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Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

GATEWAY SCIENCE BIOLOGY A

J247

For first teaching in 2016

J247/04 Summer 2022 series

Version 1

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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.

Paper 4 series overview

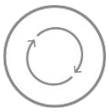
This is the second paper of the GCSE Gateway Specification A series, since examinations have resumed after the absence of two series. The candidates have been given advanced information of the key areas of the specification which were assessed. The J247/04 component assesses B4-B6 and B7, with assumed knowledge of B1-B3. It includes a multiple choice question section and a short answer section that also includes one Level of Response type question. This question assesses the quality of communication as well as knowledge and understanding. Throughout the paper there are some questions that are designed to assess the candidates' knowledge and understanding of the practical skills in the specification. These questions demand responses that identify a candidates' awareness of the skills required to successfully complete practical investigations. Most candidates made a good attempt at answering all the questions and limited their responses to the available spaces. The paper was challenging and discriminated well between candidates. There was no evidence that candidates ran out of time, and it was good to see that candidates attempted all the questions throughout the paper.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Recalled definitions on the multiple choice Questions 2, 3, 5, 8, 9 and 14. • Performed calculations following the required rubric (e.g. clear working, significant figures) on 16(b), 17(b)(i), 18(c)(i) and 20(d)(i) for percentage change. • Produced a clear and concise response to the Level of Response Question 18(c)(ii). • Applied their knowledge and understanding of natural selection to a given context on 20(b)(i) by linking the theory of natural selection to cuckoos and the development of the sticky membrane in all the population. • Calculated orders of magnitude on 20(c)(ii). • On 21(a) could recall and describe how vaccinations work. • Could analyse and draw conclusions from a diagram on 21(c).	• Lacked clear knowledge of definitions of the term's antigen, vector, and phylogenetics. • Found questions designed to assess candidates' practical abilities challenging, such as describing an experimental method on 16(a) and suggesting improvements to the method on 17(b)(v). • Demonstrated clear misconceptions such as bulbs carry out asexual reproduction in Question 18(a). • Produced a narrow response on the Level of Response Question, 18(c)(ii), only answering part of the Question, either on the usefulness of the machine or the advantage of early detection to the grower. • Found it difficult to apply what they had learnt to unfamiliar situations, such as natural selection on 20(b)(i).

Section A overview

Candidates coped well with selecting choices. The technique of elimination was also evident throughout this section. Candidates had been well prepared as most candidates used capital letters and placed the letter in the answer box. All candidates answered every multiple choice question.

Assessment for learning



Candidates should be encouraged to learn definitions. Many candidates didn't seem to understand the term phylogenetics, vector, and antigen.

Question 3

3 What is phylogenetics?

A Classification using behavioural characteristics

B Classification using evolutionary links

C Classification using physical characteristics

D Classification using species name

Your answer ☐ **[1]**

This is an AO1.1 question testing the recall of the definition of phylogenetics. The most common incorrect answer was for the distractor B.

Question 6

6 Animal populations can be estimated using a method called capture-recapture.
The number of animals in the population is estimated using the formula:

$$\text{population estimate} = \frac{\text{number in first sample} \times \text{number in second sample}}{\text{number of marked animals in second sample}}$$

Sometimes marking the animals makes them less well-camouflaged.

What effect would this have on the population estimate?

A The estimate is always too high.

B The estimate is always too low.

C The estimate is either too high or too low.

D There is no effect on the estimate.

Your answer ☐ **[1]**

This AO2.2 question required applying knowledge of the capture-recapture technique and how the markings that would make the animals less camouflaged would affect the population estimate. Half of the candidates correctly chose A showing an understanding that the number of marked animals in the second sample would be less due to predation, causing a high estimate. Some candidates incorrectly thought the estimate would be too low and chose B, and some candidates did not commit either way choosing C.

Question 8

8 Which is a description of an antigen?

A A chemical group on the surface of a pathogen.

B A chemical that kills bacteria or stops them dividing.

C A drug that is used to kill viruses.

D A protein molecule made by white blood cells.

Your answer ☐ **[1]**

Recalling their knowledge in this AO1.1 was answered well by the higher ability candidates. They could successfully describe an antigen, choosing A. The most common incorrect answer was D, as an antigen can be a protein molecule but it is not made by white blood cells.

Question 9

9 Charles Darwin and Alfred Wallace were both involved in the development of the theory of evolution by natural selection.

How were they involved?

A Darwin first suggested the theory and Wallace developed it a hundred years later.

B They both travelled together on a ship called the Beagle.

C They worked together writing a book called 'On the Origin of Species'.

D They wrote scientific papers separately but then presented them together.

Your answer ☐ **[1]**

This is an AO1.1 question testing recall of Darwin and Wallace and the development of the theory of evolution by natural selection. In general candidates chose either A or D, although B and C were also seen. Many candidates incorrectly choosing that Wallace developed Darwin's theory 100 years later. Candidates that performed well chose the correct answer D.

Assessment for learning

Candidates should be encouraged to study the work of Darwin and Wallace in more detail. Many candidates assumed that they had wrote the book or travelled together. Most incorrect answers suggested that they were unaware that Darwin and Wallace were alive during the same time period.

Question 10

10 Which statement is correct about HIV/AIDS?

A AIDS is a virus that weakens the immune system.

B HIV and AIDS are alternative names for the same disease.

C HIV is a pathogen and AIDS is a set of infections.

D HIV is a virus that produces toxins which kill an infected person.

Your answer ☐ **[1]**

In this AO1.1 question many candidates incorrectly put A, indicating that they did not know that HIV is a pathogen and AIDS is a set of infections, choice C.

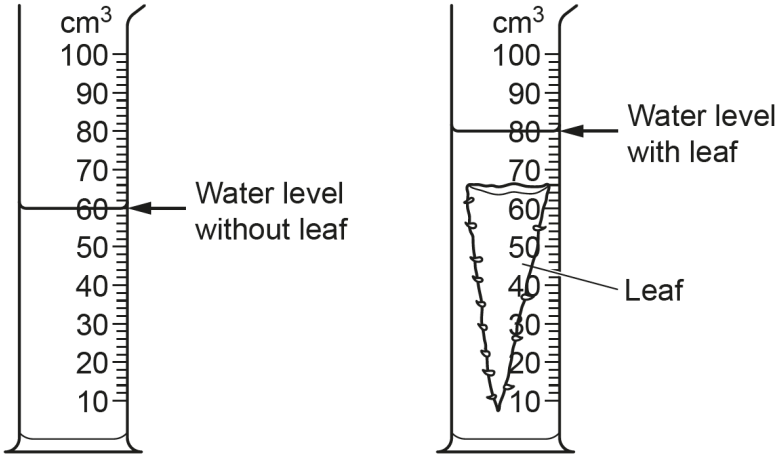
Misconception

? Many candidates are unaware of the distinction between HIV, the virus and AIDS, the set of infections.

Question 13

13 A teacher measures the volume of a leaf by placing it in a measuring cylinder of water.

They take the two measurements shown in the diagram.



The uncertainty of the scale is half of the smallest divisions shown on the scale.

What is the volume of the leaf, including the correct level of uncertainty?

A $20 \pm 0.1\,cm^3$

B $20 \pm 0.2\,cm^3$

C $20 \pm 1\,cm^3$

D $20 \pm 2\,cm^3$

Your answer ☐ **[1]**

In this AO2.2 question candidates had to apply their knowledge and understanding of practical techniques. Although many candidates demonstrated that they understood how to identify an uncertainty, and picked C, they needed to consider that there is a change in the volume. The uncertainties for each reading must be added to give the uncertainty of the combined measurement, which would be answer D.

This question has been discounted from the paper due to its ambiguity. In accordance with policy, this was achieved by crediting all candidates the single mark tariff for the question.

OCR support

For more support with teaching uncertainties, please see the Language of measurement in context resource.

Question 14

14 Genetic engineering involves the use of vectors.

Which is an example of a vector?

A A set of unpaired bases on the end of a DNA molecule.

B A small ring of DNA present in a bacterium.

C An enzyme that joins together two pieces of DNA at specific sites.

D An organism that has undergone genetic modification.

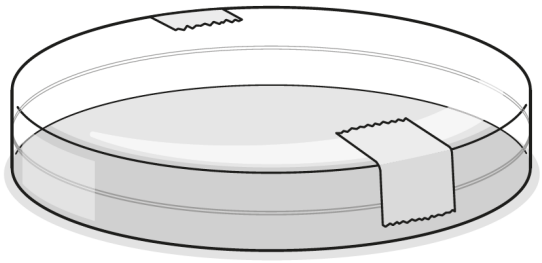
Your answer ☐ **[1]**

Many candidates answered this AO1.1 question well, choosing B. All the other letters were seen in the responses, most commonly D.

Question 15

15 A scientist inoculates an agar plate with bacteria.

The plate is now ready to be incubated.



Why do they seal the lid with two strips of tape, rather than sealing it all round the lid?

A If sealed all round the lid, no bacteria could grow.

B To make it easier to remove the lid after incubation.

C To prevent water condensing on the lid of the Petri dish.

D To reduce the chance of pathogenic anaerobic bacteria growing on the dish.

Your answer ☐ **[1]**

Candidates found recalling their knowledge of a scientific technique in the AO1.2 question challenging. Some candidates were distracted by A.

Section B overview

Candidates scored well across question 16, an overlap questions with the Foundation tier paper, suggesting that they had been entered for the correct tier. Candidates were able to demonstrate a sound understanding of the use of quadrats and how to calculate the mean population of thistle plants in question 16. Calculations at this level were also well answered.

In general candidates could confidently state the advantage to the grower of identifying infected plants early and express the usefulness of the machine in the Level of Response question. Many did not go on to discuss the advantage of this early detection and were limited to Level 2. As in previous years candidates should make sure that they deconstruct the question and provide a response to all parts of the question.

As in previous examination years candidates should further develop their ability to apply knowledge and understanding of practical skills in questions set in the context of unfamiliar practical activities and investigations. They should practice identifying independent, dependent and control variables, and use the correct language of measurement terms.

OCR support

See Language of measurement in context – Biology for further support.

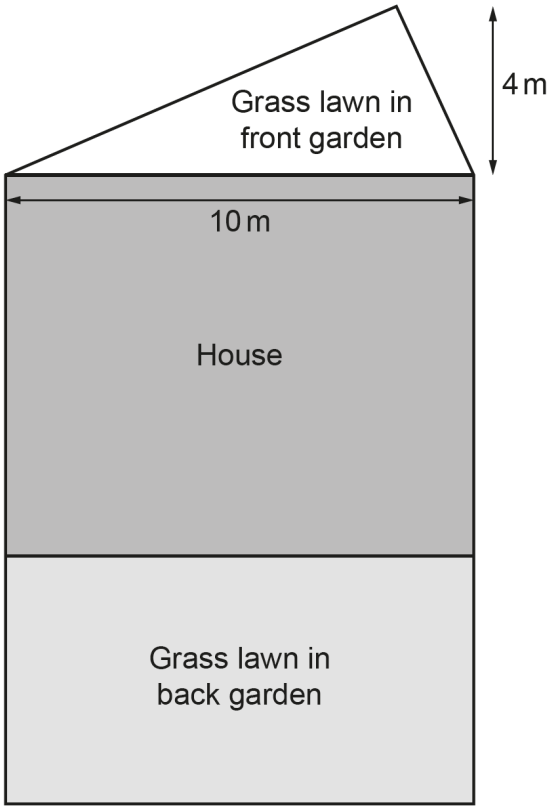
OCR support

See the Mathematical Skills Handbook for further support.

Question 16 (a)

16 A gardener grows thistle plants as weeds in his grass lawns.
He wants to see if thistle plants grow better in the front garden than in the back garden.

The diagram shows a plan of the grass lawns in each garden.



(a) The gardener estimates the number of thistle plants in each metre squared of the **back** garden. He gets an estimate of 2.5 thistle plants / m^2.

Describe an experimental method the gardener uses to get this estimate.

Include the name of the piece of apparatus he uses.

.....

.....

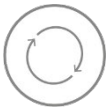
.....

.....

..... **[3]**

This question on AO1.3 was generally well answered with most candidates gaining at least 1 mark or more. Some candidates described a transect and so negated the quadrat mark and some candidates had not read the question fully so went on the describe how to calculate the number of thistle plants in the whole field, instead of the estimate which is the mean number of thistle plants per m^2.

Assessment for learning



Candidates should be encouraged to read the question fully and not just assume that the question is about the exact practical investigation that they carried out to estimate the whole population in the field. This question was asking for a mean number of thistle plants per m^2.

Question 16 (b)

(b) The **front** garden is smaller so he counts all the thistle plants growing in the lawn.
He counts 36 plants.

Calculate the number of thistle plants per metre squared in the front garden.
Use the formula: area of a triangle = ½ × base × height

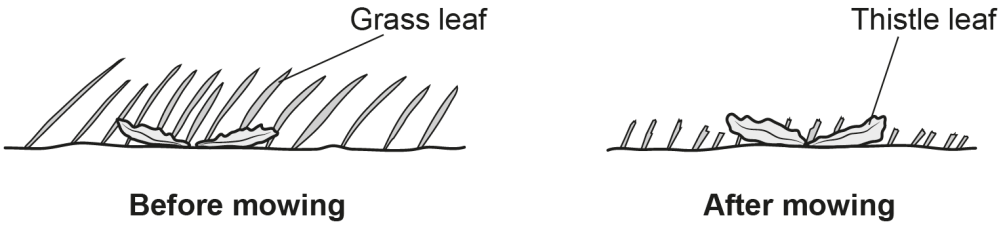
Number of thistles = ... /m^2 **[2]**

This AO2.2 calculation question was well answered by all candidates. Very few candidates scored zero. Very rarely candidates calculated the area of the triangle and then stopped as if they were planning to come back to this question. This emphasises the need for candidates to check that they have answered all the questions fully at the end of the examination.

Question 16 (c)

(c) The gardener cuts the grass more often in the back garden. He thinks thistles grow better when he mows the grass more often.

The diagram shows the grass lawns before and after he has mown them.



Before mowing **After mowing**

Explain how cutting the grass more often can affect how well the thistles grow.

Use ideas about competition and photosynthesis.

.....

.....

.....

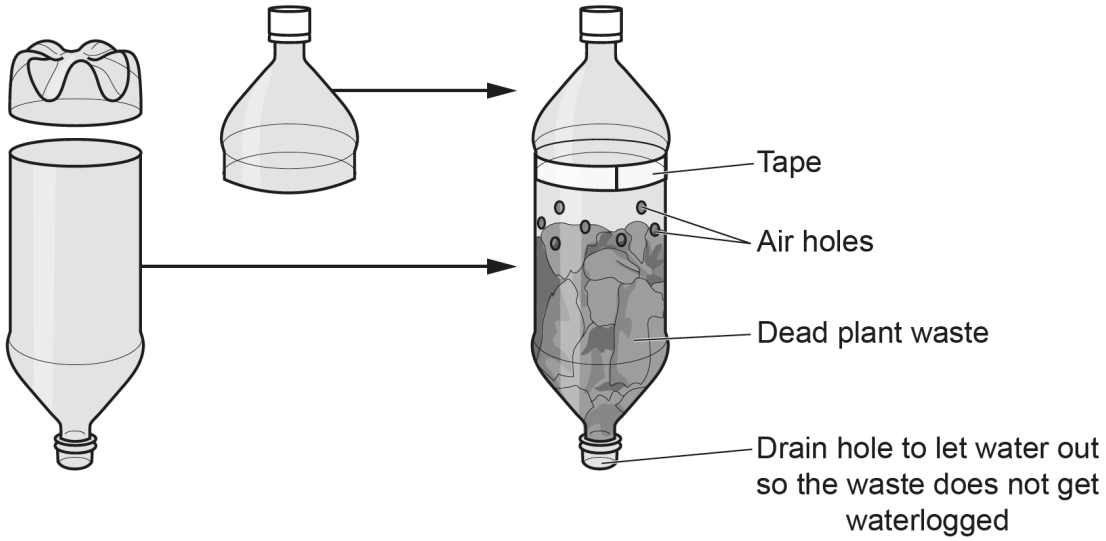
.....

..... **[3]**

Most candidates scored 2 of the 3 marks available for this question. The most common were the thistles gaining more light and for photosynthesis. Candidates missed the requirement by the question to link this to how well the thistles grow so did not mention the production of glucose for growth for the second AO2.1 mark. Candidates that only gained one mark often gave answers only referring to the long grass and not to the thistle plants after cutting the grass so were limited to the first marking point.

Question 17 (a)

17 Some students investigate decomposition of dead plant waste.
They make a composter from two plastic bottles.



(a) Why do the students make air holes in the bottle?
Tick (✓) **one** box.

To allow heat into the bottle. ☐

To allow oxygen gas into the bottle. ☐

To prevent the build-up of nitrogen gas in the bottle. ☐

So that carbon dioxide gas can enter. ☐

[1]

This AO1.2 question was well answered. Most candidates knew that the holes were to allow oxygen into the bottle.

Question 17 (b) (i)

(b) The students want to see if the number of air holes in the bottles affects the rate of decomposition.

- They set up bottles with different numbers of air holes.
- They then measure the mass of the bottle and compost at the start and after four weeks.

The table shows their results.

	Mass of bottles and plant waste (g)	
Number of air holes	**At the start**	**After 4 weeks**
2	300	270
4	300	250
8	300	240
16	300	235

(i) Calculate the loss in mass **per week** of the bottle and plant waste with 16 air holes.

Give your answer to **3** significant figures.

Loss in mass = ... grams / week **[3]**

This calculation question was well answered. Most gave their answer to 3 significant figures. When only 2 marks were scored it was because the answer was not given to 3 significant figures and the answer left at 16.25. Very few candidates were given 1 mark. This was for an incorrect calculation that had been given to 3 significant figures. This highlights the importance of candidates showing their working so that it can be given at any of the different stages of the calculation process.

Exemplar 1

$\frac{235}{4} = 58.75$

Loss in mass = ... 58.8 ... grams/week **[3]**

This response is an excellent example of the candidate showing their calculation method. ECF was applied to an incorrect answer that had been calculated but then given to 3 significant figures, scoring 1 mark.

This highlights the importance by candidates of showing their working out. Clear evidence of the correct conversion to 3 significant figures was required to be able to award 1 mark, otherwise it would not have been possible to apply ECF.

Question 17 (b) (ii)

(ii) Describe the effect of the number of air holes on the rate of decomposition of the plant waste.

.....

.....

.....

..... **[2]**

The majority of candidates scored 1 mark on this question for describing the increase in number of air holes and increase in the rate of decomposition. Very few candidates recognised that the relationship was not a linear one. Many went on to explain this relationship by the increase in oxygen and increase in respiration of the decomposers that would increase the rate, even though this had not been asked.

Assessment for learning

Candidates should practice describing data and graphs that are linear and not linear. They should attempt description questions that are worth more than 1 mark to highlight the importance of describing the data or graph in more detail.

Question 17 (b) (iii)

(iii) The students checked that all the bottles and plant waste had a mass of 300 g at the start of the experiment.

Explain why this helps the students to analyse the results.

.....

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

Candidates found this AO2.2 question challenging. Many candidates suggested it was a control variable, instead of explaining how it would help students to analyse the results.

Question 17 (b) (iv)

(iv) What is the independent variable in the students' investigation?

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

The number of air holes as the independent variable was successfully identified by many candidates. Some candidates were not specific enough and just said air holes so did not score.

Question 17 (b) (v)

(v) The students notice that during the experiment, water drips through the drain hole at the bottom of the apparatus on to the floor.

Explain why this can produce inaccurate results **and** how the students can change their method to correct this.

.....

.....

.....

..... **[2]**

Many candidates were able to recognise that the loss of the water would decrease the mass of the bottle and plant material for the AO2.2 part of the question. Some incorrectly suggested the plant material would be lost. The AO3.2b part of the question required candidates to improve the experimental design to overcome the loss of water in the mass. Some were able to correctly describe collecting and measuring the mass of the water that came out of the drain hole by a variety of methods. Measuring the amount of water was too vague. Some suggested blocking the drain hole. This would have caused waterlogging as seen in the diagram so would not have been a successful change to the method.

Question 18 (a)

18 The diagram shows a tulip plant. Many gardeners like to grow tulip plants.

(a) Tulips can be grown from seeds produced from sexual reproduction.

They can also be grown from bulbs that are produced by asexual reproduction.

Explain why most gardeners choose to grow bulbs produced by asexual reproduction rather than seeds.

.....

.....

.....

..... **[2]**

Many candidates were able to score at least 1 mark on this AO2.2 question by knowing that the bulbs would all be identical. It was common to see the incorrect answer that asexual reproduction was quicker as there was only one parent, showing a misinterpretation of the question. Candidates that scored full marks said that the bulbs grow quicker or that the gardeners will be able to get the desirable plants.

Misconception

There was a misconception that the seeds and bulbs undergo sexual and asexual reproduction themselves, respectively, rather than being the product of the two different types of reproduction. This led to the incorrect answers about asexual reproduction of bulbs being faster, or that bulbs do not need to find a mate.

Question 18 (b)

(b) In 1637, tulip growers found that a small number of their tulip plants produced flowers with different coloured stripes.

Until recently, there were two possible theories that explained the colours of these tulips.

Theory **1** – The stripes are caused by a mutation in the gene that produced the chemical that coloured the flower.

Theory **2** – The stripes are caused by a pathogen that infects the plant and changes the production of the coloured chemical.

Put ticks (✓) or crosses (✗) in the table to show whether each theory would produce changes in the phenotype and in the genotype of the tulip plants.

	Theory 1	**Theory 2**
Changes the phenotype of the tulip plant		
Changes the genotype of the tulip plant		

[2]

Candidates scored well on this AO2.2 question if they followed the instructions and put ticks or crosses in the table. Those that scored 1 mark got the first row correct with 2 ticks but omitted the cross in the second row.

Assessment for learning

Candidates should practice a variety of questions asking for just ticks or ticks and crosses. This would encourage candidates to read the question carefully and to follow the directions in the question.

Question 18 (c) (i)

(c) Scientists now know that the colour changes are caused by a virus which infects the tulip tissue.

- The virus is injected into the phloem of the tulip by feeding insects.
- Although the infected bulbs produce attractive flowers, the infected bulbs become weaker every year until they die.

(i) 2.0×10^9 tulips are grown in the Netherlands every year. This uses 14 200 hectares of land.

1.5% of all the tulips grown are infected.

Calculate how many infected tulips there are in one hectare of land.

Number of infected tulips = ... **[2]**

Most candidates carried out this calculation well and scored full marks. Those that did not score often missed out the division by 14 200 hectares to convert their answer to the number of infected tulips in one hectare of land.

Question 18 (c) *(ii)

***(ii)** Growers need to identify infected tulips as soon as possible.

This allows them to only spray a small area with insecticide.

Scientists have developed a machine that moves rapidly through the fields scanning for infected tulips.

The text box shows the results of a trial of the machine in a field containing 1000 tulips.

The results of a trial of the machine are:

Actual results:
- 15 tulips infected
- 985 tulips not infected

Machine results:
- All 15 infected tulips identified
- 14 not infected tulips identified as infected
- 971 not infected tulips identified as not infected

Discuss the advantage of early detection of infected tulips and how useful the machine may be in making this possible.

Use data from the text box in your answer.

.....

.....

.....

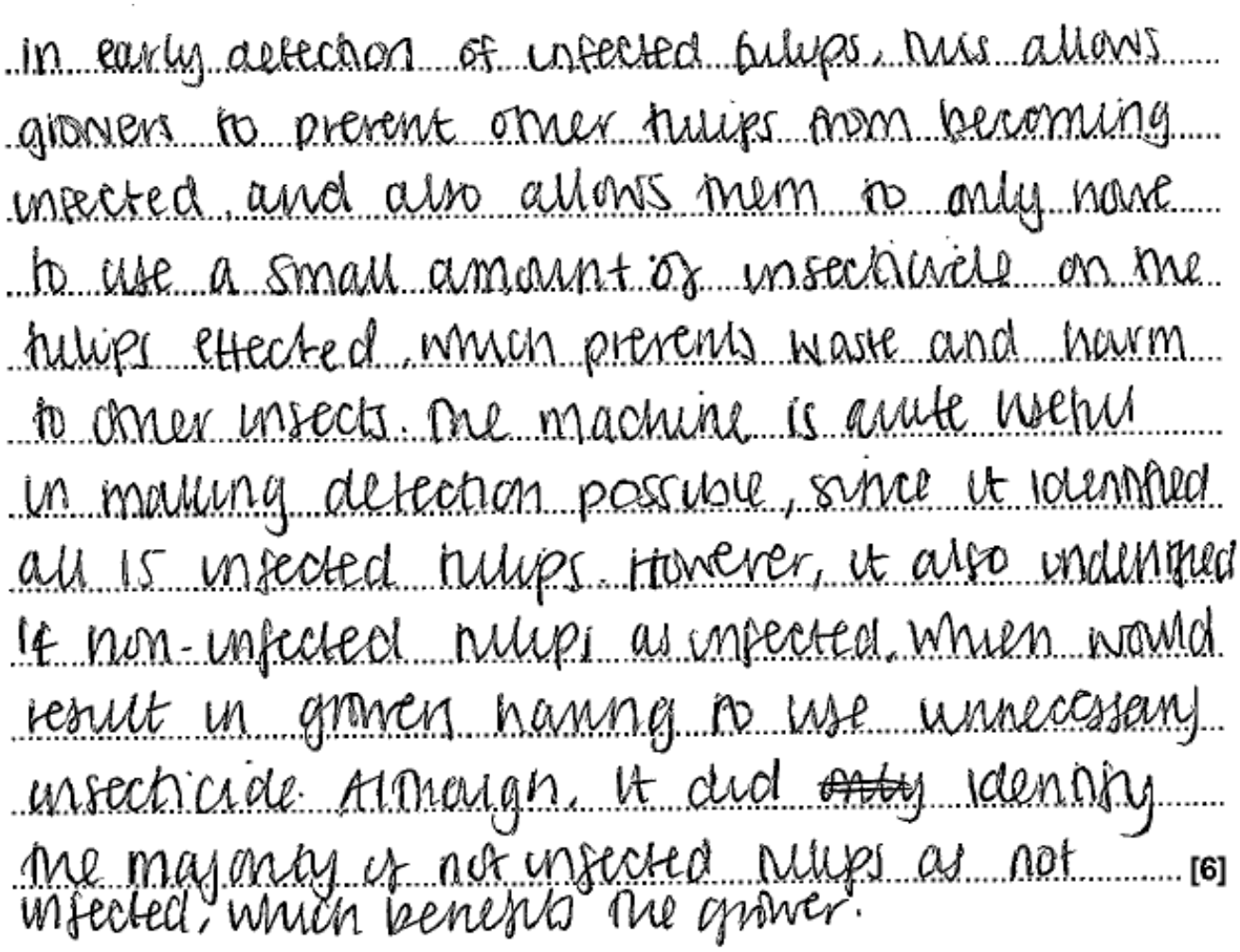
.....

.....

..... **[6]**

There were a lot of well-constructed answers to this Level of Response question covering the AO1.1 and AO3.2a components. Most candidates could state that early detection of the virus would stop the spread of infection and that the machine helped the farmer to quickly identify the infected tulips. Many candidates discussed the diagnosis rates of the machine and although it did identify some non-infected tulips as infected, they recognised that it did not miss out any infected tulips. The most common score was Level 2, 4 marks. The discussion of the advantage for AO2.1 was rarely seen to score at Level 3, as many candidates mentioned that there would be a disadvantage to using the machine if it detected non-infected tulips as infected.

Exemplar 2



This response represents an excellent example of how to gain maximum marks. The candidate has clearly stated the advantage of early detection by 'preventing other tulips from being infected' for AO1.1. They also discuss the advantage of the early detection as 'the use of a small amount of insecticide on the tulips effected, preventing waste and harm to other insects' for AO2.1. The candidate then discusses how useful the machine is, 'since it identified all 15 infected tulips' for AO3.2a. The communication is clear, concise and all aspects of the question have been covered so it scores Level 3, 6 marks.

OCR support

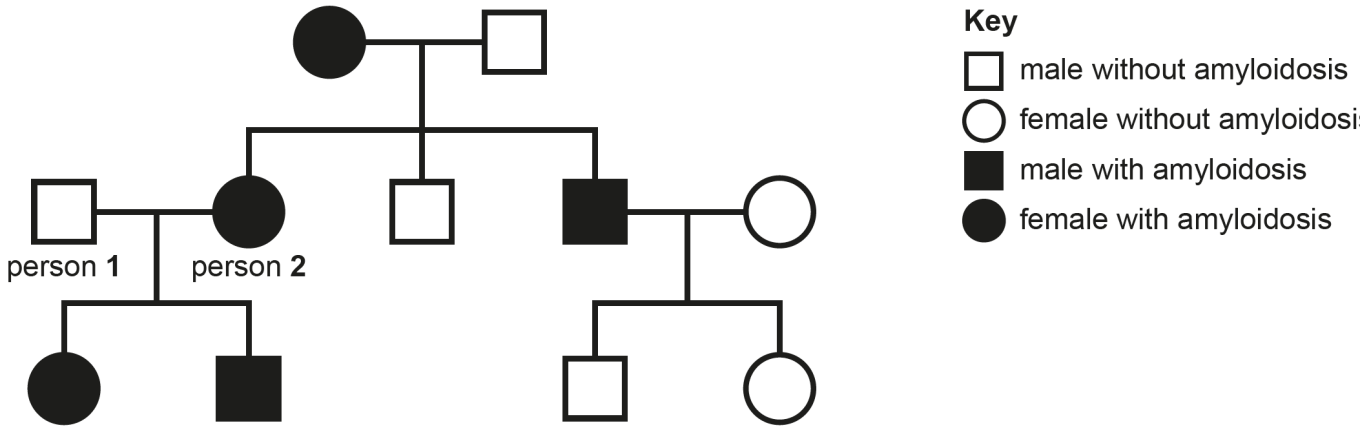
This How to answer 6 mark Level of Response questions set of activities will be useful to share with candidates. It will allow them to practice identifying key parts of questions, as well as familiarise themselves with different levels of answer.

Question 19 (a) (i)

19 Amyloidosis is a group of inherited conditions that affect people's health.

The most common type of amyloidosis is caused by a dominant allele (**A**) of a gene.

(a) The diagram shows the inheritance of amyloidosis in a family.



(i) Complete the table about the family tree.

The first row has been done for you.

	Number of people in the family
males	6
people who are **homozygous recessive** for the gene	
people who are **homozygous dominant** for the gene	

[2]

Many candidates scored at least 1 mark on this AO2.1 question as they could identify and count the 6 people that were homozygous recessive for the gene, by counting the white circles and squares. The second number was only identified by the higher ability candidates as it required further application and understanding of the inheritance of the dominant allele in the family tree diagram. Some candidates counted the black circles and squares so put 5, without recognising the offspring genotypes that couldn't be produced if these parents were homozygous dominant. These parents had to be heterozygous to get the offspring shown on the family tree, so the answer should have been 0.

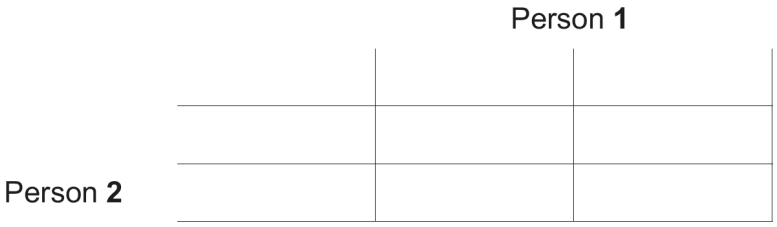
Assessment for learning

Candidates should practice genetic crosses using family tree diagrams. This would encourage candidates to work out the genotypes from the genetic crosses shown in the diagram and from the key of circles and squares and not assume that all people are either homozygous dominant or homozygous recessive.

Question 19 (a) (ii)

(ii) Person **1** and person **2** are expecting another baby.

Complete the genetic diagram to find the probability that the baby will have amyloidosis.



Probability = ... **[3]**

Even if the candidate had suggested incorrectly that person 2 was homozygous dominant in their count in Question 19(a)(i) they did not always use this information to complete the genetic diagram in this question and went on to score full marks. If the gametes and cross were both correct for AO2.1, then most candidates went on to score full marks by concluding the probability was 50% for the AO3.2b part of the question. Candidates that did not get the gametes correct, as they did not appreciate that person 2 was heterozygous were able to score 1 mark for the ECF for the correct offspring.

Question 19 (b)

(b) Allele **(A)** codes for the production of a protein called amyloid.
Amyloid can block the blood vessels that leave the pancreas and the thyroid gland, preventing the release of hormones.

Complete the sentences to explain the symptoms that might be shown by person **2** in **(a)**.

Symptoms of person **2** can include:

- Being unable to control blood ..... due to a lack of the hormones ..... and ..... .
- Being unable to control ..... rate due to a lack of the hormone ..... .

[4]

This question discriminated well as only higher ability candidates scored full marks. The most common correct answer was sugar for the first marking point and thyroxine for the fourth marking point. Insulin was often given but the second hormone was not correct for marking point 2, with answers such as glycogen, thyroxine, and adrenaline. Some candidates missed the link to the thyroid gland in the question and thought that the third marking point was referring to heart rate and so put adrenaline as the hormone that was lacking.

Assessment for learning

Candidates should be encouraged to read and highlight or underline key parts of the question which provide relevant information. This would highlight the pancreas and thyroid as the two glands that were being affected and would help the candidate to make the link to the symptoms and hormones that would be lacking.

Question 19 (c)

(c) One treatment that doctors use for amyloidosis involves:

- Killing all the plasma cells in the body.
- Then giving the patient healthy stem cells.

Explain how this treatment could help people with amyloidosis.

.....

.....

.....

..... **[2]**

Many candidates, even higher ability candidates found this AO2.1 question challenging. Candidates had not recognised the two bullet points as a direction on how to structure their answer. Many answers referred to killing amyloid, forming new blood plasma, and making new cells. Candidates that scored 1 mark were able to link killing plasma cells to the stopping of the production of the amyloid protein. Many candidates appreciated that stem cells could differentiate into new cells, but it was rare to see 'differentiate into plasma cells' for the second marking point.

Question 19 (d)

(d) Scientists are now developing a new treatment called gene silencing.
They have developed a drug that destroys the mRNA that codes for the amyloid protein.

Explain why this technique is called **gene silencing**.

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..... **[2]**

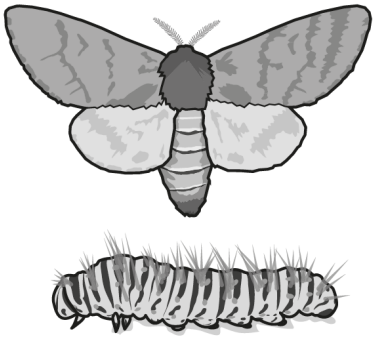
Again, this AO2.1 question was challenging for all candidates and only a very small number scored full marks. Many candidates thought that the gene or DNA code had been destroyed. Few candidates appreciated that since the mRNA had been destroyed, transcription had already taken place and that it was translation or the production of the protein that could not take place.

Misconception

There was a misconception that if a gene is silenced, the gene is destroyed.

Question 20 (a)

20 Pine processionary moths lay eggs that develop into larvae and then into caterpillars, as shown in the diagram.



moth

caterpillar

The caterpillars are a major pest, eating and killing pine trees.

The caterpillars are fed on by birds such as cuckoos. The caterpillars are also parasitised by fungi.

(a) Draw a labelled pyramid of biomass for these feeding relationships showing the organisms at each level.

[2]

Candidates found this AO2.1 question challenging as there were 4 named organisms in the stem of the question. This led to many candidates drawing and labelling 4 trophic levels, without realising that both the birds and fungi fed on the caterpillars so were part of the same trophic level. Some candidates did score 1 mark for drawing 3 trophic levels but then missed off the fungi label so did not score the second marking point.

Question 20 (b)

(b) The caterpillars have long hairs on their bodies that cause irritation to predators. Cuckoos have a special sticky membrane lining their guts that traps these hairs. This allows the cuckoos to eat the caterpillars.

Explain how natural selection may have resulted in all cuckoos having the sticky membrane.

.....

.....

.....

.....

.....

..... **[4]**

Most candidates were able to score some marks on this AO2.1 question. Candidates did not generalise their description of natural selection and most answers were clearly linked to the cuckoos and the sticky membrane. Some candidates missed the first marking point by not mentioning mutation and/or the second marking point by saying they could survive better, without referring to being able to eat the caterpillars. As in previous years even the higher ability candidates referred to passing on the gene or characteristic for sticky membranes instead of the allele. Many candidates had clearly been taught that this occurred over many generations however some missed the idea that this continued until **all** the cuckoos had the sticky membrane as mentioned in the question.

Question 20 (c) (i)

(c) Scientists are controlling the pine processionary moth to conserve pine trees.

They spray the caterpillar's eggs or larvae with fungal spores.

This has been successful when spraying different concentrations of spores:

- 1×10^6 spores / ml on the eggs
- 1×10^8 spores / ml on the larvae.

(i) Name this type of control method.

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

On this AO1.1 recall question only the higher ability candidates scored. A whole range of incorrect answers were given included pesticides, fungicides, spore control, pest control and artificial. It was also the most frequently omitted question as candidates either knew the term 'biological' or did not.

Question 20 (c) (ii)

(ii) The concentration of spores used on the larvae is higher than the concentration used on the eggs.

By how many orders of magnitude is it higher?

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

A good number of candidates could calculate 2 orders of magnitude higher from 1 x 10^6 and 1 x 10^8. The most common incorrect answers were 10^2 and 100.

Question 20 (d) (i)

(d) Scientists have also tried to use natural plant defence methods on the larvae.

The table shows the effects of two plant-based oils on the larvae in laboratory conditions and on the pine trees.

Type of oil	**Deaths per 1000 larvae**	
	In the laboratory	**On the pine tree**
Ginger	712	874
Rosemary	300	761
Control treatment	13	22

(i) Calculate the percentage increase in the death of larvae on the pine trees compared to in the laboratory for the control treatment.

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

Higher ability candidates scored full marks on this calculation question. A common error was to put the 9 over 22 instead of 13, giving a percentage change of 40.9. Some candidates misread the question and used the data for ginger or rosemary instead and not the control treatment as asked for in the question.

Question 20 (d) (ii)

(ii) More larvae die in the natural environment of the pine trees than in the laboratory for all treatments.

Suggest **one** reason why.

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

This AO2.1 was generally well answered by most candidates. The larvae having predators on the pine trees was the most common correct answer. When candidates did not score it was usually because their answer was too vague, for example a less controlled environment, or unsuitable conditions on the pine tree.

Question 20 (d) (iii)

(iii) Evaluate the use of the two plant oils in the control of the larvae.

Use data from the table.

.....

.....

.....

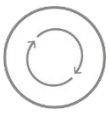
.....

.....

..... **[3]**

The majority of candidates gained some marks on this AO3.1b question, with a minority gaining maximum marks. Most candidates were able to analyse the information and recognise that the ginger oil was the most effective at killing the larvae. Fewer commented on the ginger or rosemary oil being more effective on the pine tree and fewer still used data from the table and just quoted it instead. Some candidates only referred to one oil instead of evaluating the two oils as asked for in the question.

Assessment for learning



Candidates should be prepared to evaluate by processing information from the table provided, before attempting to answer the question. This will help them to construct a response that will cover the marks available in the question and make sure that the data is used to support their evaluation.

Question 21 (a)

21 Measles is an infectious disease caused by a virus.

A vaccine is available to protect people against measles.

(a) Explain how vaccinations can protect people against diseases such as measles.

.....

.....

.....

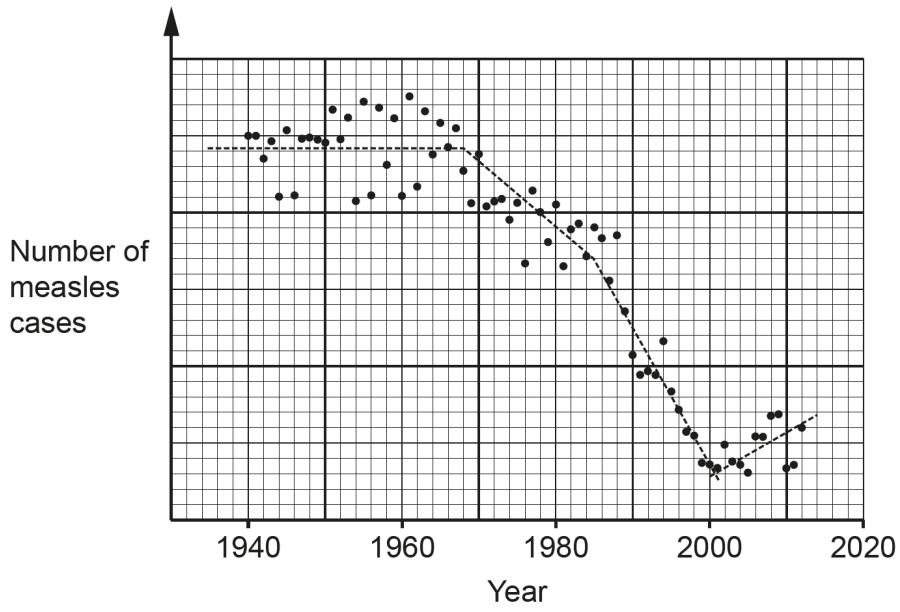
.....

..... **[3]**

This question discriminated well. The higher ability candidates had a very good understanding of his AO1.1 question recalling knowledge of how vaccinations protect people against diseases. Answers were extremely thorough and detailed using the correct terminology. Most candidates described the action of the lymphocytes and antibodies before getting to the formation of memory cells and the faster production of antibodies. A common mistake for the first marking point was to give a more generic response about what the vaccine would contain, such as the disease or infection. Some candidates thought that the antibodies made the memory cells, which did not score a mark.

Question 21 (b) (i)

(b) The graph shows the number of cases of measles in the UK from 1940 to 2012.



In 1968, vaccinations against measles started for children.
Since then, there have been two other significant events that have affected the number of measles cases.

Use the graph to suggest a year when each event occurred.
Give **one** reason for your choice of year for each event.

(i) The measles vaccine was given as a triple vaccine called MMR. This was more convenient because MMR vaccinated children for three diseases at the same time.

Year .....

Reason .....

.....

..... **[2]**

Most candidates that identified the correct date, also got the reason correct and scored full marks on this AO3.1a question. 1968 was the most common incorrect date given. This is the date that the vaccinations against measles started so the number of cases started to fall, but it was not the date of the MMR vaccine as asked for in the question.

Question 21 (b) (ii)

(ii) A report claiming a link between the MMR vaccine and an increased risk of the disorder called autism.

Year .....

Reason .....

.....

.....

..... **[2]**

This AO3 question was asking candidates to analyse the information given and make judgements. Most candidates could identify the correct year of 2001. The reasons for making this judgement were the concern about the risk or autism and the link to less vaccinations causing the increase in measles cases. Some candidates only gave one part of the reason and did not score this second marking point.

Question 21 (c)

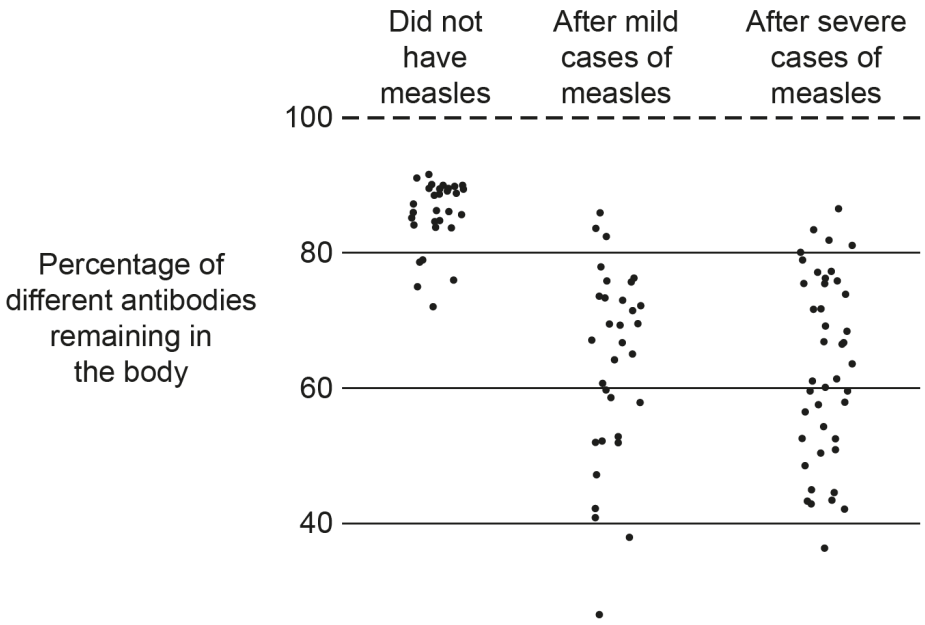
(c) A study looked at how measles infections can affect the number of antibodies for other pathogens in a person's body.

The study included three groups of children:

- children who did not have measles
- children with mild cases of measles
- children with severe cases of measles.

The study measured the percentage of different antibodies remaining in the children six weeks after infection.

The diagram shows the results. The result for each child is marked with a dot.



Most people recover from measles but may get ill again with different symptoms afterwards.

How do the findings shown in this diagram explain this after-effect of a measles infection?

.....

.....

..... **[2]**

Candidates were being asked to analyse the information and draw conclusions in this AO3.2b question. Many candidates did not recognise that the graph was showing the **different** antibodies remaining and gave answers suggesting it was the antibodies to measles that had decreased and therefore concluded that people would get ill with measles again. Higher ability candidates did recognise that the percentage of different antibodies had decreased and that this would give people less protection against other diseases.

Question 22 (a) (i)

22 Read the text below about two different genetic disorders or syndromes.

> Human genes are found on chromosomes in the nuclei of cells.
>
> In body cells, there is the diploid number of chromosomes, and in gametes there is the haploid number.
>
> Sometimes a gamete is formed that has an extra chromosome.
>
> - If this is chromosome number 18, a child with Edward's syndrome can be born.
> - If it is chromosome 21, a child that has Down's syndrome can be born.

(a) (i) Explain the difference between haploid and diploid cells.

.....

.....

..... **[2]**

The majority of candidates were able to score at least 1 mark on this AO1.1 recall question. 'Haploid cells have half the number of chromosomes' was the most common marking point seen. Some candidates found it more difficult to express how diploid cells were different. Incorrect answers included they 'were full cells' and 'two pairs of chromosomes'. Some candidates scored 1 mark for stating that haploid cells have 23 chromosomes and diploid cells have 46 chromosomes. A good number were able to express the difference in terms of sets of chromosomes for full marks.

Question 22 (a) (ii)

(ii) Explain how meiosis usually makes gametes that will produce children without these genetic disorders.

.....

.....

.....

..... **[2]**

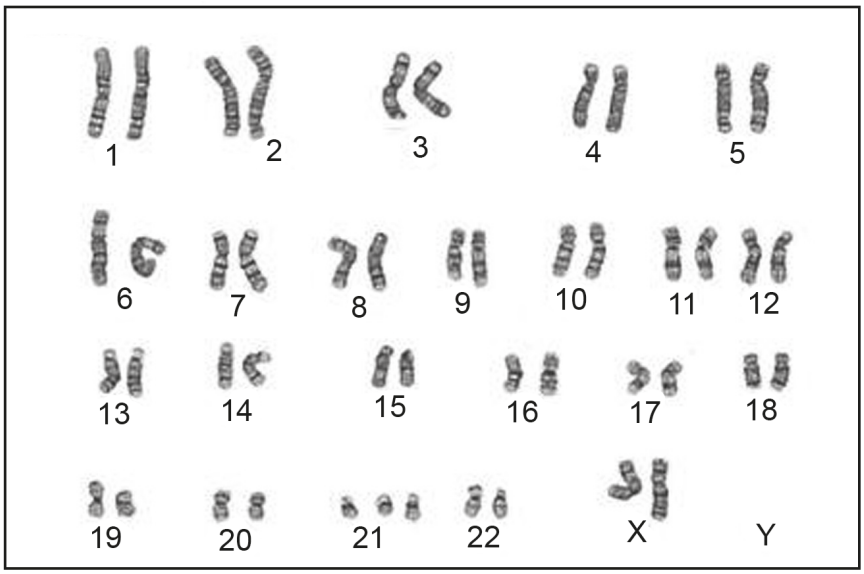
Candidates found the second part of 22a more challenging and only a small number scored full marks on this AO1.1 question. Many candidates knew that gametes were haploid, and that the gametes would not have any extra chromosomes if the children did not have a genetic disorder. Many responses included lots of detail about the process of meiosis to make these haploid gametes. Very few candidates went on to explain how these gametes would make children without these genetic disorders.

Assessment for learning

A good technique for centres to adopt would be for their candidates to be able to de-construct the question. The first part of this question is asking for an explanation of how meiosis makes gametes. The second part of this question is asking for an explanation of how children are produced without the genetic disorders. This required a response about the 2 gametes joining at fertilisation to make a diploid zygote, or to restore the full chromosome number.

Question 22 (b)

(b) The diagram shows the chromosomes found in a cell of a child.



Write down **two** conclusions that can be made about this child from the diagram.

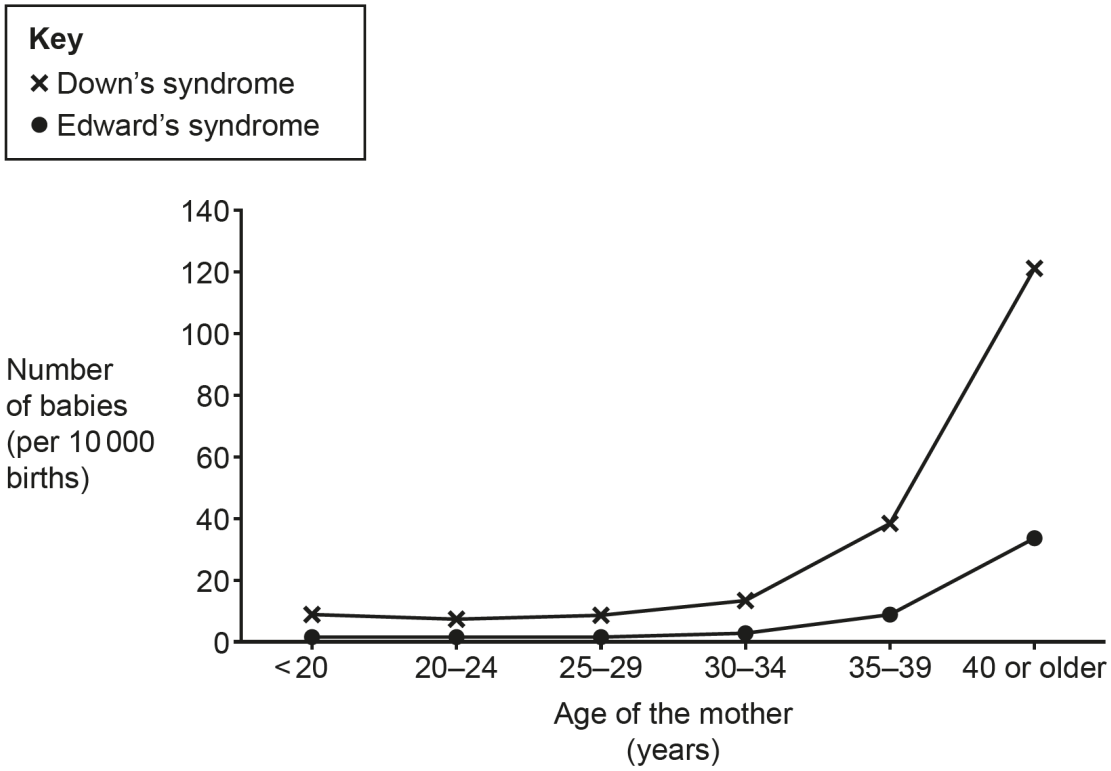
1.....

2..... **[2]**

This AO3.2b question required candidates to draw suitable conclusions from the diagram. A good number of candidates recognised the 2 X chromosomes and the 3 copies of chromosome number 21. They concluded that this child was a female, and that they had Down's syndrome. A surprising number of candidates were distracted by the Y on the diagram and suggested this was a male. This child does have Down's syndrome so answers that said, 'may have' or 'could have' Down's syndrome did not score the second marking point.

Question 22 (c) (i)

(c) The graph shows how the number of babies born with Down's syndrome or Edward's syndrome varies with the age of the mother.



(i) Give **two** conclusions that can be made from this graph.

1 .....

.....

2 .....

..... **[2]**

This AO3.2b question was extremely well answered by all candidates. Most candidates scored full marks as they could draw correct conclusions from the graph. A very small number of candidates only scored 1 mark. This was because one of their conclusions was too vague, referring to genetic diseases or genetic conditions instead of Down's syndrome and/or Edward's syndrome as seen on the key on the graph.

Question 22 (c) (ii)

(ii) In the ovary, meiosis starts before a woman is born and is not completed until just before ovulation.

How does this information explain the trends shown in the graph?

.....

.....

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

This AO3.2b question proved to be very challenging, even for some of the higher ability candidates. Very few candidates scored the mark. Some candidates correctly suggested that meiosis had been going on for longer but then didn't link it to increasing the chance of an egg having a mutation or an extra chromosome to explain the trends shown in the graph. Many answers referred to the menopause, or that older women had been making eggs for longer or that they now do not have any eggs. None of these answers would explain the trends in the graph as required by the question.

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