CAMBRIDGE TECHNICALS

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CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 3 January 2023 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 of two hours duration.

This unit assesses:

- the ability 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 6 mark level of response question. Questions 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.

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 line graphs and kite diagrams • were able to calculate the gradient of a line graph showing the method used • showed working when carrying out calculations and were confident in the use of standard form, significant figures, and units • were able to use knowledge gained from having carried out or observed practical activities to answer Question 4 • answered questions precisely within the context given, demonstrating depth of knowledge • were confident in the use, analysis, and evaluation of data presented in unfamiliar contexts.	• did not understand the conventions to be followed when constructing line graphs and kite diagrams • were unable to calculate the gradient of a line graph and did not show the method used • did not show working when carrying out calculations and had difficulties with the use of standard form, significant figures, and units • were not able to draw on knowledge gained from having carried out or observed practical activities to answer Question 4 • provided vague responses to questions, that were not framed within the context given and did not demonstrate depth of knowledge • experienced difficulties in processing information and data presented in unfamiliar contexts.

Question 1 (a) (i)

1 The top ten windiest areas of the UK are listed in the table.

The data show the annual average wind speed (in knots) recorded between 1981 and 2010.

Location	**Annual average wind speed (knots)**
Shetland	14.6
Orkney	14.3
Western Isles	12.6
Argyll and Bute	12.1
Gwynedd	11.3
Tweeddale	11.0
Ross and Cromarty	10.9
Banffshire	10.9
Sutherland	10.8
Isle of Wight	10.7

(a) Use the data in the table to:

(i) determine the mode, median and range of the annual average wind speed values.

mode = ...

median = ...

range = ...

[3]

Candidates did well on this question, and were confident in determining the mode, median, and range of the given values.

Question 1 (a) (ii)

(ii) calculate the mean of these annual average wind speeds.

Mean = ... **[1]**

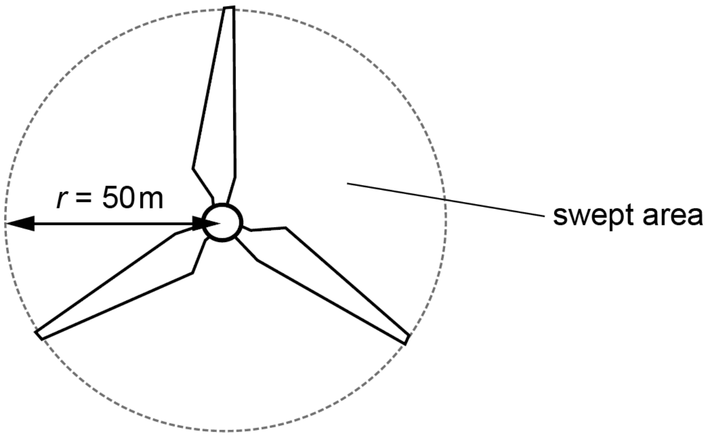
Candidates did well on this question, and were able to correctly calculate the mean average of the given values.

Question 1 (b) (i)

(b) Wind turbines work by converting kinetic energy in the wind to electrical energy in the national grid.

The blades of a vertical wind turbine are shown below. Each blade is 50 m long.

The area covered by one rotation of the turbine blades is called the swept area.



(i) Calculate the swept area A of the turbine.

Use the equation

$A = \pi r^2$

A = ... m^2 **[2]**

Candidates did well on this question, and were able to correctly calculate the swept area A.

Question 1 (b) (ii)

(ii) The mass of air moving through the turbine each second *M* is calculated using the equation:

$M = \rho A v$

where ρ, the density of the air = $1.23\,\text{kg}\,\text{m}^{-3}$ and *A* is the swept area calculated in **(b)(i)**.

Calculate *M* when the wind speed $v = 7.0\,\text{m}\,\text{s}^{-1}$.

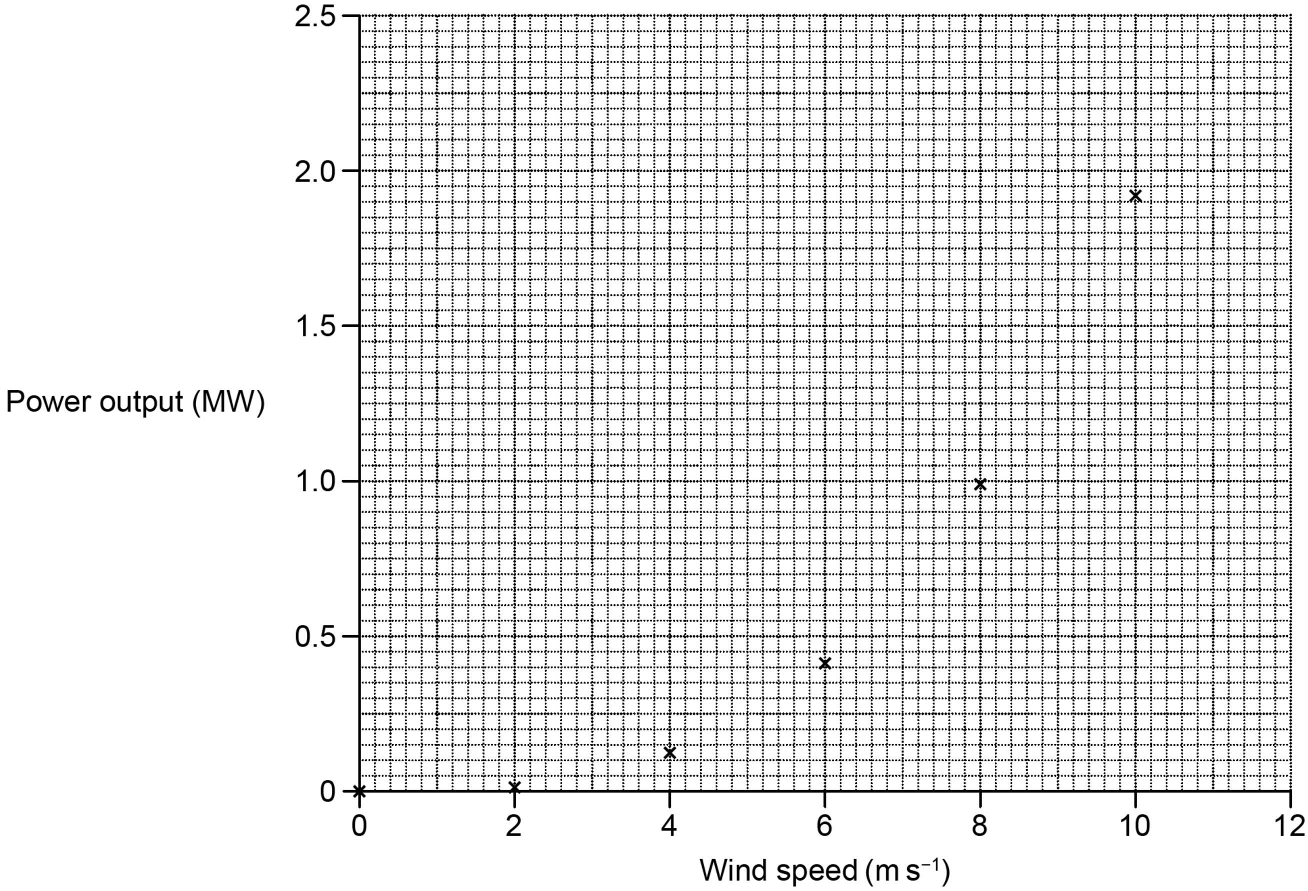
Give your answer to **2** significant figures and state the units.

M = ... units.. **[4]**

Nearly all candidates were able to substitute the given values into the equation provided to correctly calculate M. However, not all candidates then gave the calculated value to two significant figures, as requested, or incorrectly rounded down to 67 000 when converting. A wide range of units was offered, only a small number of candidates correctly stating kg s^{-1}

Question 1 (c) (i)

(c) The graph below shows the relationship between the wind speed and the power output of a wind turbine.



(i) On the graph draw the curved line of best fit. **[1]**

Nearly all candidates attempted to draw a smooth curve through all the points; however many curves were 'feathered' or composed of disconnected lines, or missed one or points by more than the +/- one small square that is allowed.

Question 1 (c) (ii)

(ii) On the graph, show how you determine the power output of the wind turbine when the wind speed is 8.4 m s^{-1}.

Record this power output in **Watts** using standard form.

Power output = ... W **[2]**

Nearly all candidates understood to draw a vertical line from the x-axis at 8.4 intersecting with the drawn line-of-best-fit and then a horizontal line drawn across to intersect the y-axis, scoring MP1. However, incorrect reading of the scales on either or both of the axes cost a number of candidates MP2; in many cases where the intercept on the y-axis had been correctly read candidates did not convert the power output from megawatts to Watts as required, or applied an incorrect conversion leading to a power-of-ten error in the stated value.

Question 1 (c) (iii)

(iii) Describe the trend in the graph.

....

....

.... **[2]**

Nearly all candidates identified the positive correlation between power output and wind speed shown in the graph but a handful of candidates did not score MP1 because they did not identify both of the variables concerned. Only a handful of candidates identified that power output increases non-linearly as wind speed increases.

Assessment for learning

Where candidates are asked to describe or identify a trend or relationship between two variables they must always identify the variables concerned.

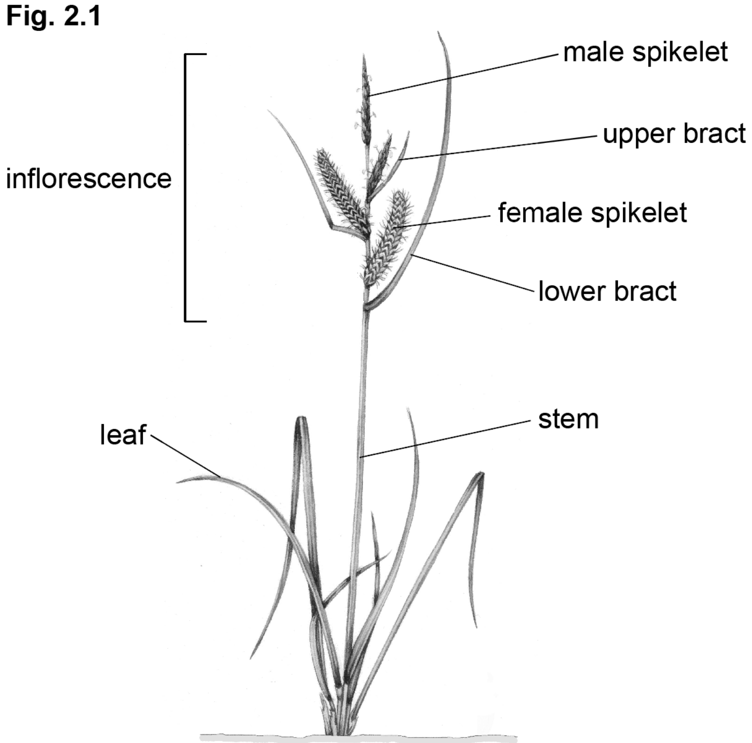
Question 2 (a)

2 *Carex* is a genus of more than 2000 species of grass-like plants in the family *Cyperaceae*.

These plants are commonly known as sedges.

Fig. 2.1 is a diagram adapted from a botany textbook showing the structure of a typical sedge plant.

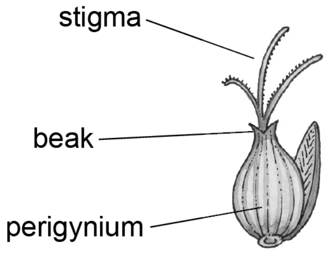
Fig. 2.1



Sedges have the following features:

- The flowering structure in *Carex* is called the inflorescence.
- The inflorescence consists of male and female spikelets.
- Male and female spikelets can be found on the same stem or on different stems.
- Each female floret develops into a structure called a perigynium (plural, perigynia) as shown in **Fig. 2.2**.

Fig. 2.2



The variations in size, shape and colour of the leaf, bract and perigynia are used to identify different species of *Carex*.

(a) Explain why **Figs 2.1** and **2.2** are examples of secondary evidence.

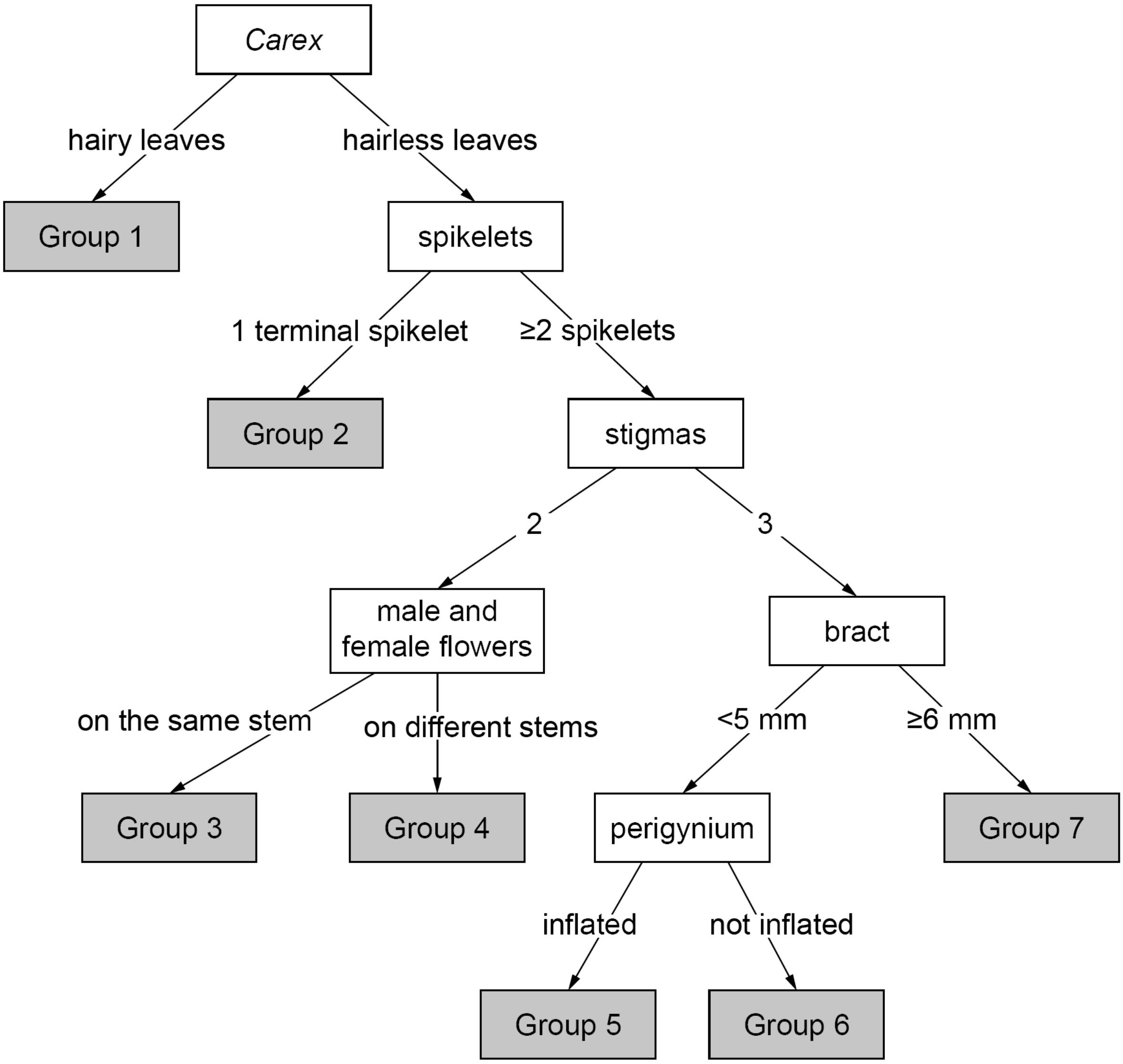
.... **[1]**

Almost all candidates gained the mark. The overwhelming majority of candidates did so through referring to the source of the diagrams Figs 2.1 and 2.2 as being from a text book, while a small number of candidates referred to the diagrams having been produced by another person. The idea that a diagram is a representation of an actual plant was not seen.

Question 2 (b) (i)

(b) **Fig. 2.3** shows features of *Carex* used to place species native to California into seven different groups.

Fig. 2.3



(i) What type of key is shown in **Fig. 2.3**?

.... **[1]**

Nearly all candidates correctly identified Fig 2.3 as being a dichotomous key, although a number of attempts to spell dichotomous were seen – those candidates who did gain the mark had generally attempted a spelling of dichotomous, but produced something which was not phonetically similar.

Question 2 (b) (ii)

(ii) Describe how the diagram shown in **Fig. 2.3** is used to identify which group a particular sedge plant belongs to.

....

.... **[2]**

This question proved problematical for almost all candidates, very few gaining either mark. The basis of dichotomous keys being a choice between two features seems not to be understood by candidates, who also overlooked that there are a repeated number of stages at which a choice is made before an organism is identified.

Question 2 (b) (iii)

(iii) Give **three** reasons why using the diagram in **Fig. 2.3** is **not** totally reliable.

1 ....

....

2 ....

....

3 ....

....
[3]

Few comprehensive responses to this question were seen, with very few candidates scoring maximum marks. The majority of candidates gained 1 or 2 marks for the idea that it might be difficult to match descriptions to observations and/or the idea that features may very between individuals for one reason or another, and handful of candidates gained a mark for the idea that the key does not cover all varieties. No candidate referred to the difficulty in understanding specialist terms when using the key, even though a number of candidates themselves exhibited difficulty in understanding the specialist terms used.

Question 2 (c) (i)

(c) (i) Suggest why the *Carex* shown in **Figs 2.1** and **2.2** could be in either Group 5, Group 6 or Group 7 of **Fig. 2.3** and explain why you cannot be certain which group it belongs to.

....

....

....

....

.... **[3]**

The majority of candidates answered this question well, generally identifying that it was impossible to know whether the perigynium in Fig 2.2 was inflated or not and that it was impossible to determine the size of the bract in Fig 2.1 from the diagram. Reference to the presence of three stigmas was usually only made by those candidates who scored maximum marks.

Question 2 (c) (ii)

(ii) Use **Fig. 2.3** to identify **two** features that the plant in **Figs 2.1** and **2.2** has in common with the *Carex* species in Group 3.

1 ....

2 ....

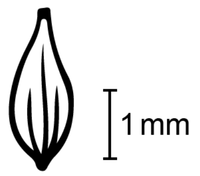
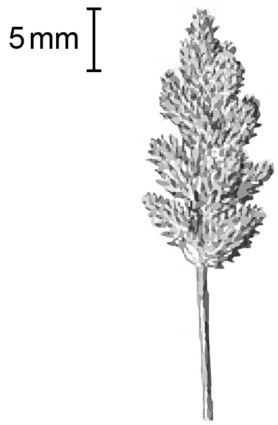
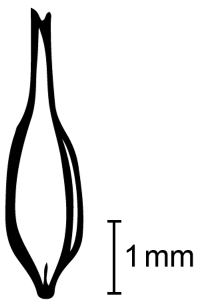
[2]

A significant number of candidates offered 'male and female spikelets' without qualification, while other candidates referred to spikelets as flowers in their responses. Nevertheless, most candidates managed to score at least 1 mark for identifying hairless leaves as a common feature.

Question 2 (d)

(d) The perigynium (female floret) and inflorescences of two of the Group 3 *Carex* species that are native to California are shown in **Fig. 2.4**.

Fig. 2.4

	Surface view of perigynium	**Inflorescence (flowering structure)**
Carex arcta		
Carex bolanderi		

Use **Fig. 2.4** to identify **three** structural differences to distinguish between *Carex arcta* and *Carex bolanderi*.

1 ....

....

2 ....

....

3 ....

....

[2]

Most candidates managed to gain 1 mark for offering two correct structural differences but few candidates gained maximum marks. The most commonly offered differences were perigynium length and inflorescence length. References to inflorescence appearance were also fairly common, but here many candidates were unable to convey the description of a branched/open versus compact/dense appearance. A number of candidates did not use the correct terminology in their responses, referring to 'flowers' rather than inflorescences or flowering structures. Very few candidates made reference to the difference in the surface views of the perigynia.

Question 2 (e)

(e) Many species of *Carex* are indicator species.

Suggest **one** reason why.

.... **[1]**

Most candidates gained the mark for this question, the overwhelming majority doing so by referring to the use of the plant to indicate the presence of pollutants or other environmental factors – very few candidates extended their responses to incorporate the idea that it is a change in population of the species that allows them to be used for this purpose. Some candidates, who were clearly thinking along the correct lines, referred just too vaguely to indicator species 'growing in particular areas'. Other candidates were obviously confused by the word 'indicator' and wrote about the ability to use them to determine pH, but without an environmental context. A common incorrect response was to suggest indicator species are used in classification keys; clearly those candidates had little understanding of how dichotomous keys are constructed.

Question 3 (a) (i)

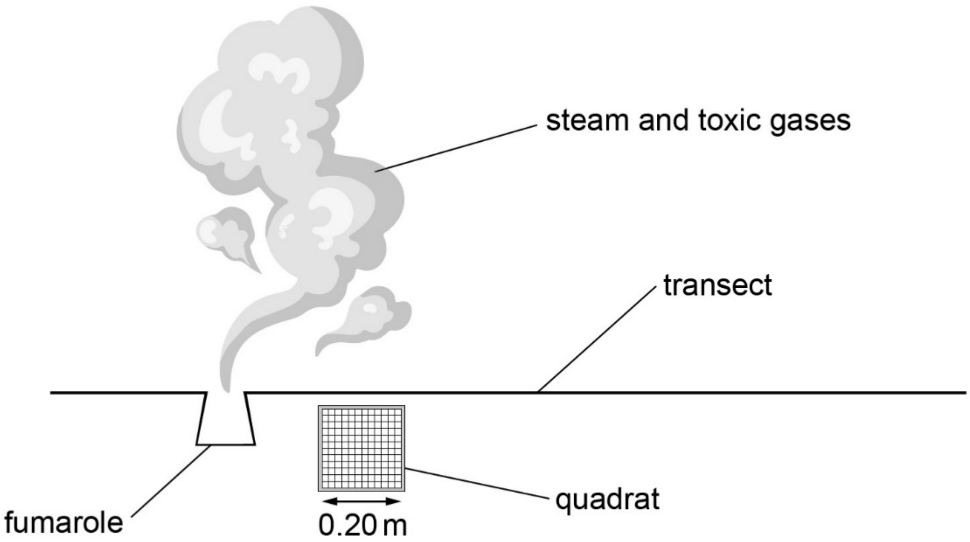
3 A fumarole is an opening in the Earth's surface that emits steam and toxic gases, such as sulfur dioxide and hydrogen sulfide. Fumaroles can occur as holes, cracks or fissures near active volcanoes.

Azmi is investigating the distribution of different species of lichen plants growing on the rocks around a fumarole.

Lichen species may look like plants but they are a combination of a fungus and an alga. They are sensitive to very high temperatures and toxicity.

Azmi measures the percentage (%) area covered by three species of lichen (**X**, **Y** and **Z**) in quadrats along a transect.

A diagram of Azmi's method is shown below.



Her results are shown in the table.

Item removed due to third party copyright restrictions

(a) **(i)** Many species of lichen do **not** grow where the air is very toxic or the temperature is high.

Use the data in the table to suggest a location along the transect where it may be too hot or too toxic for lichen to grow.

.... **[1]**

Nearly all candidates correctly identified 40 m as being the location along the transect where conditions were unfavourable for lichen growth, and stated the unit – just a handful of candidates correctly identified the distance but omitted to state the unit. There was no more commonly offered incorrect location along the transect, suggesting that candidates who stated an incorrect location may simply have been guessing.

Question 3 (a) (ii)

(ii) In addition to measuring the % covered by each of the three lichen species, suggest **two** further readings that Azmi must take to find out if the answer in **(a)(i)** is correct.

Reading 1 ....

Reading 2 ....
[2]

This question proved challenging to many candidates, who did not seem to understand the question – candidates referred to repeating measurements, repeating the investigation at other locations, using secondary sources to confirm findings. Those candidates who did understand the question invariably gained both marks for identifying air quality and temperature as the required measurements.

Question 3 (a) (iii)

(iii) Suggest **two** ways in which Azmi can ensure that the measurements described in **(a)(ii)** are repeatable.

....

.... **[2]**

In general, candidates either gained both mark points or neither. A significant number of candidates clearly did not understand the concept of repeatability and suggested getting other investigators to repeat the investigation, using a different method, using different equipment, repeating the investigation at a different fumarole or at more distances from the fumarole. Those candidates who did have an understanding of the concept of repeatability were usually able to correctly identify use of both the same method and equipment as being the required factors.

OCR support

Links to resources on the correct use of scientific terminology can be found in the OCR publication *A guide to resources* which has been produced to support the teaching of Level 3 Cambridge Technicals in Applied Science.

Question 3 (b)

(b) On the grid, draw a kite diagram of the percentage (%) cover of species **X** against distance from the fumarole.

[4]

Responses to this question were either very good, with symmetrical kite diagrams correctly plotted on labelled axes with suitable scales, or low scoring, with incoherent plotting on incorrect unlabelled axes demonstrating a both lack of understanding of how kite diagrams are constructed and what they represent. However, the representation of many kite diagrams seemed to lack attention to detail, with freehand drawing/sketching and/or use of blunt pencils.

Question 3 (c) (i)

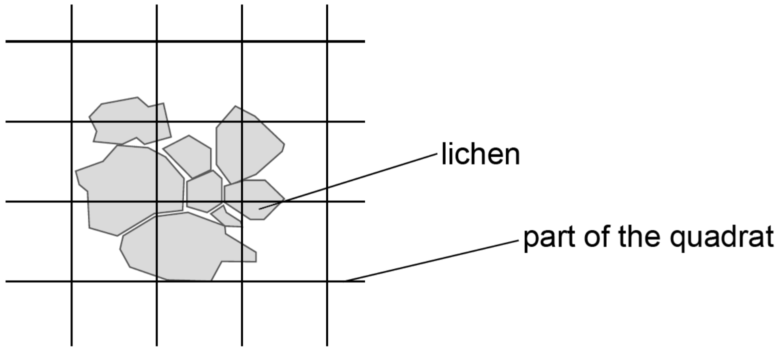
(c) Azmi uses a quadrat to estimate the % area of rock covered by the lichen species.

The quadrat is a square with 0.2 m sides.

The quadrat is divided into 400 smaller squares.

Each small square of the quadrat has an area of $1.0\,cm^2$.

The figure below shows **one** of Azmi's observations in part of the quadrat.



(i) Azmi determines a value for the shaded area, *A*, covered by the lichen in the figure.

Explain why there is uncertainty in the measurement of *A*.

....

.... **[2]**

The majority of candidates gained maximum marks for reference to two out of irregular shapes, gaps between shapes, partly-filled squares – all possible combinations were equally common. Only a few candidates identified that the area covered by the lichen can only be an estimation.

Question 3 (c) (ii)

(ii) Determine a possible value for *A* and a reasonable value for the uncertainty in *A*.

A = ... cm^2

Uncertainty = ...

[2]

The overwhelming majority of candidates gained the mark for correctly determining the value of A, and of those the majority also correctly determined the uncertainty of A.

Question 3 (c) (iii)

(iii) Some species of lichen look very similar.

Identifying a species **incorrectly** is a source of error.

Identify this type of error.

Draw a ring around the correct type.

instrument **measurement** **systematic**

[1]

The majority of candidates correctly identified the error as systematic, a significant number selected measurement, and just a small number selected instrument – candidates seem to remain unsure about categorising types of error.

Question 4

4 Sara is a chemist working for an Environment Agency. One of her jobs is to use spectrophotometry to determine the concentration of iron(II) ions in waste water.

Sara uses a spectrophotometer which is designed to determine concentrations of iron(II) ions between 0 and 4 mg dm^{-3}.

She first needs to calibrate the instrument using a stock solution containing 100 mg dm^{-3} of iron(II) ions.

Explain how she would use the stock solution to produce a calibration curve, and describe the measurements needed to determine the concentration of iron(II) ions in waste water samples.

....

....

....

....

....

.... **[6]**

This question proved challenging to virtually all candidates. A significant number of candidates were unable to provide a general outline method (without addition of indicator solution) for determining the concentration of a substance by spectrophotometry. Only a small number of candidates attempted to answer the question in the context of determining the concentration of iron (II) ions, by referring to the use of an indicator solution.

Assessment for learning

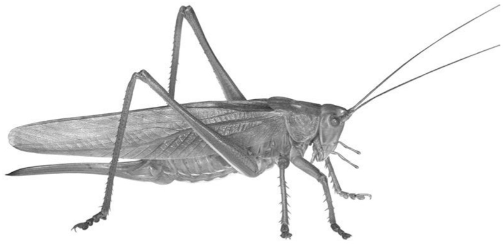
Centres should provide candidates with as many opportunities as possible to gain experience with the practical techniques specified in the unit specifications both for this unit and Unit 2 (Laboratory Techniques). Centres should make sure that candidates understand why particular items of equipment are used and why certain processes are followed.

Question 5 (a)

5 A cricket is an insect that produces sounds, or chirps, by scraping its wings together.

A cricket is shown in **Fig. 5.1**.

Fig. 5.1



Taylor is a student investigating the claim that the number of cricket chirps counted in a period of time can be used to calculate an accurate value of the temperature.

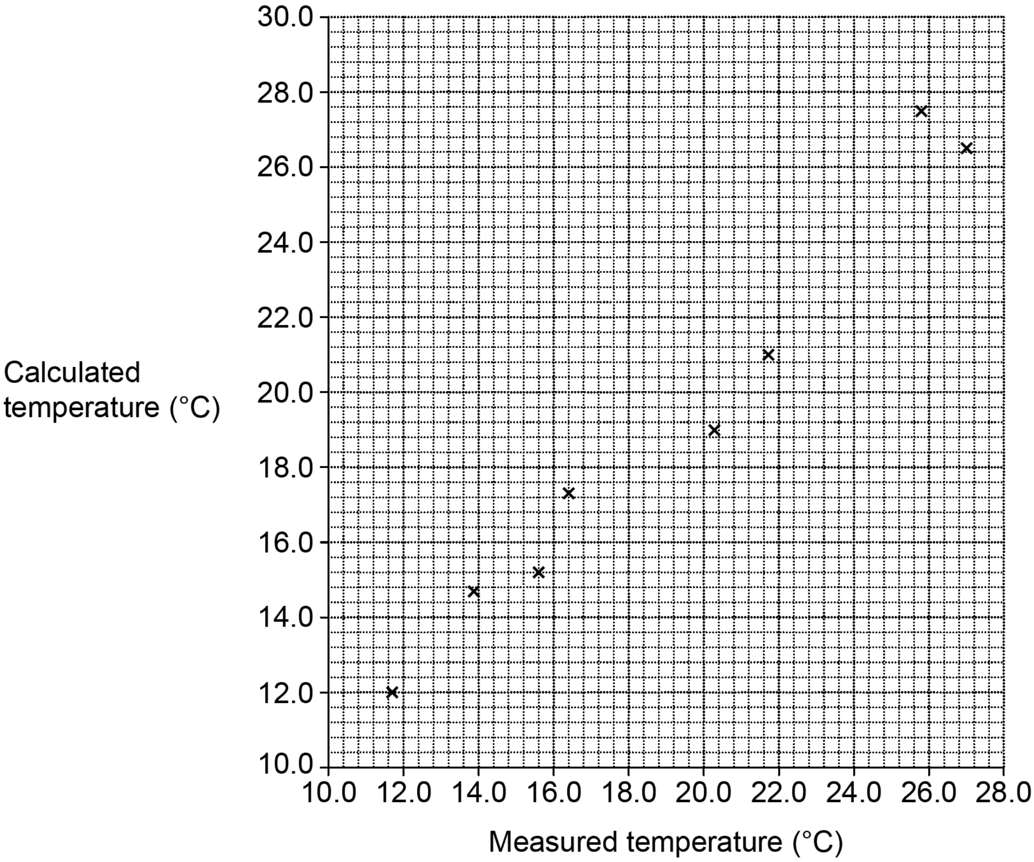
He counts the number of chirps, N, in 15 seconds over a wide range of measured temperatures.

Taylor then calculates the temperature, T_c, in Celsius using the equation:

$$T_c = 9 + \frac{N}{2}$$

Fig. 5.2 is a graph of Taylor's calculated temperatures against his measured temperatures.

Fig. 5.2



(a) What type of graph is shown in **Fig. 5.2**?

Tick (✓) one box.

histogram	☐
line	☐
scatter	☐

[1]

The overwhelming majority of candidates correctly identified the graph as a scatter graph, all but one or two incorrect responses selected 'line', and some of these had been altered from 'scatter', possibly after (b)(iii) had been completed.

Question 5 (b) (i)

(b) In one observation, Taylor counts 37 chirps in 15 s at a measured temperature of 24.8 °C.

(i) Calculate T_c.

T_c = ... °C **[2]**

The majority of candidates gained both marks on this question; no candidate gained 1 mark as correct substitution invariably led to the correct evaluation. A range of incorrect substitutions was seen.

Question 5 (b) (ii)

(ii) On **Fig. 5.2** use a cross (X) to plot your value of T_c calculated in **(b)(i)**. **[1]**

A significant number of candidates were unable to correctly identify the point as (24.8, value from [b][i]); when the point was correctly identified errors in reading the axes and/or lack of care in plotting points (the maximum allowable error being +/- half a small square) cost many candidates the mark.

Question 5 (b) (iii)

(iii) On **Fig. 5.2** draw the line of best fit and circle the point that is an outlier. **[2]**

A significant number of candidates drew lines-of-best fit that did not have an even distribution of points above and below the line drawn. All but a small number of candidates were able to identify the outlier from the line drawn and cross plotted for 5(b)(ii).

OCR support

Links to resources on the correct plotting of graphs and the identification of outliers can be found in OCR's *A guide to resources* which has been produced to support the teaching of Level 3 Cambridge Technicals in Applied Science.

Question 5 (c)

(c) Calculate the gradient *G* of this line of best fit.

Use the equation $G = \dfrac{\text{change in y}}{\text{change in x}}$

Show your working on **Fig. 5.2**.

G = ... **[4]**

This question proved challenging for many candidates; often the only marks gained were for the substitution of dy and dx values and the correct evaluation of G without units – a significant number of candidates substituted incorrect dy and/or dx values but gained MP4 for correctly calculating G and reporting it without units. Only a handful of candidates <u>selected and marked</u> points on the line-of-best fit that were apart by not less than half the length of the drawn line. A small number of candidates stated the coordinates of the marked points.

OCR support

Links to resources on the correct plotting of graphs and the determination of their gradient can be found in the OCR's *A guide to resources* which has been produced to support the teaching of Level 3 Cambridge Technicals in Applied Science.

Question 5 (d)

(d) Discuss whether the information from the graph and your answer to **(c)** supports the claim that the number of cricket chirps counted in a period of time can be used to calculate an accurate value of the temperature.

....

....

....

.... **[2]**

This question generally proved challenging to all but the higher achieving candidates. A significant proportion of candidates did not appreciate that whether or not the gradient of their drawn line-of-best fit was or was not close to one supported or did not support the claim.

Question 5 (e) (i)

(e) Taylor has **not** provided all the information about his investigation.

His data is not reproducible by other scientists without this information.

(i) Explain what reproducible means.

....

.... **[2]**

A significant number of candidates were unable to correctly define reproducibility, many confusing the term with repeatability – but many, nevertheless, gained one mark for the idea that the same/similar results should be obtained.

OCR support

Links to resources on the correct use of scientific terminology can be found in the *OCR's A guide to resources* which has been produced to support the teaching of Level 3 Cambridge Technicals in Applied Science.

Question 5 (e) (ii)

(ii) Suggest **three** pieces of information that Taylor must provide so that other scientists are able to reproduce his data.

1 ....

....

2 ....

....

3 ....

....
[3]

This question proved challenging to nearly all candidates, only a small number of responses worth maximum marks were seen. A significant number of candidates made unqualified references to the location of the investigation. Other commonly-seen incorrect suggestions were: who had conducted the investigation, number of crickets used, and length of time of the investigation.

Question 6 (a)

6 Nina uses an app on her smartphone to measure atmospheric air pressure.

She records the air pressure (p) in hPa for one minute indoors, and for one minute outdoors.

1 hPa (hectopascal) = 100 Pa (pascal)

Her results are shown in **Figs 6.1** and **6.2**.

Fig. 6.1

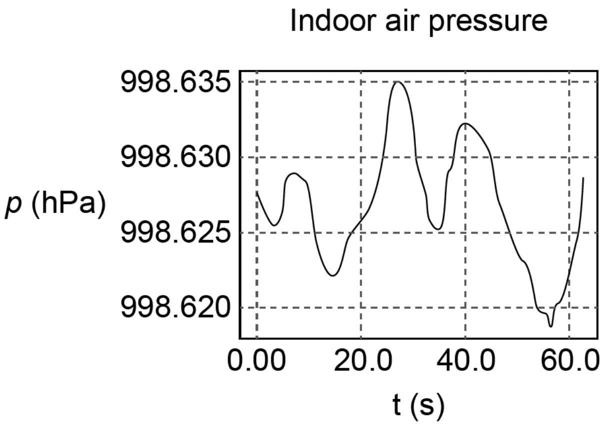
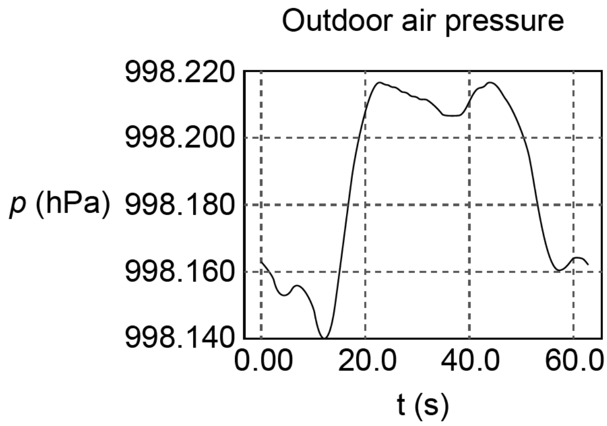


Fig. 6.2



(a) Complete the following sentences by putting a ring around the correct word in each bracket.

The data in **Figs. 6.1** and **6.2** show random error because the measurements vary in **(predictable / unpredictable)** ways and **(can / cannot)** be corrected for.

Whenever a measurement is taken, random error is always **(expected / unexpected)**.

[3]

The majority of candidates correctly selected the first and second options, but often selected the incorrect third option – possibly the selection of unpredictable for the first option cued them into selecting unexpected for the third option. A minority of responses had no discernible pattern to the selection of options.

Question 6 (b)

(b) Use **Fig. 6.1** to explain why the pressure measurements are precise.

....

.... **[2]**

The majority of candidates correctly identified that the measured values were in close agreement, but only a small minority extended their responses to quote data to support their statement.

Question 6 (c) (i)

(c) At the same time as Nina takes her own measurements, she also collects data from the website of a weather station at her local airport.

Location:	Local airport
Latest report:	18 Jan 2021, 14:20
Air pressure:	1016 hPa
Temperature:	6 °C
Conditions:	Mostly cloudy
Humidity:	76%

(i) Nina decides to use the air pressure reading at the weather station as the 'accepted value'.

Calculate the percentage error in Nina's minimum outdoor air pressure measurement when p = 998.140 hPa.

Use the equation:

$$\text{percentage error} = \frac{(\text{accepted value} - \text{measurement value}) \times 100}{\text{accepted value}}$$

Percentage error = ... **[2]**

Candidates achieved well on this question, with most gaining both marks for correct substitution and evaluation.

Question 6 (c) (ii)

(ii) Nina concludes that

"The atmospheric air pressure measured by my smartphone is accurate."

State and explain whether Nina's conclusion is supported by your calculation in **(c)(i)** and suggest **one** piece of further information that would make her conclusion more secure.

Explanation

....

....

Further information

....

.... **[2]**

Nearly all candidates provided a correct explanation, almost without exception stating that the percentage error was small. Only a small number of candidates then went on to suggest a further piece of evidence that would improve the security of the conclusion.

Question 7 (a) (i)

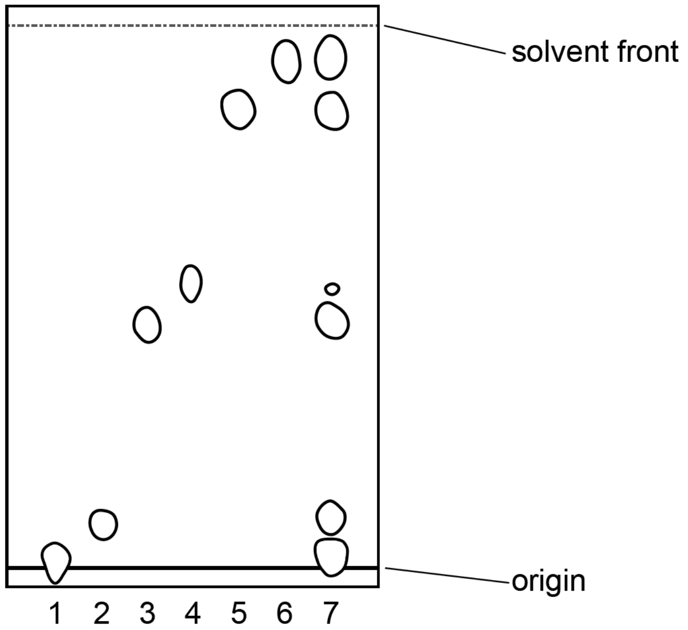
7 Amaya works for a pharmaceutical company which manufactures a range of painkillers. Many painkillers such as morphine and codeine are alkaloids which occur naturally in poppy seeds. Amaya is investigating which species of poppy have seeds that contain codeine so that it can be extracted for use as a painkiller.

(a) Amaya uses thin layer chromatography (TLC) to identify which alkaloids are present in poppy seeds.

She runs 6 known alkaloids (numbered 1 to 6) against a sample of the poppy seed extract (number 7).

Fig. 7.1 shows the chromatogram she obtained.

Fig. 7.1



(i) Explain why Amaya runs her chromatogram using known alkaloids as well as the extract from the poppy seeds.

....

.... **[1]**

Nearly all candidates conveyed the idea of comparing the components of the poppy seeds with the known alkaloids, although the identification of alkaloids present in the poppy seeds was often implicit rather than explicitly stated.

Question 7 (a) (ii)

(ii) Use the chromatogram in **Fig. 7.1** to state the number of alkaloids in the poppy seed extract.

....

.... **[1]**

A small number of candidates suggested six or seven alkaloids as being present in the poppy seed extract.

Question 7 (a) (iii)

(iii) One of the known alkaloids (1 to 6) is thebaine. The *Rf* value for thebaine is 0.47. Write the letter **T** on **Fig. 7.1** to indicate which of the known alkaloid spots corresponds to thebaine. **[1]**

Nearly all candidates were able to correctly calculate Rf values for the spots and so identify the spot corresponding to thebaine.

Question 7 (a) (iv)

(iv) Amaya thinks that one of the spots in her poppy seed extract might be due to more than one alkaloid with the same *Rf* value.

Describe how Amaya could use the **same** TLC plate to investigate this.

....

....

.... **[2]**

Only a small number of candidates were aware of the possibilities of using a different solvent or using 2D-TLC – some candidates did refer to the use of a second solvent, but in the context of running the same plate again.

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 make sure 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.

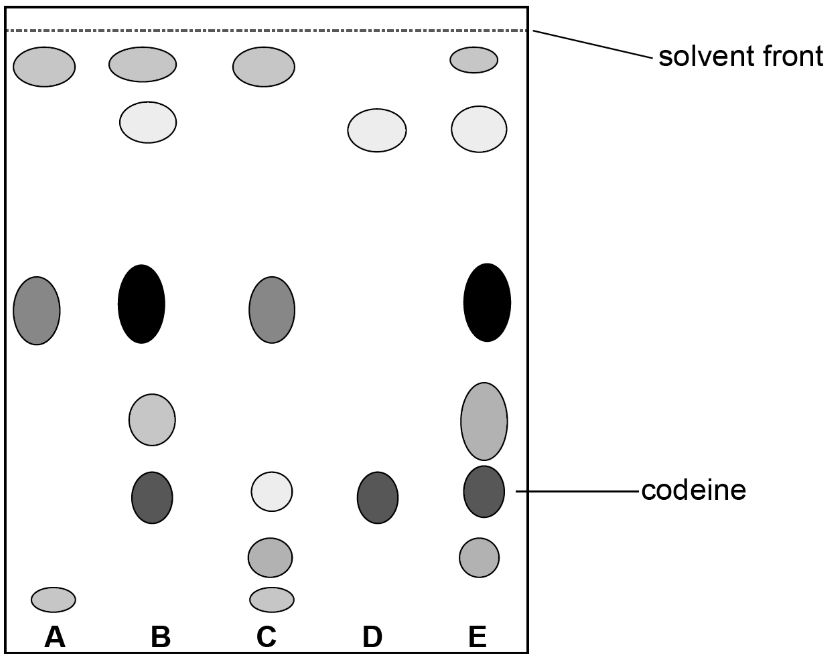
Question 7 (b) (i)

(b) Amaya then finds out which poppy plants could be used as a source of codeine.

- She runs a TLC plate using poppy seeds from 5 different plants, **A** to **E**.
- She uses the same mass of seeds to prepare each extract.
- After running the TLC she uses a locating agent to reveal the positions of the spots, and then draws a circle round each spot.

The chromatogram obtained is shown in **Fig. 7.2**.

Fig. 7.2



(i) Explain why Amaya draws round each spot immediately after using the locating agent.

.... **[1]**

Responses were almost equally split between candidates who had identified that spots might fade over time and those who thought that spots might spread over time or that it allowed a more accurate determination of the Rf value.

Question 7 (b) (ii)

(ii) Use **Fig. 7.2** to suggest why Amaya might choose plant **D** to extract codeine from to make painkiller tablets.

....

.... **[1]**

Nearly all candidates referred, in some way, to the purity of the extract – although in many cases the language used lacked clarity and/or the comparison with the other plants was absent.

Question 7 (b) (iii)

(iii) Complete the sentences about the elution technique using words from the list.

The words may be used once, more than once or not at all.

chamber	**mass spectrometer**	**oven**
paper	**plate**	**salt solution**
solute	**solvent**	**spectrophotometer**

Scrape the (codeine) spot from the ....

Elute the codeine using a suitable ....

Place in a .... to measure how much light is absorbed.

[3]

All but a small number of candidates gained at least 1 mark, and generally 2 marks. The number of candidates who gained maximum marks was small. There was no identifiable pattern to the response selected.

Question 7 (b) (iv)

(iv) Tick (✓) the box next to the name of a method other than elution that Amaya could use to determine the amount of codeine in the sample.

calorimetry	☐
colorimetry	☐
densitometry	☐
micrometry	☐
titration	☐

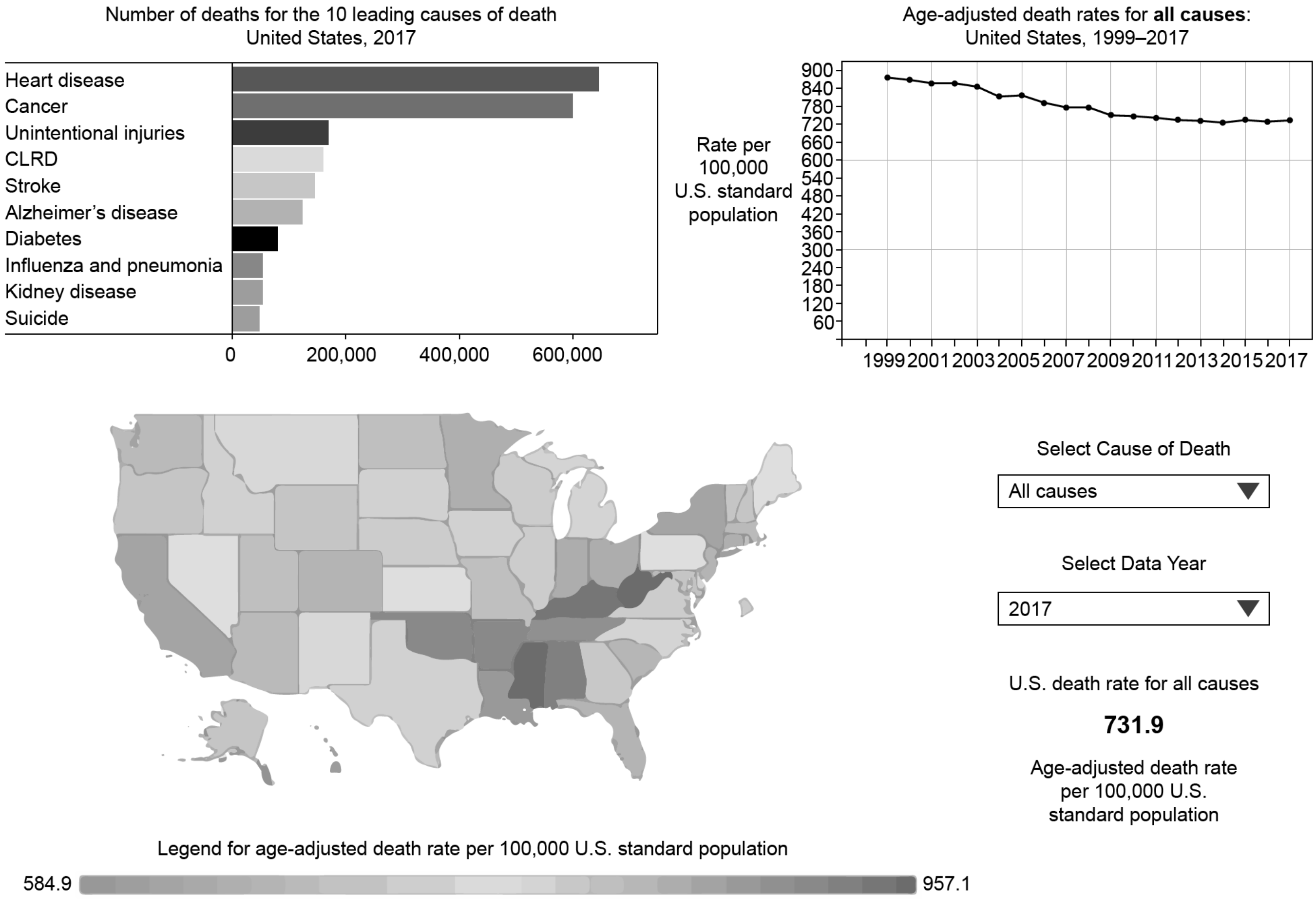
[1]

Only a minority of candidates correctly selected densitometry, the majority preferring titration, with a handful split across the other options.

Question 8 (a)

8 The Centers for Disease Control and Prevention (CDC) in the United States of America (USA) collects and collates data on the causes of death in the USA. The results are published on their website, part of which is shown in **Fig. 8.1**.

Fig. 8.1



(a) List **three** methods of displaying data that can be seen on the website shown in **Fig. 8.1**.

1 ....

2 ....

3 ....

[3]

Nearly all candidates identified bar chart/graph and (line) graph as two methods, but many did not identify map as the third method – suggestions ranged from visual representation, pictogram, and GIS image.

Question 8 (b)

(b) Describe and explain **one** advantage of publishing data on the internet rather than in printed publications.

....

....

.... **[2]**

Nearly all candidates either suggested ease of updating or ease/availablilty of access.

Question 8 (c)

(c) Suggest why data published by the CDC in **Fig. 8.1** is likely to be accepted as reliable by its intended audience.

....

.... **[1]**

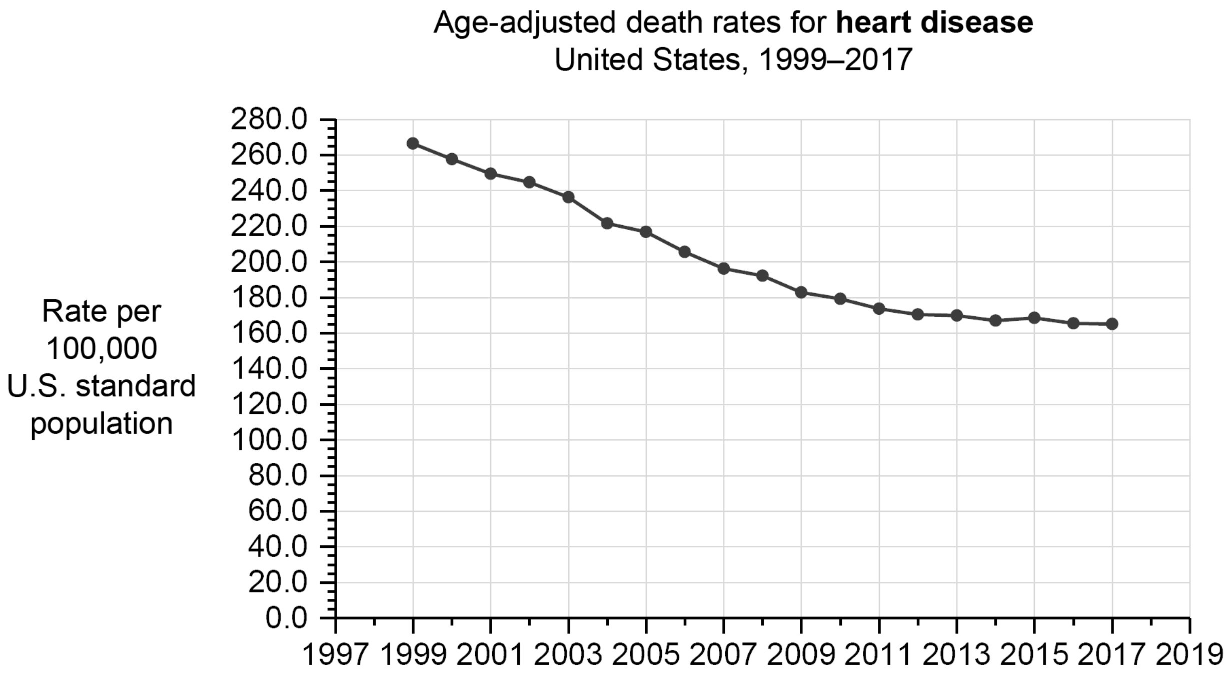
A significant number of candidates wrote about how the display of the data would lead it to be accepted as reliable. Of those candidates who referred to the CDC as being seen as reliable organisation only a minority were aware that it was part of the United States government, many referring to it as a 'reputable/reliable/trusted company'. Only a small number of candidates made reference to the data having been peer reviewed.

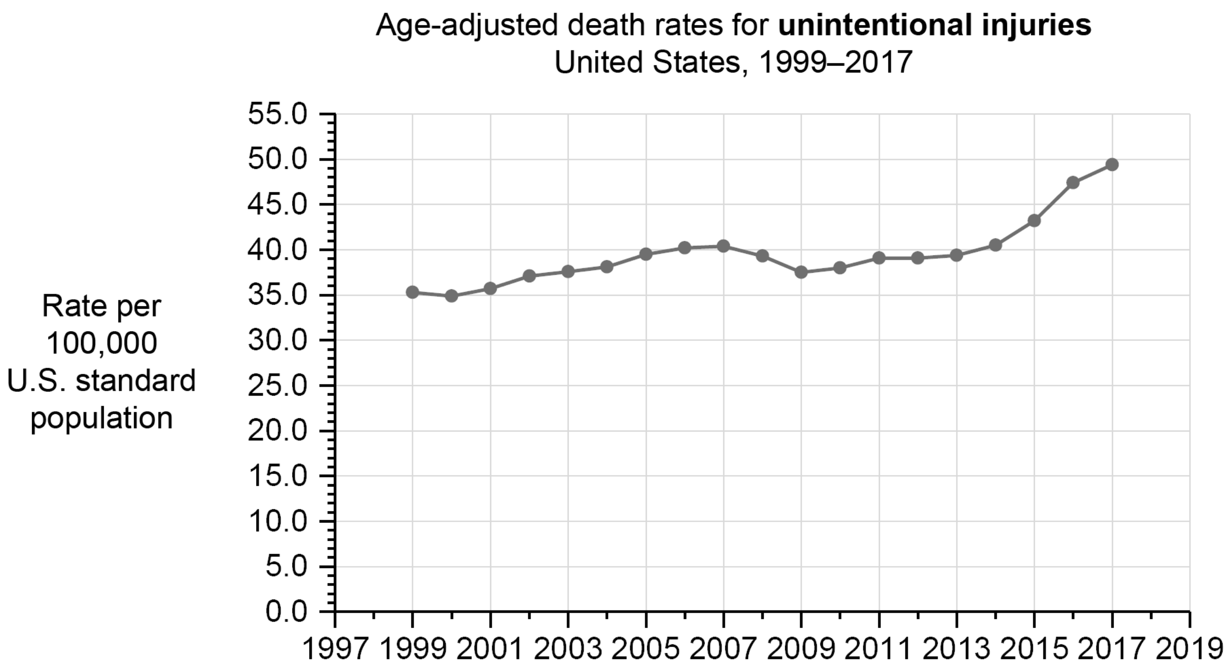
Question 8 (d) (i)

(d) The CDC website can also be used to obtain additional information about death rates from different causes.

Fig. 8.2 shows how the death rate from heart disease and unintentional injuries (accidents) have changed between 1999 and 2017.

Fig. 8.2





(i) Describe the trends shown in the two graphs.

Heart disease ....

....

Unintentional injuries (accidents) ....

.... **[3]**

Nearly all candidates were able to describe the overall trend for both graphs, but only a small number were able to correctly identify the detail within the trends for both graphs.

Question 8 (d) (ii)

(ii) Suggest how the data shown in **Fig. 8.2** could be useful to the US government.

Heart disease ....

....

....

Unintentional injuries (accidents) ....

....

.... **[4]**

This question proved challenging for many candidates; in many cases candidates seemed to have difficulty in communicating what they were trying to express. A considerable degree of latitude was allowed when applying the mark scheme, but many candidates were unable to develop their responses general statements about stating that initiatives needed to be put in place or identifying causes for the trends.

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