

GCSE (9-1)

Examiners' report

**GATEWAY SCIENCE
COMBINED
SCIENCE A**

J250

For first teaching in 2016

J250/08 Summer 2022 series

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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. A selection of candidate answers are also provided. 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.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our [website](#).

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Paper 8 series overview

J250/08 is the second of two Higher Tier papers that determine the biology content of the GCSE (9-1) Gateway Combined Science A course. It assesses content from specification topics B4-B6 and B7. This paper is synoptic and so does contain material covered by topics B1-3. There are also questions that involve the assessment of key mathematical requirements from Appendix 5f of the specification.

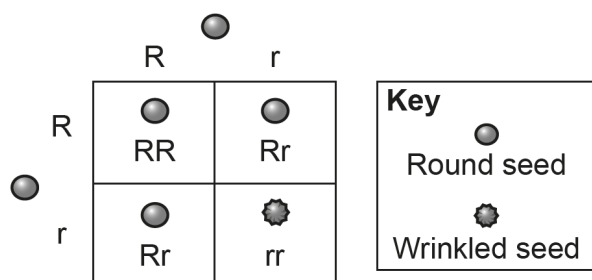
Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
<ul style="list-style-type: none"> • constructed a line graph that included labelled axis in Question 11 (b) (i). • were able to explain concepts and apply knowledge and understanding in Question 12 (c). • were able to evaluate the associated personal and social implications of science in Question 15 (b). • complete calculations without error in Questions 11 (a) (iii) and 14 (b). 	<ul style="list-style-type: none"> • attempted an explanation of data in Questions 11 (b) (iii) and 14 (a) (ii). • attempt to describe scientific method in Question 12 (b) (i). • recalled some basic concepts of biology in Questions 11 (a) (i) and 12 (a) but were unable to apply their knowledge. • demonstrated a lack of understanding of how to develop investigation.

Section A overview

Section A consisted of multiple-choice questions. It was encouraging to see that most candidates attempted all these questions. Of these questions, candidates tended to be more successful on Questions 4, 5, 8 and 10 and less well on Questions 2, 3, 6 and 9. Where candidates decide to change their answer, they should be encouraged to cross out their original answer. They should then write the correct answer next to the box rather than try and write one letter over the original choice of letter.

Question 1

1 The diagram shows a genetic cross for seed shape in peas.



Which prediction about the offspring is **most** likely?

- A All the offspring will be heterozygous for seed shape.
- B All the offspring will be homozygous for seed shape.
- C The ratio of heterozygous to homozygous offspring will be 1:1.
- D The ratio of heterozygous to homozygous offspring will be 3:1.

Your answer

[1]

More successful response identified C as the correct answer. Option D was seen as a common incorrect answer, these candidates had identified the 3:1 ratio of phenotypes but not understood the terms heterozygous and homozygous.

Question 2

- 2 The diameter of a human ovum is 100 000 nm. The diameter of the HIV pathogen is 100 nm.

How many orders of magnitude larger is the diameter of a human ovum compared to an HIV pathogen?

- A 3
- B 10
- C 99
- D 1000

Your answer

[1]

Many candidates find order of magnitude a difficult concept. Most candidates incorrectly chose option D rather than the correct answer of A.

Question 3

- 3 Which term describes **all** the different organisms living in an environment?

- A Community
- B Ecosystem
- C Population
- D Species

Your answer

[1]

Candidates confused the correct term of community with ecosystems. Ecosystems includes the physical environment not just the living organisms.

Question 4

4 Which number per cell is halved during meiosis?

- A Chromosome
- B Gamete
- C Haploid
- D Nucleus

Your answer

[1]

The most common incorrect answer seemed to be haploid. Candidates had picked up on the word 'halved' not realising the answer referred chromosome number rather than the type of cell formed in meiosis.

Question 5

5 HIV is spreading rapidly in many countries.

Which method is used to screen for the HIV virus in a person with **no** symptoms?

- A Detection of the HIV antigen
- B Detection of white blood cells
- C DNA testing for TB
- D Visual identification

Your answer

[1]

Most candidates gave the correct answer A. There was no clear pattern to the incorrect answers seen.

Question 6

6 Which substance in the blood plasma is changed by platelets during blood clotting?

- A Fat
- B Glucose
- C Glycogen
- D Protein

Your answer

[1]

Very few candidates could demonstrate their knowledge of platelets to correctly answer D.

Question 7

7 What medicine can be used to treat tuberculosis?

- A Antibiotics
- B Antiseptics
- C Antitoxins
- D Antivirals

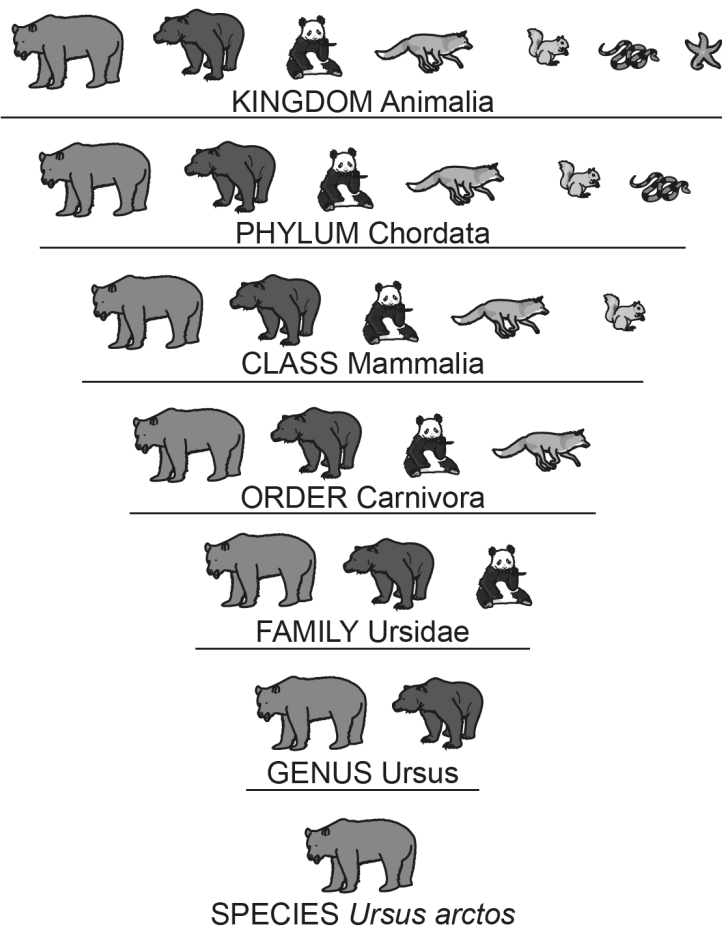
Your answer

[1]

The majority of candidates were able to apply their knowledge that tuberculosis is a bacterial disease and therefore treated with antibiotics; option A.

Question 8

8 The diagram shows the classification of the brown bear and its relationship with other species.



Which classification group would show the **most** similarities in DNA sequencing?

- A Class
- B Family
- C Genus
- D Order

Your answer

[1]

Many lower performing candidates struggled to interpret the diagram. They assumed animals within a family rather than a genus would show the most similarities.

Question 9

- 9 Scientists that genetically engineer bacteria need to identify those bacteria that have taken up the modified plasmid.

What is used to identify bacteria that have taken up the modified plasmid?

- A Antibiotic resistant genes
- B Ligases
- C Restriction enzymes
- D Vectors

Your answer

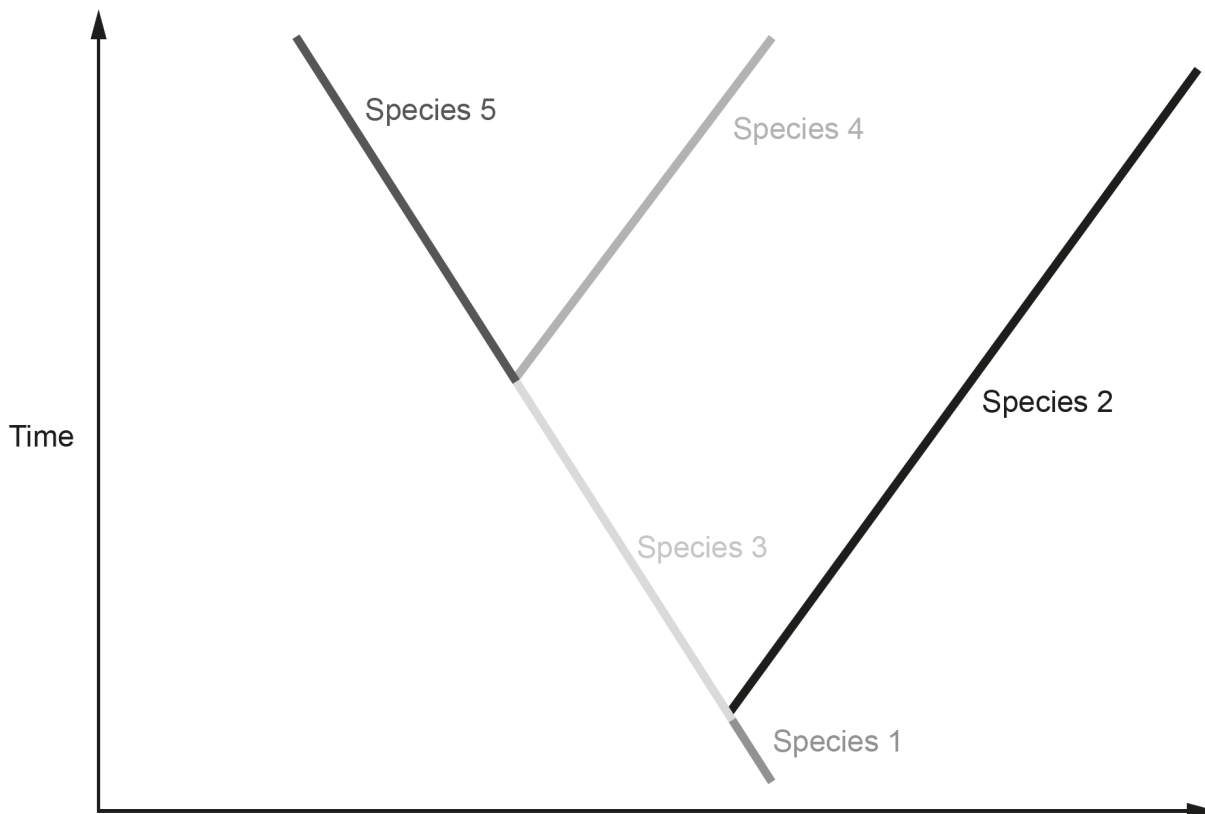
[1]

Candidates found this concept difficult. Only the higher performing candidates identified the correct answer of A. Other candidates chose either B or C as they were more familiar terms linked to genetic engineering.

Question 10

- 10 When one species splits to become two new separate species it is called a **speciation event**. Phylogenetic trees represent speciation events from the past.

The diagram shows a phylogenetic tree.



How many speciation events are in this phylogenetic tree?

- A 1
- B 2
- C 3
- D 4

Your answer

[1]

Most of the candidates successfully interpreted the diagram and correctly identified B. A few candidates gave the number 2 as their answer. In this instance it was accepted but should be discouraged.

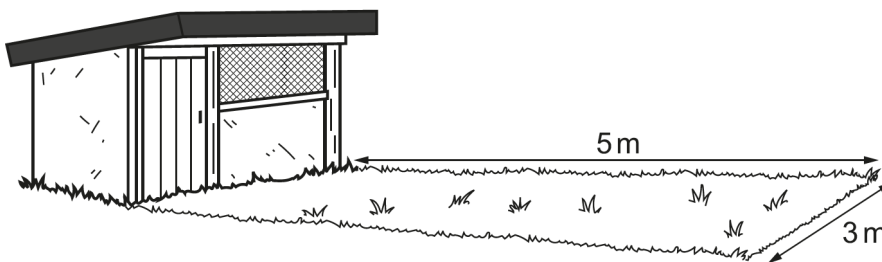
Section B overview

Section B consisted of structured questions ranging from 1 to 6 marks. There was clear evidence of knowledge and understanding (AO1). Candidates did not perform as well when required to apply their knowledge to answer questions (AO2) or analyse information and ideas (AO3). Candidates appeared to have had enough time to complete the paper, with the majority attempting most of the questions in Section B.

The additional pages at the back of the paper are available for those candidates who do need extra room to answer a question. However, some candidates still think they need to use the additional pages to write one word that could have easily fitted onto the end of a line. Candidates should also be encouraged to clearly number any responses written on the additional pages. There were scripts where examiners had to determine which question the response was for.

Question 11 (a) (i)

- 11 Two students investigate the population of daisies in a lawn. The diagram shows the lawn in front of a shed.



- (a) (i) Complete these sentences about the method the students use to find the population of daisies.

Use the words in the list.

pooter	quadrat	random	square
--------	---------	--------	--------

The lawn is sampled using a square frame called a

Drop the square frame over one shoulder to provide a sample.

Count and record the number of daisy plants present in the square grid.

Repeat this process in 10 different areas of the lawn.

[2]

Most of the candidates correctly stated quadrat and random. Very few incorrect answers were seen. The most common incorrect response being 'square' sample.

Question 11 (a) (ii)

(ii) Table 11.1 shows their results.

Table 11.1

Square frame	1	2	3	4	5	6	7	8	9	10	Total
Number of daisies counted	14	3	8	10	16	15	11	10	11	12	110

Estimate the population of daisies in the lawn.

- The students used a $0.5\text{ m} \times 0.5\text{ m}$ frame to sample the lawn.
- The lawn size is $5\text{ m} \times 3\text{ m}$.

Estimate of population of daisies in the lawn = [3]

The majority of candidates were given at least 1 mark for this question. Usually this was for correctly calculating the area of the frame and lawn. Fewer candidates then calculated a mean for a single square of 11 daisies. They then struggled to realise that there would be 4 frames in 1 m^2 resulting in a final estimate of 660. Many candidates gave an incorrect answer of 6600 having divided 15 by 0.25 then multiplying by 11. They did not realise that the area tested was ten times larger than 0.25 m^2 . However, it was encouraging to see that most candidates showed their working. This enabled them to be given marks even when the final answer given was incorrect.

Question 11 (b) (i)

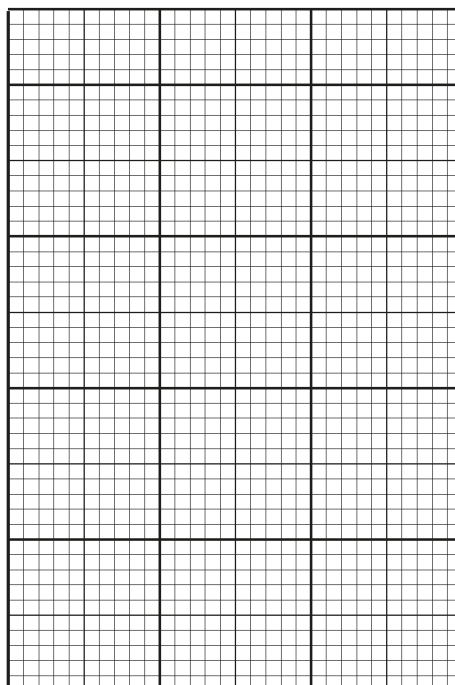
(b) The students develop their investigation to show how the shed affects where daisies grow in the lawn.

Table 11.2 shows the results.

Table 11.2

Distance from shed (m)	Number of daisies
1.0	0
1.5	2
2.0	4
2.5	6
3.0	8
3.5	10
4.0	12
4.5	14
5.0	16

(i) Plot a line graph of the results from **Table 11.2**. Draw a straight line of best fit.



[4]

The majority of candidates attempted to draw a graph. Many candidates added a scale and plotted points but neglected to label the axis or they missed (m) from the distance label. Candidates should be encouraged to label axis including units.

Assessment for learning



Centres are advised to encourage candidates to plot the independent variable on the x-axis. This would usually be the first column of a results table, which may be an easier way for candidates to remember. Candidates should also be made aware that the size of the grid provided is a clue to the scale needed. In this case the x-axis is 6cm and the distances 1-5m. Therefore, the most sensible scale is 1cm = 1m. The y- axis scale would be 1cm= 2 daisies. A few candidates used complicated scales such as 2cm = 5 daisies, making plotting the points more complicated. Candidates should also be encouraged to add zero to their scale. This helps to prevent errors such as non-linear scales.

Question 11 (b) (ii)

(ii) Use the graph to determine the slope of the line.

Slope = [1]

Determining the slope of a graph is mathematical skill M4d. Candidates struggled with this concept. Many incorrectly divided x by y, rather than y by x.

Question 11 (b) (iii)

(iii) Daisy plants require lots of light.

Explain the effect of the shed on the growth of daisies in the lawn.

.....

.....

.....

..... [2]

The majority of candidates successfully answered this question. There was clear understanding that the shed prevented light needed for growth reaching the plants.

Question 12 (a)

12 (a) Complete these sentences about different factors that affect the ecosystem.

Use the words or phrases in the list.

abiotic	biotic	carbon dioxide	food	oxygen
pH in soil	predators	temperature		

Living organisms affecting the ecosystem are known as factors.

Physical factors that affect living organisms are described as factors.

Physical factors that can directly affect the rate of photosynthesis include and concentration.

[3]

Most of the candidates achieved 2 out of 3 marks for this question. Many incorrectly assumed that pH was one of the physical factors. Although it will have an effect on photosynthesis this would be an indirect affect. Some candidates incorrectly assumed oxygen was needed for photosynthesis.

Question 12 (b) (i)

- (b) A student investigates the relationship between bean plants and the bacteria that live in the roots of the bean.

They think the bacteria live inside root nodules.

Fig. 12.1 shows root nodules on a bean plant.

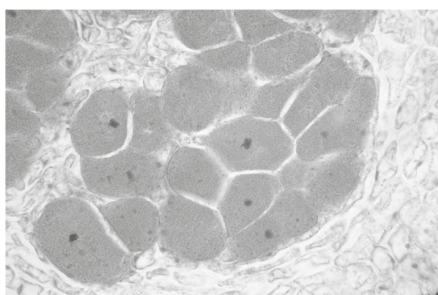
Fig. 12.1



The student takes a thin section of the nodule and looks at it under a light microscope.

Fig. 12.2 shows bacteria inside the root nodule.

Fig. 12.2



- (i) Describe how to take a **thin** section of the nodule **and** prepare it to view under a light microscope.

.....

.....

.....

.....

.....

..... [3]

This question was linked to the suggested practical for learning outcome B4.1f. The majority of candidates provided a description of how to prepare a microscope slide. Candidates should be encouraged to use the correct scientific terms such as cover slip and microscope slide. Using a stain is preferable to using a dye. Where candidates struggled was in the application of their knowledge to this example. They had not described how to obtain a thin section using a scalpel or sharp knife. Many described peeling a layer, which demonstrates knowledge of onion cells but not a wider practical experience. The use of sharp scalpels by candidates may not be possible; however, centres are encouraged to demonstrate a variety of PAG skills in some way.

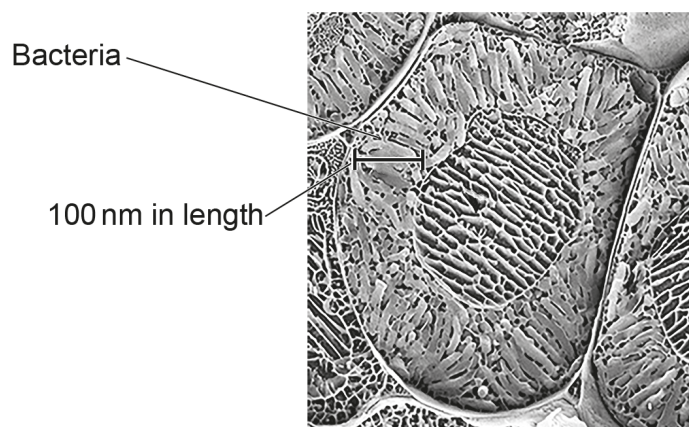
Question 12 (b) (ii)

- (ii) The bacteria were **not** visible clearly using a light microscope.

The student found an image taken using a different type of microscope.

Fig. 12.3 shows this image.

Fig. 12.3



The maximum resolution of a light microscope is 200 nm.

What type of microscope is used to take this image?

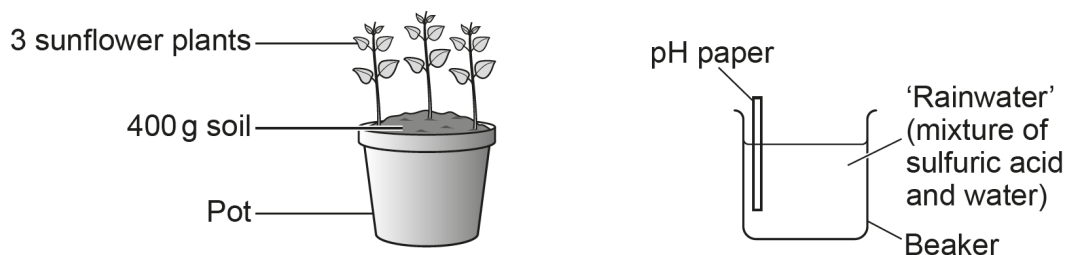
..... [1]

The majority of candidates named the electron microscope. A few candidates incorrectly called it an eclectic microscope.

Question 13 (a) (i)

- 13 (a)** A science club set up an experiment looking at the effect of acid rain on the growth of sunflower plants.

The diagram shows the apparatus they use.



This is the method they then used.

- Prepare 5 plant pots with 5 beakers of the 'rainwater' with varying pH values as shown in the table.

Pot with 3 sunflower plants	Beaker of 'rainwater'	pH Value
A	A	6.0
B	B	5.0
C	C	4.0
D	D	3.0
E	E	2.0

- Water each pot twice a day from its corresponding beaker with similar amounts of 'rainwater'.
- Leave the pots in the same place with the same growing conditions for 14 days.
- Measure the height of each sunflower every other day. Record the mean height of the 3 sunflowers in each pot.

- (i) What is the **independent** variable in this investigation?

Put a tick (✓) in the correct box.

Amount of light sunflowers receive	
Height of sunflowers	
Number of sunflowers	
pH of acid rainwater	
Volume of rainwater added to sunflowers	

[1]

Candidates struggled to identify the independent variable in this investigation. There seemed to be no clear pattern to the incorrect answers observed.

Question 13 (a) (ii)

- (ii) Write down **two** changes that would improve the **accuracy** of these acid rainwater measurements.

1

.....

2

.....

[2]

Questions linked to practical procedures are challenging especially when candidates have not had the opportunity to experience the practical procedure. This investigation based on the suggested practical for learning outcome B6.1b. Where it is not possible for candidates to use equipment then centres are encouraged to find alternative arrangements.

Many candidates did evaluate the method in the question and instead provided general improvements. A common response observed was 'repeat the experiment and take a mean'. A high proportion of candidates had read the method given and realised the plants had been provided with similar amounts of 'rainwater'. Of these candidates many stated that an exact amount of 'rainwater' should be provided but did not explain that the same exact amount should be applied.

OCR support



This [Practical support guide](#) has a variety of videos, activities and simulations that can be shared with candidates. These link to the Practical Activity Groups, and the apparatus and skills candidates must be aware of. Some of the practicals shown are in a different context than they may be carried out in the classroom, giving candidates further practice for examinations.

Question 13 (a) (iii)

- (iii) Acid rain forms due to the emission of sulfur dioxide and nitrogen oxides when fossil fuels are burnt. These gases react with water, oxygen and other chemicals in the atmosphere.

The science club used sulfuric acid to represent acid rain.

Suggest why this is **not** a true representation of acid rain.

..... [1]

Candidates tended to provide very vague answers to this question. They needed to apply their scientific knowledge to state that the water used did not contain any nitrogen compounds. Many candidates did not make it clear in their answer if they were describing the sulfuric acid or acid rain. Candidates should be discouraged from starting answers with 'it' when 'it' could be more than one substance.

Question 13 (a) (iv)

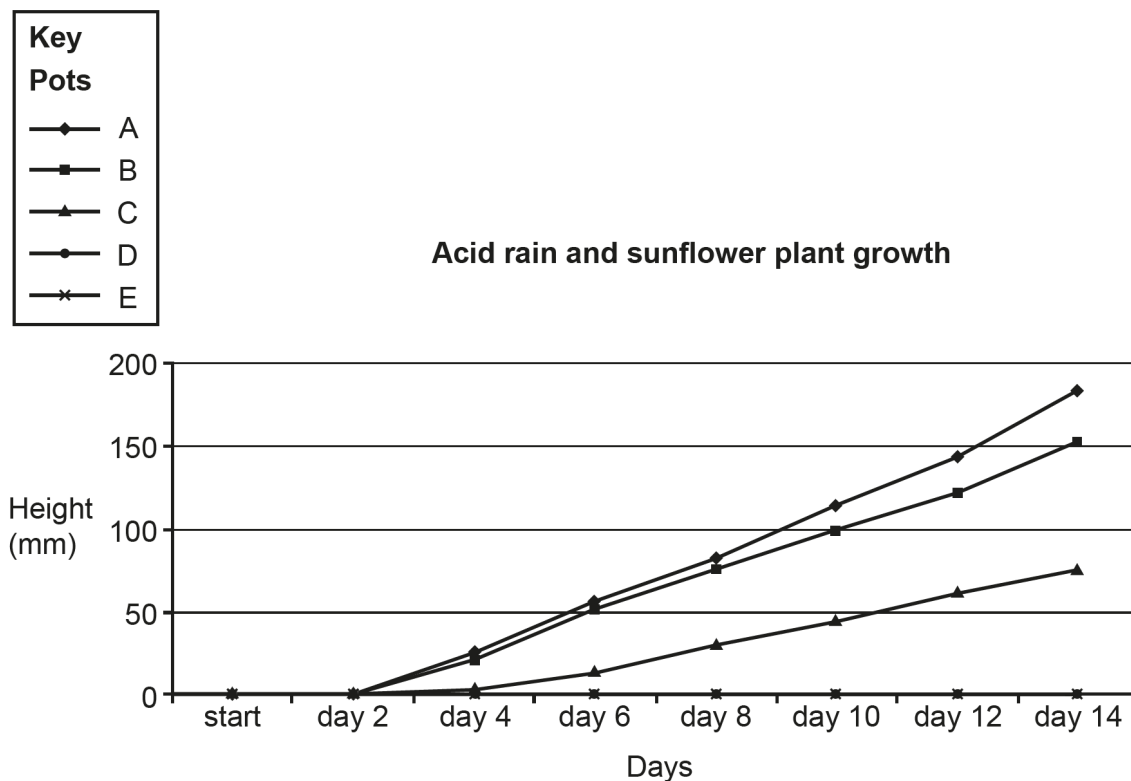
- (iv) Suggest how the investigation could be developed to better represent acid rain.

.....
..... [1]

Very few candidates understood that nitric acid would need to be added. Many assumed you could collect and use actual rainwater without realising it would be difficult to control the pH.

Question 13 (b) (i)

(b) This is a graph of the results, produced using computer software.



(i) Estimate the range of acidity that by day 14 causes the sunflower plants to be reduced in height by about 50% compared to the sunflower plants in pot A.

Put a tick (✓) in the correct box.

- pH 2.0–3.6
- pH 3.0–3.6
- pH 4.0–4.6
- pH 5.0–5.6

[1]

Few candidates were able to link the information from the table in part (a) and the graph in part (b).

Question 13 (b) (ii)

(ii) Describe the impact of acid rain on biomass production.

.....


.....

.....

..... [2]

The majority of candidates were given 1 mark for identifying that biomass production would decrease due to acid rain. Fewer candidates were able to link this to growth rate in plants. Candidates should be encouraged to answer these types of questions in terms of increase or decrease. There were many vague answers using terms such as impacts, affects or disrupts.

Misconception

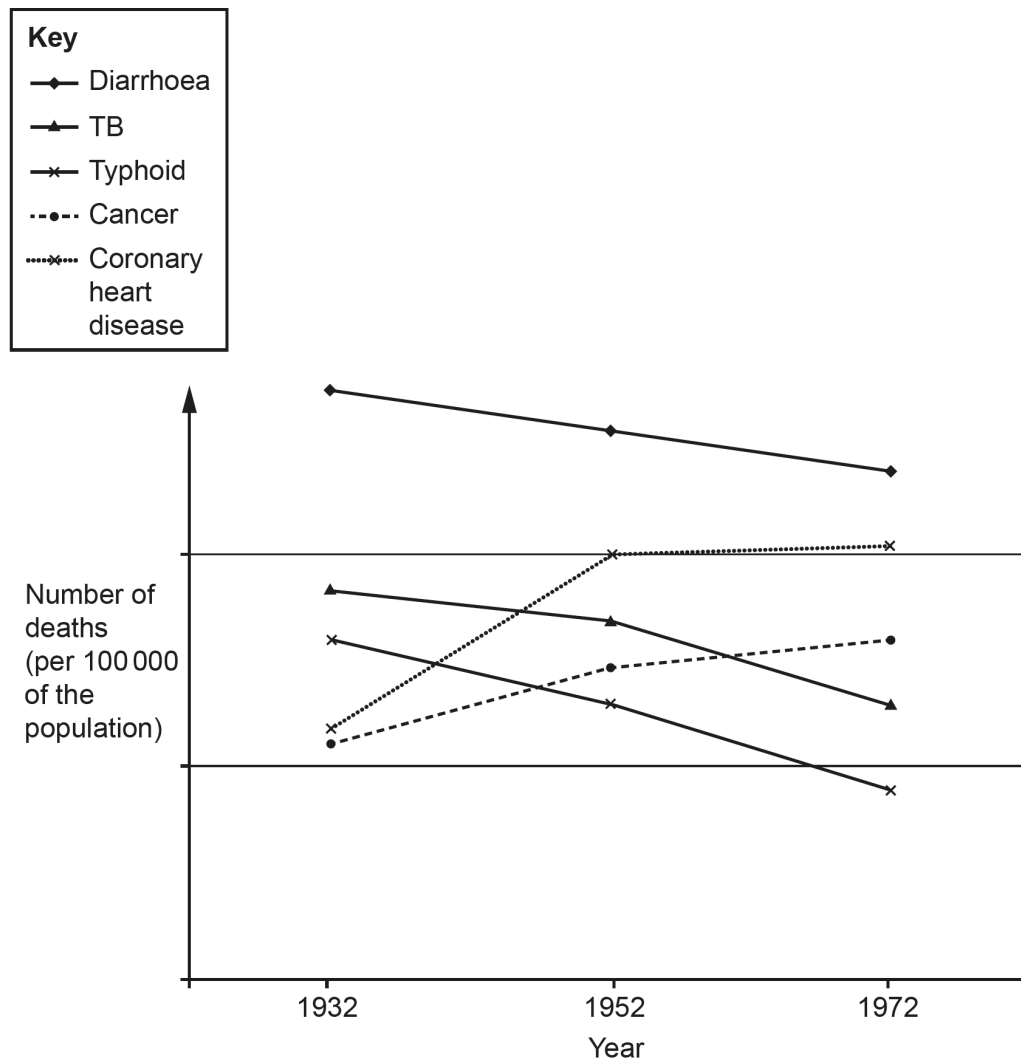
 There was evidence that some candidates misinterpreted the pH scale. A few candidates assumed a higher pH value indicated a stronger acid.

Question 14 (a) (i)

14 (a) The deaths in one country from different diseases were measured over a 40-year period.

Lifestyle and living conditions in this country changed during the 40 years of the study.

The graph shows the number of deaths per 100 000 of the population for each disease.



(i) The diseases can be grouped into communicable and non-communicable diseases. The graph shows the trends of these two different types of disease over the 40-year period.

Complete the sentences explaining these trends shown in the graph.

Communicable diseases have

.....

Non-communicable diseases have

.....

[2]

The majority of candidates identified the correct trends. A few candidates confused communicable and non-communicable diseases and gave the opposite trends.

Question 14 (a) (ii)

- (ii) Suggest how lifestyle and living conditions in this country might have changed to cause the trends shown in the graph.

.....

.....

.....

..... [2]

The majority of candidates were given 1 mark rather than 2. This was because they only suggested a cause of one of the trends and not both. A few candidates just repeated the stem suggesting that lifestyle and living conditions had improved. When referring to lifestyle changes candidates should be encouraged to identify the direction of these changes, for example 'there has been an increase in unhealthy eating and not simply stating the trend is cause by poor diet'.

Question 14 (b)

- (b) To calculate the death rate in a given year, the following formula is used:

$$\text{death rate per } 100\,000 = \frac{\text{number of deaths} \times 10^5}{\text{population size}}$$

In 1972, the population was 55 million. The death rate from coronary heart disease was 28 deaths per 100 000 people.

Calculate the number of deaths from coronary heart disease in 1972.

Number of deaths = [2]

More successful responses were able to rearrange the formula and use standard form correctly. A large proportion of candidates were given 1 mark for correctly rearranging the formula but providing an answer that was out by multiples of 10, e.g. 154000 and not the correct answer of 15400. A common error was to confuse the death rate with the number of deaths, multiply 28 by 10⁵ and dividing by 55 million.

Question 14 (c)

(c) The immune system provides a defence against bacterial diseases like TB (tuberculosis).

Part of this defence involves the production of antibodies.

Describe how antibodies help defend the body. Use ideas about antigens in your answer.

.....

.....

.....

..... [2]

Candidates find the concept of immune response challenging. Only the more successful responses demonstrated detailed knowledge of the process. Candidates should be encouraged to use the correct scientific terminology when describing the actions of phagocytes. Phagocytosis involves the engulfing and digestion of pathogens. The use of terms such as 'fight', 'eats' and 'germs' should be discouraged.

Misconception



Many candidates misunderstood the terms antigens and antibodies. They incorrectly described antibodies producing antigens to fight the disease. A few candidates seemed to think that antibodies rather than white blood cells engulf the pathogens.

Exemplar 2

Lymphocytes in the ~~body~~ ^{body} detect antigens on pathogens as non-self. Receptors in the membrane bind to the antigens and the antibodies lock onto antigens. ~~Then~~ This means the pathogen can no longer affect the body. Phagocytes engulf the dead pathogens afterwards. Memory cells are left. [2]

This exemplar is from a more successful response. The candidate was given 2 marks. They demonstrate knowledge of antigens as part of a pathogen. They have correctly described that the antibodies lock onto the antigens, which enables the white blood cells to engulf the pathogen. The reference to memory cells is not relevant but does not contradict any of the marking points so is ignored.

Question 14 (d)

(d) What does a vaccination contain **and** why does it protect the body from infection?

Vaccinations contain

.....

Vaccinations protect the body because

.....

[2]

The majority of candidates demonstrated some knowledge of vaccines. However, there were several vague answers observed. Candidates should be encouraged to describe vaccines in terms of pathogens and not diseases. A few candidates assumed the vaccine contained a small dose of the pathogen rather than a weakened version.

Very few candidates demonstrated a clear understanding of how vaccines protect the body. Simply producing antibodies was felt insufficient as this idea had been stated in Question 14(c). Candidates needed to provide a correct reference to memory cells or explain that the response to future infection would be faster.

Question 15 (a) (i)

15 (a) Some forms of breast cancer are linked to specific mutated genes called BRCA.

BRCA is a dominant allele.

Inheriting the BRCA allele means in both males and females, the risk of developing breast cancer is affected. It does not mean a person has been diagnosed with cancer.

(i) A male who is heterozygous for BRCA has children with a female who is homozygous recessive.

How are they affected by the BRCA allele?

Put ticks (✓) in the correct boxes.

	Risk of Developing Breast Cancer	
	Increased risk	Less risk
Heterozygous male		
Homozygous recessive female		

[1]

The majority of candidates were able to interpret the information to tick the correct boxes. A few candidates misunderstood the question and assumed the boxes were there for the genetic cross in Question 15 (a) (ii)

Question 15 (a) (ii)

(ii) What is the percentage probability of them having a child with an increased risk of developing breast cancer?

Use a labelled genetic diagram to explain your answer.

Use the letter **B** for the dominate BRCA allele.

Percentage probability = % [3]

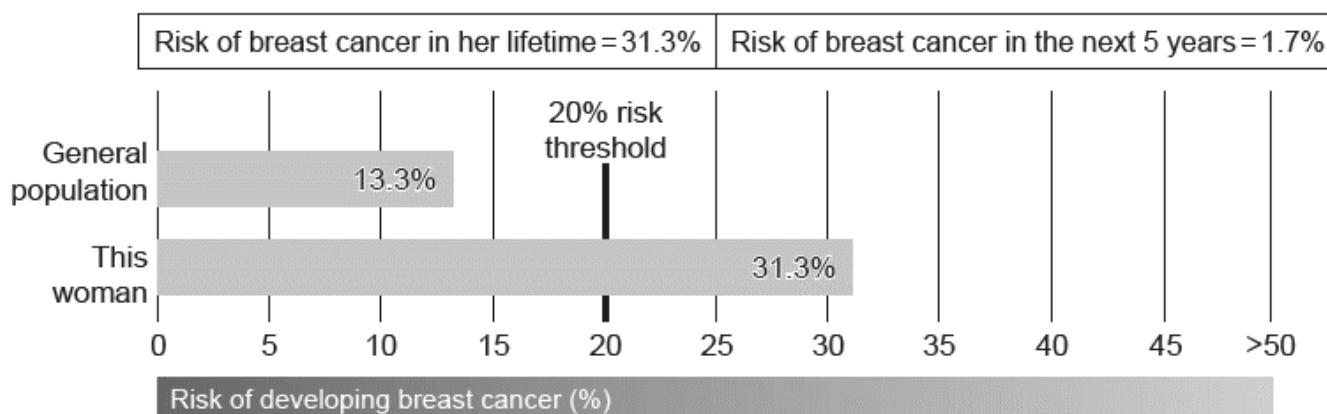
Most candidates demonstrated a good knowledge of how to complete a genetic cross. However, the question asks for a labelled genetic diagram. Therefore, it was important that candidates labelled the genotypes to identify Bb as male and bb as female.

Question 15 (b)*

*(b) Breast cancer has many genetic and clinical factors that affect its development.

A woman has her genome mapped because her mother had breast cancer. Medical risk factor tools are then used to predict her risk of developing breast cancer comparing it with the general population.

The diagram shows the results for this woman.



All women over the age of 50 have the opportunity to be screened for breast cancer every five years. Women at high risk of developing breast cancer are given the option of having their breasts removed and replaced with silicone implants.

Discuss how useful the results shown in the diagram are for this woman **and** suggest some of the ethical and practical issues involved in being made aware of the results.

..... [6]

The majority of candidates demonstrated some understanding of the personal, social and ethical implications associated to scientific developments. They were able to interpret the data and attempt to make informed decisions about the risks and benefits. The more successful responses were also able to suggest practical issues other than those provided in the question. Less successful responses tended to just repeat the information about screening and breast implants.

A few candidates referred the diagram in general terms. Explaining that the diagram shows the risk but not making it clear that the woman in the question had a higher risk than the general population. Most candidates identified ethical issues; however, candidates should be encouraged to qualify vague statements about religion or 'playing god'. To secure a Level 3 answer candidates needed to develop the practical issues of screening and breast implants by linking these to the data. The risk to the woman over the next five years was very low, so candidates could have explained that she had time to make practical decisions or she could choose to get checked in less than five years.

Exemplar 3

The results shown in the diagram show that this woman has a 31.3% risk of developing breast cancer in her lifetime. This is 18% above the general population, and above the 20% risk threshold. This is useful to the woman, as she can be screened more regularly to detect the early onset of breast cancer. She can also be made aware of not only her risk for developing cancer, but also options to reduce her risk, by removing her breast. However the ~~these~~ results may cause the woman to worry, causing possible mental distress on her affecting her lifestyle ~~and~~ and her daily life. There is also no guarantee that this woman will ever develop breast cancer, causing ^{possible} unnecessary worry and stress. [6]

15(b) There are also practical issues involved, such as conducting regular screenings, lifestyle changes. There is also risk of infection during breast removal surgery. Undertaking this risk maybe ~~unnecessary~~ ^{unnecessary}, if she never develops cancer.

This exemplar is a response that gained all 6 marks. They have evaluated the data and made judgement on both ethical and practical issues.

The candidate clearly identifies that the woman is at a much higher risk than the general population. The practical implication of this is that she should be screened more regularly. The candidate mentions making lifestyle changes which is an attempt at another practical issue. If the candidate had not already mentioned the regular screening, they would need to qualify this lifestyle change to secure Level 3. One suggestion would be a change in diet or checking herself more often.

The candidate has identified several ethical issues, including mental health issues and the fact that the data is only an indication of risk and not a certainty that the woman will develop breast cancer.

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