resolution/detail for both points. A number of candidates did, however, identify that satellites can be used to photograph areas where it would be dangerous to send photographers, frequently citing volcanoes as an example; this was the most common expression of MP2.

Question 7 (d)

(d) Suggest **two** limitations of using satellites to obtain photographic data.

1 ....

2 ....

[2]

Many candidates had difficulty providing two limitations. "Cost" was the most commonly offered option, one or two candidates referred to the possibility of cloud cover or "atmospheric effects" interfering with photography, or that a satellites fixed-orbit might be limiting or that it might be on the wrong side of the earth. Both explanations were considered acceptable for MP1.

Question 7 (e)

(e) Describe **two** changes, apart from breaking off the ice shelf, that have happened to the iceberg between taking **Figs 7.1** and **7.2**.

1 ....

2 ....

[2]

Nearly all candidates stated two changes and correctly identified that the iceberg had moved away from the Larsen ice shelf and got smaller; a small number of candidates incorrectly referred to the iceberg changing shape, but also stated a correct point. Some candidates made correct observations but referred incorrectly to the ice shelf [sic] in their answers, thereby negating the relevant mark point(s).

Question 7 (f)

(f) Data taken from several different sources, including satellite photographs, can be linked together and modelled using GIS.

Put a tick (✓) in the box next to the correct meaning of GIS.

Graphical Information Survey	☐
Geological Implementation Security	☐
General Instrumentation System	☐
Geographical Information System	☐

[1]

Although the acronym GIS has a number of different meanings, nearly all candidates identified Geographical Information System as being correct within the context of the question.

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