

OCR A GCSE BIOLOGY 9-1 PAPER 2 2022 EXAM

Advance Information for Summer 2022

GCSE (9–1)

Biology A (Gateway Science)

J247

We have produced this advance information to help support all teachers and students with revision for the Summer 2022 exams.

Information

- The format/structure of the papers remains unchanged.
- This notice covers all examined components.
- For each paper, the main list shows the major focus of the content of the exam.
- Topics **not** assessed, either directly or synoptically, have also been listed.
- The information is presented in specification order, **not** in question order.
- Assessment of practical skills, maths skills, and Working Scientifically skills will occur throughout all of the papers.
- You are **not** permitted to take this notice into the exam.
- This document has **3** pages.

Advice

- It is advised that teaching and learning should still cover the entire subject content in the specification, so that students are as well prepared as possible for progression.
- Topics not explicitly given in either list may appear in low tariff questions or via synoptic questions (e.g., questions where students are asked to bring together knowledge, skills and understanding from across the specification).
- Students will still be expected to apply their knowledge to unfamiliar contexts.

J247/04

- Section 5.1 Inheritance
- Section 5.2 Natural selection and evolution
- Section 6.1 Monitoring and maintaining the environment
- Section 6.3 Monitoring and maintaining health

Required practical skills that will be assessed:

- Practical Activity Group 3: The use of sampling techniques to investigate organisms in a habitat.
- Practical Activity Group 4: Investigation of the most favourable conditions for composting.
- Practical Activity Group 7: Investigate the effectiveness of antimicrobial agents on the growth of a bacterial lawn.

Topics not assessed in this paper:

- Section 1.1 Cell structure
- Section 1.3 Respiration
- Section 2.2 The challenges of size
- Section 3.1 Coordination and control – the nervous system

Higher Tier, grades 9 to 4

Content is split into six teaching topics B1–B6 and a practical activity skills topic B7:

- Topic B1: Cell level systems
- Topic B2: Scaling up
- Topic B3: Organism level systems
- Topic B4: Community level systems
- Topic B5: Genes, inheritance and selection
- Topic B6: Global challenges
- Topic B7: Practical skills

Paper 3 assesses content from Topics B1–B3 and B7

Paper 4 assesses content from Topics B4–B6 and B7, with assumed knowledge of Topics B1–B3.

Paper 3

J247/03

90 marks

1 hour 45 minutes

Written paper

**50%
of total
GCSE**

Paper 4

J247/04

90 marks

1 hour 45 minutes

Written paper

**50%
of total
GCSE**

J247/02 and J247/04 include synoptic assessment.

Note:

This revision pack only covers the main content mentioned in the paper 2 of advance information for summer 2022 OCR A GCSE Biology exam. Topics not listed in either assesses or not assessed sections may still come as low tariff questions.

Science
With Saul

Tutoring & Exam Prep

Gateway Biology A (9-1)

OCR A GCSE paper 2 2022 exam

Baljit Saul

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

OCR
Oxford Cambridge and RSA**Duration: Not set**

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **305**.
- The total number of marks may take into account some 'either/or' question choices.

Mark scheme

| Question | Answer/Indicative content | Marks | Guidance |
|----------|--|-------|---|
| 1 a | <p>[Level 3] Explains implications of all three conditions, at least one of them in detail and at least one calculation that indicates the number of people that may be involved. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>[Level 2] Explains implications of two conditions and at least one calculation that indicates the number or a calculated percentage of people that may be involved or two conditions at least one of them in detail. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>[Level 1] Explains implications of at least one condition. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p> | 6 | <p>This question is targeted at grades up to A.</p> <p>Indicative scientific points at level 3 may include:</p> <ul style="list-style-type: none"> • plaque formation / fatty deposits in the coronary arteries can lead to reduced blood supply to heart muscle / lack of oxygen and or glucose to heart muscle / thrombosis • high blood pressure is linked to (an increased risk of) thrombosis / strokes / kidney damage • allow Type 2 diabetes causes kidney damage / blindness / poor circulation / ulcers <p>Indicative scientific points at level 1, 2 may include:</p> <ul style="list-style-type: none"> • too much cholesterol in the blood can form plaques in the walls of arteries ignore high blood cholesterol is linked to (an increased risk of) heart disease (low demand) • failure to respond to insulin is failure to control blood sugar levels / Type 2 diabetes • ignore failure to respond to insulin is diabetes (low demand) <p>Indicative scientific points at level 1 only:</p> <ul style="list-style-type: none"> • high blood pressure is linked to (an increased risk of) heart disease / heart attack • allow 1 mark for correct calculation only with no other explanations <p>example of calculations</p> |


| | | | | |
|---|-----|---|----------|---|
| | | | | <ul style="list-style-type: none"> • 30 000 people in Singapore have all three conditions (or similar calculation) • 330 000 have high blood pressure only • 68% have a single condition • 60% have at least one heart related / circulatory disease <p>Use L1, L2, L3 annotations in scoris; do not use ticks.</p> <p>Examiner's Comments</p> <p>There were some good descriptions of the effects of cholesterol and high blood pressure. A number of candidates simply repeated the data given in the pie chart without any type of numerical calculations. The distinction between type 1 and 2 diabetes was often confused and this often limited access to the higher marks.</p> |
| | b | 29% have two of the conditions only but we do not know which two (1) | 1 | <p>allow some people have two conditions but we don't know which one</p> <p>Examiner's Comments</p> <p>This was generally well answered.</p> |
| | | Total | 7 | |
| 2 | a | <p>50% /$\frac{1}{2}$/1 in 2 (1)</p> <p>Gemma must be / heterozygous / (only) got one dominant allele and Leroy is / homozygous recessive / has no dominant allele (1)</p> | 2 | <p>allow 50/50</p> <p>allow letters such as Hh and hh in a punnet square but must indicate which genotype belongs to who Look for correct labelling on diagram</p> <p>Examiner's Comments</p> <p>There were a lot of Punnett squares drawn in response to this question, the majority correct. Although many did work out the correct ratio, a number of candidates tried to work out the probability based on the ratio of brothers and sisters affected, rather than the genotypes of Gemma and Leroy.</p> |
| | b i | <p>Gemma's phenotype but not her genotype (1)</p> <p>last box</p> | 1 | <p>Examiner's Comments</p> <p>A good discriminator question.</p> |
| | ii | <p>any two from:</p> <p>(antigens trigger) white blood cells release antibodies / antitoxins (1) antibodies / antitoxins lock on to antigens</p> | 2 | <p>allow attach on to antigens allow phagocytosis / digest antigen ignore eaten</p> |



| | | | | | | |
|------------------------------|-------------------------|---|------------------------------|---|---|---|
| | | (and destroy them) (1) white blood cells engulf antigens (1) | | ignore antibodies engulf antigens ignore pathogens Examiner's Comments The best responses clearly described the roles of white blood cells in antibody production and phagocytosis. With a few candidates there was some confusion between antigens, antibodies and even antibiotics, for example 'antibodies engulfing antigens' or 'antigens producing antibodies'. Other candidates incorrectly referred to pathogens. | | |
| | | Total | 5 | | | |
| 3 | | comment 1 / about being better for health overall is an opinion (1) comment 2 / difference in fat content / link between fat and heart disease are scientific facts (1) | 2 | must clearly link each statement to opinion or fact allow comment 1 is opinion, comment 2 is fact (2) | | |
| | | Total | 2 | | | |
| 4 | a | contains a dead / weakened / harmless form of the virus (1) (white blood cells) make antibodies (1) the antibodies / memory cells remain / are still present (1) | 3 | allow pathogen / antigens not bacteria ignore small amount of the virus / weakened dose of disease ignore antitoxins / antivirals allow on reinfection then antibodies made faster (2) | | |
| | b | a tablet / dose / medicine that does not contain any drug / medicine (1) idea to see if any effect is psychological / to see if thinking you had the drug makes a difference (1) | 2 | allow fake drug / sugar pill / inactive drug ignore pill that has no effect allow effect of drug can be compared to placebo effect / feel good factor / to prevent bias / to compare the results between the real drug and the placebo / to see if the drug works / has any effect | | |
| | | Total | 5 | | | |
| 5 | a | <table border="1" style="width: 100%; text-align: center;"> <tr> <td>Charles Darwin's observation</td> <td>Scientists' observation</td> </tr> </table> | Charles Darwin's observation | Scientists' observation | 2 | three or four correct = 2 marks two correct = 1 mark one or none correct = 0 marks |
| Charles Darwin's observation | Scientists' observation | | | | | |


| | | | | | | | | | | | | |
|---------------------------------------|----------|--|-------------------------|---|---------------------------|----------|---------------------------------------|----------|-------------------------------|----------|--|--|
| | | <table border="1"> <tr> <td>survival of the fittest</td> <td>C</td> </tr> <tr> <td>competition for resources</td> <td>B</td> </tr> <tr> <td>inheritance of successful adaptations</td> <td>D</td> </tr> <tr> <td>presence of natural variation</td> <td>A</td> </tr> </table> | survival of the fittest | C | competition for resources | B | inheritance of successful adaptations | D | presence of natural variation | A | | |
| survival of the fittest | C | | | | | | | | | | | |
| competition for resources | B | | | | | | | | | | | |
| inheritance of successful adaptations | D | | | | | | | | | | | |
| presence of natural variation | A | | | | | | | | | | | |
| | b | <p>[Level 3] idea of how carbon dioxide contributes to the greenhouse effect AND effect on snowshoe hares and their habitat AND linked to a reason for numbers dropping / extinction</p> <p>Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] idea of how carbon dioxide contributes to the greenhouse effect AND effect on snowshoe hares and their habitat OR linked to a reason for numbers dropping / extinction</p> <p>Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] idea of how carbon dioxide contributes to the greenhouse effect OR effect on snowshoe hares and their habitat OR a reason for numbers dropping / extinction</p> <p>OR reference to the prediction by the scientists (1 – 2 marks)</p> | 6 | <p>This question is targeted up to grade C</p> <p>Indicative scientific points about carbon dioxide in the environment include:</p> <ul style="list-style-type: none"> • the greenhouse effect • carbon dioxide being a greenhouse gas • trapping more heat in the Earth’s atmosphere / less radiated out to space • global warming <p>Indicative scientific points about the hares habitat include:</p> <ul style="list-style-type: none"> • loss of habitat • not having as much camouflage • numbers may fall below critical level <p>- reduced population</p> <p>Indicative scientific points about the hares extinction include:</p> <ul style="list-style-type: none"> • this may result in <p>- higher predation</p> <p>- lack of genetic variation</p> <p>- inability to find mates / lower reproduction rate</p> | | | | | | | | |

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|--|---|---|---|----------|--|--|--|--|--|---|---|--------------------------|
| | | | <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p> | | <p>Indicative scientific points about prediction by the scientists at Level 1</p> <ul style="list-style-type: none"> predictions show that less hares will survive <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p> | | | | | | | |
| | | | Total | 8 | | | | | | | | |
| 6 | a | <table border="1"> <tr> <td>the same class, genus and species.</td> <td></td> </tr> <tr> <td>different class, genus and species.</td> <td></td> </tr> <tr> <td>same class and genus but different species</td> <td></td> </tr> <tr> <td>same class but different genus and species</td> <td>✓</td> </tr> </table> | the same class, genus and species. | | different class, genus and species. | | same class and genus but different species | | same class but different genus and species | ✓ | 1 | more than one answer = 0 |
| the same class, genus and species. | | | | | | | | | | | | |
| different class, genus and species. | | | | | | | | | | | | |
| same class and genus but different species | | | | | | | | | | | | |
| same class but different genus and species | ✓ | | | | | | | | | | | |
| | b | i | an artificial (system) (1) | 1 | | | | | | | | |
| | | ii | <p>we use a system based on evolutionary relationships /</p> <p>does not allow any predictions to be made about other characteristics /</p> <p>does not allow any predictions to be made about evolutionary relationships (1)</p> | 1 | <p>allow DNA / genetics used to classify now</p> <p>allow this classification only uses one characteristic ora</p> <p>allow this classification cannot be based on ancestral relationships ora</p> | | | | | | | |
| | c | | <p>Sam is correct because:</p> <p>any two from:</p> <p>7 spotted would decrease the mean (1)</p> <p>an even spread would decrease the mean (1)</p> <p>harlequins would increase the mean (1)</p> | 2 | <p>no mark for Sam</p> <p>Tom or Harry correct no marks</p> | | | | | | | |
| | | | Total | 5 | | | | | | | | |
| 7 | a | | <p>37 (2)</p> <p>But if incorrect</p> <p>$\frac{17 \times 11}{5}$ or $\frac{187}{5}$</p> <p>(1)</p> | 2 | allow 37.4 (1) | | | | | | | |
| | b | i | Any two from | 2 | | | | | | | | |

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|---|---|-----|---|----------|---|
| | | | (overall) decrease in population (1) numbers remained steady for first 4 years / at start (1) population is starting to fall in year 5 or at end / idea that largest decrease is in year 5 or at end (1) | | |
| | | ii | Any one from: limited set of results (1) idea that there is only one set of data from each year (1) need to sample at different times of the year / population may vary over (a single) year (1) need monitor for more years to see if trend continues (1) idea that populations may change due to migration / immigration / less birth / more death / effects of marking (1) | 1 | allow small sample size(1) |
| | | | Total | 5 | |
| 8 | a | | Any two from: less industrial disease / accidents (1) healthier diet (1) healthier life style (1) better medical treatments / healthcare / cures for disease (1) better housing / sanitation / hygiene (1) | 2 | allow better health and safety (1) allow better diet / balanced diets(1) allow more exercise / less smoking (1) allow better lifestyle (1) ignore less pollution ignore better standard of living ignore just better technology |
| | | b i | life expectancy continues to rise (1) life expectancy for males and females will become the same / converge / get closer together (1) | 2 | allow people will live longer (1) allow answers that match their lines drawn e.g. life expectancy for females remains higher than males(1) allow marks for age quoted for 2030 that matches line drawn e.g. women may live till they are 90 (1) e.g. women may live till they are 90 and males 86 (2) e.g. people will live longer women may live till they are 90 (2) |
| | | ii | idea that line of the graphs may not rise at the same gradient | 1 | e.g. slope of graph may change / rise more steeply / level off (1) e.g. trend may change (1) |

| | | | | | |
|----|--|--|---|-----------|--|
| | | | / other factors could stop the age reaching the predicted level (1) | | <p>ignore no evidence / no data</p> <p>e.g. such as new diseases / epidemics / outbreak of disease / increased resistance of bacteria to antibiotic / increased pollution levels / natural disasters (1)</p> <p>ignore illnesses can occur / the future is uncertain</p> |
| | | | Total | 5 | |
| 9 | | | mutation (1) recessive (1) heterozygous / carriers (1) | 3 | ignore different |
| | | | Total | 3 | |
| 10 | | | A ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 11 | | | D ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 12 | | | A ✓ | 1 (AO2.1) | |
| | | | Total | 1 | |
| 13 | | | C ✓ | 1 (AO2.1) | |
| | | | Total | 1 | |
| 14 | | | B ✓ | 1 (AO1.1) | <p><u>Examiner's Comments</u></p> <p>This question was designed to test recall of knowledge AO1.1. It was clear from the responses of the majority of candidates, that there was a lack of the knowledge of white blood cells and their ability to move out of capillaries by changing their shape.</p> <div style="display: flex; align-items: center; margin-top: 10px;">  <p>The ability of white blood cells to leave the circulatory system through the capillary walls should be taught in the context of white blood cells destroying pathogens.</p> </div> |
| | | | Total | 1 | |
| 15 | | | C ✓ | 1 (AO2.2) | |
| | | | Total | 1 | |
| 16 | | | C ✓ | 1 (AO1.2) | |
| | | | Total | 1 | |
| 17 | | | D ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |


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|----|--|--------------|-----------|--|
| 18 | | D ✓ | 1 (AO1.1) | |
| | | Total | 1 | |
| 19 | | C ✓ | 1 (AO1.2) | <p><u>Examiner's Comments</u></p> <p>This question assessed candidates' understanding of how the phenotype and genotype are affected under different conditions. Many candidates' responses were that it was only the genotype that would be affected by the treatment rather than the correct response being only the phenotype.</p> <p> This may indicate a misconception in candidates thinking that anything that happens within the body has to do with the genotype.</p> <p>Key:</p> <p> Misconception</p> |
| | | Total | 1 | |
| 20 | | B ✓ | 1 (AO1.1) | <p><u>Examiner's Comments</u></p> <p>This question tested recall of knowledge AO1.1. Many candidates incorrectly chose C. This was a very common response indicating that candidates knew the names of the scientists involved but thought that Darwin and Wallace worked together on the theory of evolution by natural selection. It is important for candidates to realise that theories can develop with research from scientists who are conducting this work independently.</p> |
| | | Total | 1 | |
| 21 | | D ✓ | 1 (AO1.2) | <p><u>Examiner's Comments</u></p> <p>This AO1.2 question required knowledge of scientific enquiry and procedures linked to interactions of diseases. Higher ability candidates were able to identify the link between HPV and cervical cancer, but some candidates assumed incorrectly that the vaccine prevents cervical cancer.</p> |
| | | Total | 1 | |

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| 22 | | B ✓ | 1 (AO1.2) | |
| | | Total | 1 | |
| 23 | i | <p>in country/advantage/where badgers live, if it rolls up in a ball then will provide more protection / less attacks from badgers/predators ✓</p> <p>in cities/disadvantage/many roads, it will be run over by cars ✓</p> | 2 (AO 2 × 2.1) | <p>ALLOW in country/advantage/where badgers live hedgehogs have defence against predators/badgers</p> <p>ALLOW hedgehogs have a reduced risk of being eaten</p> <p>Examiner's Comments</p> <p>This AO2.1 question was answered well overall. Candidates did not gain marks if they didn't correctly link their responses specifically to country or city areas. Just referring to roads was insufficient, however, candidates referring to many roads gained a mark as this distinguished the difference between city and country areas. The terms rural and urban were acceptable alternatives to country and city, in candidates' explanations. A common error was to say the rolling up was camouflage without explaining the answer.</p> |
| | ii | <p>hedgehogs that run away are more likely to survive / less likely to get run over ✓</p> <p>to they will reproduce ✓</p> <p>pass on the allele/gene for running away ✓</p> <p>over time/many generations (running away will become more common) ✓</p> | 4 (AO 4 × 2.1) | <p>ALLOW ORA for each marking point</p> <p>ALLOW reference to how change occurred e.g. mutation for running away</p> <p>ALLOW offspring produced / breed together</p> <p>ALLOW pass on advantageous gene</p> <p>IGNORE trait is pass on / genes are passed on</p> <p>Examiner's Comments</p> <p>This application of knowledge of natural selection question usually resulted in candidates gaining at least two marks. This was usually for identifying that the hedgehogs that could run away had a higher survival rate and could go on to breed. Higher ability candidates were able to link this to the advantageous gene and some could refer to the process occurring over time. Fewer candidates scored the last two marking points because they referred not to the advantageous gene, but in general to genes, mutation (not mutated gene) or to the trait or characteristic or behaviour of running away, and, for the last point, stating that because run away hedgehogs survived to breed, their numbers exceeded the numbers of roll up ones, simply because the roll up ones died.</p> <p></p> <p>Examination technique needs candidates to focus on applying their knowledge to a new scenario, and to answer the question asked, not to talk in generic terms.</p> <p>Exemplar 1</p> |


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| | | | | <p>use ideas about natural selection. ✓</p> <p>A random genetic mutation occurred in the DNA which led to this new type of hedgehog. Because these hedgehogs run away when frightened, they are less likely to get flattened by cars or die. This means they survive to reproductive age and pass on the allele. However, hedgehogs that still hup may not survive so their numbers will decrease. The new generation of hedgehogs will have the best characteristics for survival.</p> <p>pass on the allele was given as this answer is clearly referring to the advantage of running away/the genetic mutation which led to this type of hedgehog (running away hedgehog)</p> <p>This candidate has been credited 3 marks. A mark is gained for identifying that a mutation has occurred to produce the running away hedgehog. They have gained a second mark for recognising they survive to reproductive age. Many candidates just referred to breeding or producing offspring which were deemed acceptable responses for that particular marking point. Also a third mark was gained for 'pass on the allele' has been given as they clearly understand that it is referring to the advantage of running away/genetic mutation for the advantageous gene. The candidate has not gained a mark for the new generation of hedgehogs as this does not reference the idea of the process repeating over several generations/overtime.</p> |
| | | <p>Total</p> | <p>6</p> | |
| <p>24</p> | | <p>correctly chosen axes, labelled with units ✓</p> <p>suitable scale on both axes ✓</p> <p>all points correctly plotted ✓ ✓</p> <p>line of best fit through most points ✓</p> | <p>5 (AO 5 × 2.2)</p> | <p>place ticks on right hand side of grid</p> <p>minimum 50% of grid used scale must be in ascending order</p> <p>ALLOW +/- half a square 0 to 5 correct points plotted = 0 mark 6 or 7 correct points plotted = 1 mark All 8 correct points plotted = 2 marks</p> <p>DO NOT ALLOW dot to dot line ALLOW line of best fit for their plotting IGNORE any extrapolation of line</p> <p>Examiner's Comments</p> <p>This question assessed candidates' ability to apply knowledge and understanding of scientific enquiry, techniques and procedures in graphing skills. Many candidates scored 4 marks and missed out on the mark for the line of best fit as they drew straight lines that did not go through or near any of the points. The mark scheme looked for the line through most of the points and this was best achieved by a curved line. There were</p> |

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| | | | | | a significant number of candidates who plotted the variables on the wrong axes. This did lose them a mark, but they were able to score the other marking points if all points were plotted accurately, to a suitable scale and a suitable line of best fit was drawn. | | | | | | | | | |
| | | | Total | 5 | | | | | | | | | | |
| 25 | a | | Gene: a length of DNA that codes for a protein ✓ Allele: an alternative form/version of a gene ✓ | 2 (AO 2 × 1.1) | IGNORE section of DNA that codes for a specific characteristic ALLOW a particular copy of a gene Examiner's Comments This question tested recall knowledge AO1.1 of the definitions of two genetic terms. The most common error was to only describe the gene as a section of DNA coding for a characteristic rather than coding for a protein. Candidates had a better knowledge of what an allele was. | | | | | | | | | |
| | b | i | <table border="1" data-bbox="199 1070 630 1209"> <tr> <td></td> <td>R</td> <td>r</td> </tr> <tr> <td>R</td> <td>RR</td> <td>Rr</td> </tr> <tr> <td>r</td> <td>Rr</td> <td>rr</td> </tr> </table> <p>correct gametes ✓</p> <p>correct genotypes of offspring ✓</p> <p>probability = 0.25 / ¼ / 25% / 1 in 4 / 1:3</p> | | R | r | R | RR | Rr | r | Rr | rr | 4 (AO 2.2) (AO 2.2) (AO 3.2b) | ALLOW other forms of diagrams other than Punnett square Examiner's Comments This question assessed AO2.2 with the application of practical techniques in completing a genetic cross. This was particularly well done by most candidates, except some candidates did not choose the symbols recommended in the question and this caused them confusion in interpretation. The question also included an AO3 mark for interpreting and drawing a conclusion from the Punnett square. The most common error was to give 75% as the response. Some candidates also made an error by describing the ratio as 1 in 3 when they should have written 1 in 4 or 1:3. These errors could be minimised by improving examination technique, where candidates are made aware of common errors in interpreting genetic diagrams. |
| | R | r | | | | | | | | | | | | |
| R | RR | Rr | | | | | | | | | | | | |
| r | Rr | rr | | | | | | | | | | | | |
| | | ii | rod cells are do not work / damaged ✓ rod cells can work in dim light ✓ but cannot detect colour ✓ | 3 (AO 2.1) (AO 2.1) (AO 1.1) | ALLOW rods cells broken down / cones are not broken down IGNORE rod cells broken down (as in stem of question) ALLOW converse for cones ALLOW converse for cones ALLOW rods only see in black and white Examiner's Comments This question covered AO1.1 and AO2.1. Candidates often did not identify that rod cells were damaged. They frequently just put rod cells break down, missing out it was 'only' the rod cells, and hence were just repeating what was in the stem of the question. Good responses also discussed cones cells so got the reverse argument. | | | | | | | | | |

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|----|---|----|--|---|---|
| | c | i | <p>stem cells are not differentiated/can still specialise ✓</p> <p>they could become rod cells ✓</p> | <p>1 (AO 1.2)</p> <p>1 (AO 2.1)</p> | <p>ALLOW stem cells are unspecialised / can grow into any type of cell / have ability to differentiate</p> <p>Examiner's Comments</p> <p>Most candidates were able to describe what a stem cell is assessing AO1.1, and many had the AO2.1 idea that they could become rod cells. Some missed the AO2.1 mark by referring to damaged or mutated cells, instead of the rod cells.</p> |
| | | ii | <p>idea it would not be detected as foreign cells (by the immune system/WBC) ✓</p> <p>OR</p> <p>idea it would not be rejected (by the body) ✓</p> | <p>1 (AO2.2)</p> | <p>ALLOW accepted (by the body) / (body) more likely to accept</p> <p>Examiner's Comments</p> <p>This AO2 question was generally answered well. Lower ability candidates stated that stem cells from another person "wouldn't work". Marks are scored more frequently when candidates avoid general terms, and responses are specific to the question asked.</p> |
| | | | Total | 11 | |
| 26 | a | | <p>sperm/male gametes contain either an X or Y chromosome and eggs/female gametes contain an X chromosome ✓</p> <p>indication that XX is female and XY is male ✓</p> | <p>2 (AO 2 × 1.1)</p> | <p>ALLOW correct Punnett square but unlabelled for gamete mark</p> <p>ALLOW correct Punnett square that indicates XY is male and XX is female for 2 marks</p> <p>Examiner's Comments</p> <p>Most candidates scored well on this AO1 question. Candidates who didn't gain marks either mixed up the genders, saying females were XY, or occasionally they used incorrect nomenclature m and f, and some had YY as a possible genotype.</p> |
| | b | | <p>First check answer on answer line</p> <p>If answer = 357512 award 2 marks</p> <p>$\frac{105}{205} \times 698000$ ✓</p> <p>= 357512 ✓</p> | <p>2 (AO 2 × 2.2)</p> | <p>ALLOW answer given to several dps</p> <p>Examiner's Comments</p> <p>This question assessed candidates' mathematical skills in AO2.2. In the main, many candidates got maximum marks. Common incorrect responses were due to rounding errors, including rounding before multiplying. Lower ability candidates simply halved 689000. Some candidates made rounding errors but only wrote the final answer and had not shown any working. They were not able to gain the mark for correct</p> |

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| | | | | <p>working out even though they had most likely done this. Improved examination technique and practice would overcome this.</p>  <p>Examination technique needs candidates to focus on candidates showing their working out on calculations.</p> |
| | c | males do not live as long/ ORA ✓ | 1 (AO3.1b) | <p>ALLOW they (females) live longer</p> <p>Examiner's Comments</p> <p>In this AO3 question many candidates tried to explain why it was likely that males die, but few referred to them dying earlier than females, or that females live longer. Higher ability candidates correctly referred to the longer life expectancy of females.</p> |
| | | Total | 5 | |
| 27 | a | number of seeds that germinated ✓ | 1 (AO 3.1a) | IGNORE the number of seeds |
| | b | to keep the total volume constant / to dilute the acid by different amounts ✓ | 1 (AO 3.1a) | <p>ALLOW so volume adds up to 20cm³</p> <p>ALLOW change/investigate the concentration of acid</p> <p>ALLOW make it more/less acidic / vary acidity</p> <p>Examiner's Comments</p> <p>In this AO3 question many candidates found difficulty in communicating that the same volume overall was needed, or to change the concentration of acid. Where candidates did gain marks, it was often for stating 'so volume adds up to 20cm³'.</p> |
| | c | idea that germination is affected by temperature ✓ | 1 (AO 3.1a) | <p>ALLOW higher level answers such as references to rate of diffusion or enzyme action correctly linked to temperature change</p> <p>IGNORE to make it a fair test</p> <p>Examiner's Comments</p> <p>This AO3 interpretation question provided challenge for most candidates. Often responses were seen referencing prevention of evaporation, which did not gain marks. Few candidates correctly linked the temperature to its effect on germination rate. Some higher ability candidates did give correct references to enzyme action.</p> |
| | d | Any two from: acid rain will reduce the number of seeds that germinate ✓ reference to addition of small volumes of | 2 (AO 2 x 3.1b) | ALLOW ORA |

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| | | <p>acid having little effect / rapid drop in germination between third and fourth flask ✓</p> <p>germination at the highest volume of acid is still possible / acid concentration would have to be higher to stop germination ✓</p> | | <p>ALLOW indication of correct flasks from table data</p> <p>Examiner's Comments</p> <p>This question assessed AO3 evaluation. Most candidates correctly identified the effect of acid on germination, but none commented on the pattern in the data. On the very rare occasion that a second mark was obtained, it was for identifying that germination still did happen with highest concentration stating that 'the higher acid concentration reduces germination rate, but it doesn't stop it altogether' which got maximum marks.</p> |
| | e i | <p>First check answer on answer line If answer = 100 award 2 marks</p> <p>correct calculation of 10% ✓</p> <p>$VI = 100$ ✓</p> | <p>2 (AO 2 × 2.2)</p> | <p>Examiner's Comments</p> <p>This AO2 question assessed mathematical skills in a practical context. Many candidates did well and scored both marks. Some had an incorrect answer but scored the working out mark for getting 10%. Again, this emphasises the advantage of candidates ensuring that they show their working out in the space provided for them to put their response.</p> |
| | | <p>ii</p> <p>takes into account how well the seeds are growing ✓</p> <p>also better to use percentage germination than number germinated ✓</p> | <p>2 (AO3.3b)</p> | <p>ALLOW shows seeds growing roots/shoots / shows seeds growing above/below soil</p> <p>Examiner's Comments</p> <p>This AO3 question linked to improving experimental procedures was looking for the idea that VI, by measuring length of roots/shoots, looked at growth not just germination. However, candidates simply repeated the question (just referencing about the length of shoot/roots) and used terms such as accurate, precise and reliable to try and cover the improvement aspect of the question. Very few were able to identify that percentage germinated was a better value to use than number of seeds germinated.</p> |
| | | Total | 9 | |
| 28 | a | <p>Any two from:</p> <p>a protein molecule ✓</p> <p>made by the immune system ✓</p> <p>destroys/kills pathogens / clumps them together / attaches to antigens ✓</p> | <p>2 (AO 2 × 1.1)</p> | <p>ALLOW made by WBC / found in WBC</p> <p>IGNORE germs and disease</p> <p>IGNORE attack or fight pathogens</p> <p>Examiner's Comments</p> |

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| | | | | <p>This AO1 recall question did identify some areas for improvement. Candidates struggled with using correct terminology, referring to disease instead of pathogen and attacking and fighting instead of describing the mode of action of antibodies. Few candidates stated that an antibody is a protein.</p>  <p>When developing examination technique, candidates should be encouraged to use mark schemes to appreciate the importance of detail and terminology appropriate to GCSE level of study.</p> |
| b | | <p>Any four from: (inject) methamphetamine/drug into mice ✓ lymphocytes made/collected ✓ fuse with tumour cells ✓ hybridoma cells made ✓ hybridoma make antibodies against methamphetamine/drug ✓</p> | <p>4 (AO 4 × 1.2)</p> | <p>ALLOW WBC made/collected</p> <p>ALLOW fuse with cancer/myeloma cells</p> <p>Examiner's Comments</p> <p>This AO1.2 question allowed candidates to demonstrate their knowledge of a scientific technique. There were some excellent maximum mark responses by higher ability candidates and most were able to gain 1 or 2 marks. Whilst some candidates knew this process, many forgot what the role of the antibodies specific to this question was, talking in generic terms and mixing up this example with others. Those that did know this process often wrote about fusing antibodies not lymphocytes with cancer cells, however, many scored the mark for knowing the term hybridoma. Those that scored zero often got confused and wrote about genetic engineering in terms of cutting and splicing DNA.</p> <p>Exemplar 4</p> <p>techniques.</p> <p>A mouse is injected with the methamphetamine. Lymphocytes within the mouse do not replicate enough so they bind to the methamphetamine to form hybridomas. This then replicate to form monoclonal antibodies which are large amounts of antibodies to fight off this methamphetamine. [4]</p> <p>This candidate has been credited with 3 marks. They have identified specifically that it is methamphetamine that is injected rather than generic antigens. The have identified that lymphocytes are involved, but not gained a mark as they</p> |

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| | | | | <p>haven't recognised the need to harvest these. Likewise they have incorrectly linked the fusing of these to methamphetamine rather than tumour cells, so have missed that marking point. However, they have recognised that a hybridoma is formed, so get that marking point.</p> <p>Although this last marking point was seldom seen due to many candidate responses describing antibody production in generic terms, here the candidate has identified that the production of large amounts of antibodies is specifically for the methamphetamine so gets a third mark.</p> |
| | c | <p>Any two from:</p> <p>antibodies are specific ✓</p> <p>only (binds) to one drug/antigen (shape) ✓</p> | <p>2</p> <p>(AO 1.1)</p> <p>(AO 1.1)</p> | <p>ALLOW they would not fit together with other drugs</p> <p>Examiner's Comments</p> <p>Although this AO1.1 question was mostly answered successfully there were common errors shown by lower ability candidates. Often lower ability candidates referred to specific antigen rather than specific antibody. Occasionally they would write about bacteria, and in some cases confused this with the lock and key hypothesis and ideas about enzymes.</p> |
| | | Total | 8 | |
| 29 | | <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) Detailed explanation including conclusions about how the mechanism affects photosynthesis and links this to less biomass available to humans in the food chain. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Explanation of how the mechanism affects photosynthesis or affects the biomass available to humans. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> | <p>6</p> <p>(AO 3. x 1.1)</p> <p>(AO 2. x 2.1)</p> <p>(AO 1. x 3.2b)</p> | <p>AO1.1 Demonstrate knowledge of photosynthesis and biomass.</p> <ul style="list-style-type: none"> • Photosynthesis requires light energy • Mechanism reduces photosynthesis • Trapped by the leaves and used to produce food molecules • Photosynthesis required for plant growth • Plant biomass is a food source for animals including humans <p>AO2.1 Apply knowledge and understanding of photosynthesis to the production of biomass</p> <ul style="list-style-type: none"> • More light energy converted to heat, then less energy for photosynthesis • Less photosynthesis then plants can make less food / plants can grow less • Less plant biomass leads to less available food <p>AO3.2b Draw conclusions linking photosynthesis to biomass in food chains</p> |

Level 1 (1–2 marks)

Demonstrates some knowledge of how the mechanism affects photosynthesis or affects the biomass available to humans. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*

0 marks

No response or no response worthy of credit.

- In low light intensities, light availability is the limiting factor
- Less plant growth/crops therefore less food for cattle/less food for humans / in the food chain

Examiner’s Comments

This Level of Response question assessed all three main assessment objectives. It was common to be limited to a low level mark due to repeating the stem of question regarding less biomass all through their response instead of linking the protection mechanism’s impact to less light, less photosynthesis so less glucose/food made and consequently less food for cattle and humans. Candidates that did not appreciate that a reduction in light resulted in a reduction in photosynthesis, which also limited their answer to a low level.

There was little evidence of candidates planning their response. Taking time to consider how to answer a LoR, might encourage them to make notes and think through key areas. A common low level answer was to refer to the loss of energy due to the energy needed to switch on the mechanism. It was noted how many candidates did not link biomass to growth or production of food. However, those candidates that realised that the key to the answer was essentially linked to factors influencing photosynthesis, produced excellent responses.

Exemplar 5

High light intensity levels cause the plant to absorb less light, reducing the amount of photosynthesis that takes place. This means the plant will not grow as much/as quickly so there is less crops that grow. As a result yield decreases so the mass of crops decreases. This means there is less food available for humans to consume. When the protection mechanism switches off slowly, there is a gradual increase in the amount of glucose the plant makes which slowly increases biomass available. However if it slowly increases the level of photosynthesis there is still less energy available for human consumption.

This answer has less light/less photosynthesis and less crop and links this to the impact on the food chain so all Level 3, 6 marks

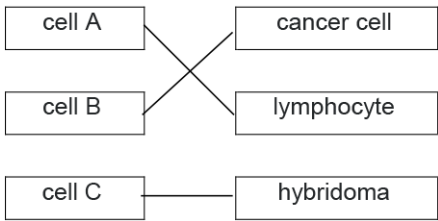
This candidate has been credited Level 3 maximum 6 marks. They have structured their answer in a concise manner but included all the relevant marking points. The candidate describes the protection mechanism’s impact in reducing light and photosynthesis. The candidate states that the decrease in mass of crops and food made means there is consequently less food for the humans to consume. They continue to give a reason why there will still be less energy available even when


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| | | | | the plants resume photosynthesis due to the mechanism switching off slowly. |
| | | Total | 6 | |
| 30 | | B | 1 (AO 2.2) | |
| | | Total | 1 | |
| 31 | | D | 1 (AO 1.1) | |
| | | Total | 1 | |
| 32 | | A | 1 (AO 1.1) | |
| | | Total | 1 | |
| 33 | | C | 1 (AO 1.2) | |
| | | Total | 1 | |
| 34 | | B | 1 (AO 1.1) | <p><u>Examiner's Comments</u></p> <p>This is an AO1.1 question testing recall of HIV and interaction with cervical cancer. In general, candidates chose either B or C. Candidates who performed well overall chose the correct answer B.</p> |
| | | Total | 1 | |
| 35 | | C | 1 (AO 1.1) | |
| | | Total | 1 | |
| 36 | | B | 1 (AO 1.1) | <p><u>Examiner's Comments</u></p> <p>In this AO1.1 question, many candidates incorrectly put A, indicating they are unsure of what an infection is, and also why cancer is not an infection. They do, however, seem to be aware of cancer being linked to uncontrollable cell division.</p> |
| | | Total | 1 | |
| 37 | | B | 1 (AO 1.2) | <p><u>Examiner's Comments</u></p> <p>Recalling their knowledge of a scientific technique in this AO1.2 question; this was generally well answered by candidates. Some candidates were distracted by A and this may show a rushed approach to reading each option. Care must be taken to read technical terms very carefully.</p> |
| | | Total | 1 | |
| 38 | | D | 1 (AO 2.1) | <p><u>Examiner's Comments</u></p> <p>Usually candidates scored on this AO2.1 question, choosing D.</p> |

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| | | | | | Candidates who had difficulty applying their understanding often chose B, incorrectly linking their knowledge of the use of DNA in classification. |
| | | | Total | 1 | |
| 39 | | | B | 1 (AO 1.1) | |
| | | | Total | 1 | |
| 40 | | | B | 1 (AO 1.2) | Examiner's Comments Recalling their knowledge of a scientific technique in this AO1.2 question, candidates generally answered this well. Some candidates were distracted by A and C. |
| | | | Total | 1 | |
| 41 | | | C | 1 (AO 1.1) | |
| | | | Total | 1 | |
| 42 | | | D | 1 (AO 1.1) | Examiner's Comments Recalling their knowledge in this AO1.1 question was answered well by higher ability candidates, less so by others. Lower ability candidates were frequently distracted by A. |
| | | | Total | 1 | |
| 43 | a | | spread by wind ✓ spores ✓ enters leaves through the stomata ✓ | 3 (AO 1.1) | ALLOW spread by water/ air / contact ALLOW enters leaf pores IGNORE holes in leaf / wounds / roots / stem Examiner's Comments On this AO1.1 recall question, most candidates were able to describe a method of spread. Fewer were able to recall the term spore. A much smaller number of candidates knew that the point of entry was stomata, however, responses referring to entry through damage, cuts or wounds and via the roots were more common but did not score. |
| | b | i | kills the spores / fungus ✓ | 1 (AO 2.1) | ALLOW kills/burns/eradicates the (barley) powdery mildew Examiner's Comments Many candidates did not score on this AO2.1 question because of the lack of reference to the specific organisms in the question. A common mistake is to give generic responses using terms like disease and infection. Rather unexpected, but throughout this question about a fungus a lot of candidates referred to bacteria and viruses. |


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| | | ii | <p>the spores left by the fungus growing on the barley cannot infect wheat / the fungus does not grow on wheat / wheat is not a host for the fungus ✓</p> <p>(after two years) there will be less spores/fungus population / the spores/fungus will die ✓</p> | 2 (AO 2.1) | <p>AW barley powdery mildew for fungus AW pathogen for fungus ALLOW wheat resistant to barley powdery mildew</p> <p>Examiner's Comments</p> <p>This AO2.1 question was approached more like a recall question by many candidates. A substantial number described crop rotation ideas about depletion/replacement of nutrients. Again, many candidates wrote about killing infections or diseases rather than spores or fungi.</p> |
| | | c | <p>(control using) the same field and divide it into two ✓</p> <p>because different fields may have different types of soil / different minerals / different levels of light ✓</p> | 2 (AO 3.3b) | <p>ALLOW any suitable improvement e.g. control light / pH / temperature / same location / use optimum concentration of each fungicide / a control</p> <p>explanation must link to suitable improvement e.g. light because photosynthesis would affect growth/yields</p> <p>Examiner's Comments</p> <p>This AO3.3b question was considering ways of improving experimental design. Many candidates were able to describe the need for a control, less were able to apply their ideas to the scenario in the question, often describing inappropriate ideas such as putting plants in greenhouses or closed systems.</p> |
| | | | Total | 8 | |
| 44 | a | | <p>all organisms show variation / mutation causes variation ✓</p> <p>Any three from: the blue tits with the longer beaks get more food / ORA ✓ they are more likely to survive / ORA ✓ they reproduce and pass on the alleles for longer beaks / ORA ✓ over many generations beak length increases in the blue tit population / ORA ✓</p> | 4 (AO 1.1) (AO 2.1 x3) | <p>ALLOW description of variation in beak length in the original population</p> <p>ALLOW the blue tits with the longer beaks get access bird feeders</p> <p>IGNORE pass on genes</p> <p>ALLOW idea of many repeats of cycle</p> <p>Examiner's Comments</p> <p>The AO2.1 aspect to this question was well answered by many candidates. Lower ability candidates wrote a generic description of natural selection, not appreciating they needed to link their answers to blue tits.</p> <p>The first AO1.1 marking point was often missed, with most candidates limiting their marks by not mentioning mutation or variation. Most candidates were able to say that the longer beaks could better access food, leading to better chance of survival. Even the higher ability candidates were not able to distinguish between gene and allele and many referred also to the passing on of characteristics, phenotypes or traits instead of the allele. It is important that candidates demonstrate an</p> |

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| | | | | <p>understanding that the specific allele is passed on during reproduction, rather than just referencing the gene.</p> <p>Very few candidates explained the change in the allele frequency over many generations, and loose descriptions such as eventually, overtime or a few generations did not score.</p> |
| | b | <p>shows that over the years the birds are laying eggs earlier (in May) ✓</p> <p>this could be because temperatures are increasing (year on year) ✓</p> <p>however, the data shows a lot of variation ✓</p> <p>there could be other factors involved ✓</p> | <p>4 (AO 3.1a)</p> <p>(AO 3.2b)</p> <p>(AO 3.1a)</p> <p>(AO 3.2b)</p> | <p>ALLOW shows downward trend</p> <p>ALLOW because Earth is getting warmer</p> <p>ALLOW examples of variation in data from the graph</p> <p>ALLOW data shows lots of fluctuations / erratic data / spikes in the data</p> <p>ALLOW examples of factors such as predator/prey relationship may be different</p> <p>Examiner's Comments</p> <p>In this AO3 question, most higher ability candidates scored well. Most candidates were able to appreciate and describe the fluctuations. Some lower ability candidates wrote about climate change without mentioning an increase in temperature, for example, 'due to climate change eggs were laid earlier'. Some referred to the number of eggs laid rather than the timing, and many that didn't lost track that eggs were laid earlier. Some candidates thought climate change might not be the cause but then didn't suggest that another factor could be involved.</p> |
| | | Total | 8 | |
| 45 | a | <p>(made by) white blood cells / lymphocytes ✓</p> <p>when stimulated by antigens / antigens detected ✓</p> | 2 (AO 1.1) | <p>DO NOT ALLOW phagocytes</p> <p>IGNORE fight off/combat antigens</p> <p>Examiner's Comments</p> <p>Candidates have a very good understanding of this AO1.1 question recalling knowledge of antibody production. Most used the correct term lymphocyte and knew antibody production was in response to antigens.</p> |
| | b i | <p>control ✓</p> <p>can act as a comparison / to check the drug works ✓</p> <p>idea of identifying / eliminates any psychological effect ✓</p> | 3 (AO 1.1) | <p>ALLOW placebo contains no active drug / dummy injection</p> <p>ALLOW see the effects of the drug</p> <p>ALLOW to test if receiving something from a doctor or the drug itself is having the effect / some people believe they are feeling better when they are not</p> <p>ALLOW to eliminate placebo effect</p> <p>ALLOW tricks body into thinking it is taking a medicine</p> |

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| | | | | <p>Examiner's Comments</p> <p>This AO1.1 question tested knowledge of using a placebo group in drug development. Although it was described in a range of ways, most candidates realised the reason for a placebo group was to make sure that any improvement was not merely psychological. Fewer candidates stated that a placebo was a control, i.e. contains no active drug. Some candidates' responses focused on double blind tests and side effects. Very few candidates referred to the data in the table.</p> |
| | | <p>FIRST CHECK ANSWER ON THE ANSWER LINE If answer = 51.6 (%) award 3 marks</p> <p>ii</p> <p>9.1-4.4 = 4.7 ✓ (4.7÷9.1) x 100 ✓ = 51.6 (%) ✓</p> | <p>3</p> <p>(AO 2 x 2.2)</p> <p>(AO 1 x 1.2)</p> | <p>51.648 / 51.65 /51.7 = two marks ALLOW ECF on the rounding IGNORE sign</p> <p>Examiner's Comments</p> <p>The AO2.2 part of this question resulted in candidates making a common error in not deriving 4.7, but the function and answer to their function were usually correct. Very few candidates scored zero, but a few worked out the correct answer then didn't round it correctly, so did not get the AO1.2 marking point.</p> |
| | | <p>c</p>  <pre> graph LR A[cell A] --- CC[cancer cell] B[cell B] --- LY[lymphocyte] C[cell C] --- H[hybridoma] </pre> | <p>2 (AO 1.1)</p> | <p>all correct = 2 marks</p> <p>one or two correct = 1 mark</p> <p>Examiner's Comments</p> <p>The vast majority of candidates managed to score both marks on this AO1.1 question.</p> |
| | | <p>Total</p> | <p>10</p> | |
| 46 | a | <p>an allele is a form/version of a gene ✓</p> <p>dominant means that it always expresses itself when present ✓</p> | <p>2 (AO 1.1)</p> | <p>ALLOW only needs one allele present to be expressed/shown in the phenotype ALLOW allele which is expressed instead of another</p> <p>Examiner's Comments</p> <p>This AO1.1 question proved to be very challenging, even for some higher ability candidates. Many candidates did not define the term allele at all, limiting their maximum mark to 1.</p> |

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| | | | |  <p style="text-align: center;">AfL</p> <p>Candidates should be encouraged to learn definitions. Many candidates didn't seem to really understand the term dominant, in a biological context, using words like stronger, override or overpower.</p> |
| b | | <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5-6 marks) What the results of the test tell the patient. AND Correctly interprets the information in the graph. AND Includes an analysis of usefulness of having the test.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3-4 marks) What the results of the test tell the patient. OR Correctly interprets the information in the graph. AND Includes an analysis of usefulness of having the test.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1-2 marks) What the results of the test tell the patient. OR The answer correctly interprets the information in the graph. OR Includes an analysis of usefulness of having the test.</p> <p><i>There is an attempt at a logical structure</i></p> | <p>6 (AO 3 x 2.2) (AO 3 x 3.2a)</p> | <p>AO2.2 Applies knowledge and understanding to interpret the results of the test and the information in the graph</p> <ul style="list-style-type: none"> the test can tell them if they have the allele and are therefore likely to get the disease the test will tell them the number of repeats they have the graph will tell them the mean age that symptoms first develop in somebody who has a certain number of repeats symptoms develop earlier with an increased number of CAG repeats / ORA lower number of CAG repeats means a much larger age range in which symptoms first develop / ORA <p>AO3.2a Analyses information and ideas to make judgements and draw conclusions.</p> <ul style="list-style-type: none"> the person may decide not to have children and therefore will not pass on the allele there is a wide range of ages that a person of a certain age can first show symptoms it does not show how bad the symptoms are or how long the person will live for some people would rather not know when, or if, they are likely to become ill it's useful to be aware and prepare for when the first symptoms will show less useful/reliable/predictable test of when the first symptoms will show with a lower number of CAG repeats. less useful as there is no cure only limited treatment for symptoms <p>Examiner's Comments</p> <p>There were a lot of good responses to this Level of Response question covering AO2 and AO3. Many candidates understood what was going on regarding the test and graph, and were able to evaluate the usefulness of these, in some cases in a very well-developed response. Most candidates understood that the test could tell the patient how many CAG repeats they have,</p> |

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| | | <p>with a line of reasoning. The information is in the most part relevant.</p> <p>0 marks No response or no response worthy of credit.</p> | <p>and this information, together with the graph, may tell them when symptoms may present. Higher ability candidates appreciated that the information from the graph had limitations. There was, however, some confusion about what the test and graph were for in lower ability candidates. Some were using the graph to decide if they were old enough to take the test so they could find out if they had a history of Huntington's disease. Quite a few suggested the test and graph would allow them to be cured. Quite a few incorrectly explained how somebody's age determined the number of repeats they would have and that this would decrease as they got older. A common misconception was that if 'caught' early, the disease could be prevented or cured. Some candidates seemed to have read the next part of the question (Q22(c)) about potential treatments and adapted their Level of Response answer, despite it saying a cure was not possible in the stem of the question.</p> <p>Exemplar 1</p> <p><i>It's useful because there is no cure so people with the disease die after 10-15 years so by knowing if you're doing the test and seeing how many CAG bases you have or alleles you can make the decision to not have children so they can't get the disease. Huntington's disease. The graph is useful because it shows the mean age of patients when they first develop symptoms. Symptoms are lower which means if you see how many CAG repeats you have you'll be prepared. However it may not be useful as it could stress people out or scare people if they see how many CAG repeats they have.</i></p> <p>This exemplar represents an excellent example of how to gain maximum marks. The candidate has clearly identified that the gene test identifies how many CAG bases are present. They also identify that the test will show if the allele is present and links this to a usefulness of making decisions about having children. The graph analysis is also evidenced in the recognition that it identifies the mean age when first symptoms develop and there is a link to the usefulness of being able to prepare, avoid stress and also mentioned about being scared. Communication is clear, concise and as all aspects of the AO2 and AO3 assessment targeted by the question have been covered it gains maximum 6 marks.</p> |
| c | | <p>mRNA prevented from carrying the code (for the protein to the ribosomes) ✓</p> <p>this stops protein synthesis ✓</p> | <p>ALLOW translation cannot take place / ribosomes don't receive the code from mRNA</p> <p>IGNORE references to transcription</p> <p>ALLOW protein (that causes symptoms) is not made/less is made</p> <p>Examiner's Comments</p> <p>In this AO2.1 question a significant number of candidates</p> |

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| | | | | thought that blocking the code meant the code would not be made at all (i.e. no transcription). A large number thought the method would somehow reduce the number of CAG repeats, and lower ability candidates thought this would get rid of the defective allele somehow. For candidates gaining 2 marks this was often for responses including ideas on 'preventing translation' so 'no protein synthesis or protein made'. |
| | | Total | 10 | |
| 47 | a | platelets are needed for blood clotting ✓ the rat would keep bleeding/bleed to death ✓ | 2 (AO 2.1) | <p>Examiner's Comments</p> <p>Many candidates were able to score both marks on this AO2.1 question although some did not mention platelets. A significant number of candidates, however, linked the poison to clotting incorrectly, saying blood would clot too much or in the wrong place. In that type of response, there were references to heart attacks and strokes. Some candidates referred to wounds clotting.</p> |
| | b | parents are Rr and Rr ✓ offspring are RR, Rr, Rr, rr ✓ rr identified as being non-resistant ✓ | 3 (AO 2.2) | <p>ALLOW all marks from a Punnett square</p> <p>ALLOW ECF on offspring</p> <p>Examiner's Comments</p> <p>Many candidates scored on this AO2.2 question. The most frequent way candidates did not get maximum marks was by omitting to identify the correct offspring genotype.</p> <p>Candidates needed to annotate rr. A significant number of candidates only identified the non-resistant rate, not noticing that homozygous dominant rats were also present in that ratio; and therefore only stating 25% were homozygous. Candidates should be encouraged to routinely include the phenotypic ratio.</p> <p> AfL</p> <p>Some candidates made errors on the Punnett square diagram. The main error was to cross R with r and derive RR. Candidates should be encouraged to check their answers for this type of error.</p> |
| | c | Rr/heterozygous rats more likely to survive than RR/homozygous rats as they need less vit K / ORA ✓ therefore, when two Rr rats mate rr rats will be born ✓ | 2 (AO 2.2) | <p>ALLOW rats that need less vit K are more likely to survive</p> <p>Examiner's Comments</p> <p>Where candidates successfully answered this AO2.2 question, it was from developing ideas from the previous question and linking the vitamin K survival rate in the heterozygous rat to when two Rr rats mate rr rats will be born. Many responses to</p> |

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| | | | | | <p>this question showed confusion. Candidates referred to a variety of incorrect explanations such as non-resistant alleles becoming dominant and rats finding enough vitamin K to become non-resistant but immune to warfarin. Other incorrect responses included non-resistant rats surviving because they don't need much vitamin K and rats in some areas not getting access to warfarin.</p> |
| | | | Total | 7 | |
| 48 | | | B ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 49 | | | D ✓ | 1 (AO2.2) | |
| | | | Total | 1 | |
| 50 | | | C ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 51 | | | C ✓ | 1 (AO2.1) | |
| | | | Total | 1 | |
| 52 | | | B ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 53 | | | C ✓ | 1 (AO2.1) | |
| | | | Total | 1 | |
| 54 | | | C ✓ | 1 (AO2.1) | |
| | | | Total | 1 | |
| 55 | | | B ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 56 | | | D ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |

| | | | | | |
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| 57 | | | B ✓ | 1 (AO2.1) | |
| | | | Total | 1 | |
| 58 | | | C ✓ | 1 (AO1.1) | |
| | | | Total | 1 | |
| 59 | a | i | <p>Yes (no marks) cooler than black/grey skin</p> <p>OR</p> <p>Yes (no marks) lighter skin is cooler</p> <p>OR</p> <p>No (no marks) zebra skin was similar temperature to the other barrels</p> <p>OR</p> <p>No (no marks) idea it is warmer than the barrel covered by the white skin / ORA ✓</p> | 1 (AO3.2a) | argument must support decision |
| | | ii | <p>paint the barrels different colours rather than using the skins / use the same type of skin painted different colours</p> <p>OR</p> <p>idea to make sure that thicknesses/SA/V /volume/temperature of water in barrel need to be controlled ✓</p> | 1 (AO3.3a) | <p>ALLOW use painted towels to cover barrels</p> <p>ALLOW for same type of skin e.g. hair-free skin</p> |
| | b | i | <p>Any two from:</p> <p>zebras with stripes attracts less/fewer insects / ORA ✓</p> <p>narrower stripes attract less insects / ORA ✓</p> <p>stripe width for least number of insects/optimum protection is about 8cm / stripe width for most number of insects is about 25cm ✓</p> | 2 (AO2x3.1a) | <p>ALLOW insect bites for insects</p> <p>IGNORE length of stripe</p> <p>ALLOW width range between 5-10cm for least number of insects / most number of insects is 22-27cm</p> |
| | | ii | <p>stripe width of 8cm because it is the lowest point on the graph/fewest number of insects ✓</p> | 1 (AO3.2a) | ALLOW width tolerance between 7-9cm and least number of insects (on tape) |
| | | iii | <p>Any three from:</p> <p>stripes developed as a mutation / variation for skin stripes ✓</p> | 3 (AO3 x 2.1) | ALLOW some more striped than others |

| | | | | |
|----|---|---|----------------------------------|--|
| | | <p>(animals with stripes) less likely to be bitten by insects / more healthy / spread less pathogens / ORA ✓</p> <p>(striped animals) more likely to survive ✓</p> <p>(striped animals) more likely to reproduce ✓</p> <p>pass on allele/gene for stripes / ORA ✓</p> <p>process occurs over many generations ✓</p> | | <p>ALLOW offspring produced / breed together IGNORE selective breeding</p> <p>ALLOW pass on advantageous gene IGNORE trait is passed on / genes are passed on</p> <p>IGNORE over time</p> |
| | | Total | 8 | |
| 60 | a | <p>normal bin has holes to allow in air / oxygen ✓</p> <p>(making normal compost) so aerobic respiration occurs ✓</p> | <p>2 (AO2.1) (AO1.1)</p> | <p>ALLOW converse arguments for bokashi bin</p> <p>ALLOW aerobic bacteria carry out respiration IGNORE bacteria work aerobically</p> |
| | b | <p>used the same pile of dead plant material for both composters / used same plant type / used equal mass in both composters ✓</p> | <p>1 (AO2.2)</p> | <p>ALLOW used the same time interval for both composters ALLOW used the same water/moisture content for both composters ALLOW idea of same external conditions e.g. put both in same place / external temperature kept the same / kept in the same environment IGNORE references to fair testing</p> |
| | c | <p>i</p> <p>Axes – both correctly labelled, including units ✓</p> <p>Axes - even scales occupying more than half of the grid ✓</p> <p>Plotting - all points correctly plotted ✓</p> <p>Line - lines labelled or a key ✓</p> <p>Line - points with curve of best-fit lines ✓</p> | <p>5 (AO5 x 2.2)</p> | <p>Must have time on x-axis and temperature on y-axis</p> <p>ALLOW +/- half a square at least 8 points correctly plotted</p> <p>IGNORE extrapolated lines</p> |
| | | <p>ii</p> <p>temperature increased as compost decomposed / bacteria released heat by respiration ✓</p> <p>temperature starts to drop as decomposition slows down/complete / bacterial respiration slows ✓</p> | <p>2 (AO2 x 2.1)</p> | <p>ALLOW rise in temperature due to energy released by respiration ✓</p> <p>ALLOW bacterial activity slows (if respiration already mentioned)</p> |

| | | | | |
|----|---|-----|---|---|
| | | | | ALLOW temperature starts to drop as enzymes in respiration denature at high temperatures |
| | | iii | idea that decomposition in bokashi (method) bin much slower ✓ anaerobic respiration releases less heat/energy than aerobic respiration ✓ | 2 (AO2 x 2.1) Enter text here. |
| | d | i | FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 27 (%) award 3 marks 400 / 1500 x 100 ✓ 26.6 (%) ✓ = 27 (%) ✓ | 3 (AO2.2) (AO2.2) (AO1.2) ALLOW ECF for correct rounding |
| | | ii | idea that the gas given off is carbon dioxide ✓ less greenhouse gas produced / less likely to result in global warming / less contribution to greenhouse effect ✓ | 2 (AO2.2) (AO3.1b) ALLOW for 2 marks less carbon dioxide produced which is a greenhouse gas ALLOW correct formula ALLOW explanations of the greenhouse effect IGNORE references to environmental damage/not environmentally friendly/pollution/not good for the environment |
| | | | Total | 17 |
| 61 | a | | Any two from: anaemia / tiredness / lack of energy due to lack of red blood cells ✓ inability to fight off infections / prone to infections due to lack of white blood cells/WBC ✓ slow blood clotting due to lack of platelets ✓ | 2 (AO2 x 1.1) DO NOT ALLOW incorrectly matched symptom to blood cell type ALLOW less immunity / reduced immune response / weakened immune system due to lack of white blood cells/WBC ALLOW (recurring) nosebleeds / bruise easily due to lack of platelets |
| | b | i | people may be ill with infection / have a pathogen / just recovering from infection ✓ therefore have produced more white blood cells to destroy the pathogen/produce antibodies ✓ OR weakened immune system/cancer/cancer | 2 (AO2 x 2.1) IGNORE fighting(off) pathogens |

| | | | | | | | | | | | | | | | | |
|--------------|----------|---|------------------------------|---|------------|--------|--------------|----------|----------|----|----|----------|----|----|--------------------------|---|
| | | treatment reducing white blood cell number so less white blood cells to defend against pathogens/produce antibodies | | | | | | | | | | | | | | |
| | ii | Area = $10 \times 10 = 100(\text{mm}^2)$ Volume = $100 \times 0.001 = 0.1 (\text{mm}^3) \checkmark$ | 1 (AO2.2) | | | | | | | | | | | | | |
| | iii | No (no mark) $1000 \div 0.1$ OR $1000 \times 10 \checkmark$ number of white blood cells/ mm^3 is $10 \times 10^3 / 1.0 \times 10^4 / 10000 \checkmark$ within the range of $6.0 - 16.0 \times 10^3 \checkmark$ | 3 (AO2 x 2.2) (AO3.2b) | ALLOW ECF from (ii) ALLOW number of white blood cells / $\text{mm}^3 = 10\ 000$ ALLOW within the normal white blood cell range/ 6000 – 16000 | | | | | | | | | | | | |
| | c | (Fanconi anaemia) (no mark) (3×10^6) is a low red blood cell count \checkmark must be Fanconi anaemia because: caused by recessive allele \checkmark obtained from heterozygous/carrier parents who don't have a blood disorder \checkmark OR cannot be D-B anaemia because: neither parents have a blood disorder \checkmark it is caused by a dominant allele \checkmark | 3 (AO3x3.2b) | if incorrect disorder then no marks IGNORE low numbers of all cells | | | | | | | | | | | | |
| Total | | | 11 | | | | | | | | | | | | | |
| 62 | a | smallest <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>nucleotide</td></tr><tr><td>allele</td></tr><tr><td>chromosome</td></tr></table> largest <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>genome</td></tr></table> | nucleotide | allele | chromosome | genome | 1 (AO1.1) | | | | | | | | | |
| nucleotide | | | | | | | | | | | | | | | | |
| allele | | | | | | | | | | | | | | | | |
| chromosome | | | | | | | | | | | | | | | | |
| genome | | | | | | | | | | | | | | | | |
| | b | $66000000 \div 500 = 132\ 000 \checkmark$ | 1 (AO2.2) | ALLOW 0.132 million or 132 thousand | | | | | | | | | | | | |
| | c | woman <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td colspan="2" style="text-align: center;">man</td></tr><tr><td></td><td style="text-align: center;">D</td><td style="text-align: center;">d</td></tr><tr><td style="text-align: center;">d</td><td style="text-align: center;">Dd</td><td style="text-align: center;">dd</td></tr><tr><td style="text-align: center;">d</td><td style="text-align: center;">Dd</td><td style="text-align: center;">dd</td></tr></table> \checkmark $0.5 / 50(\%) \checkmark$ | | man | | | D | d | d | Dd | dd | d | Dd | dd | 2 (AO2.2) (AO3.1a) | ALLOW appropriate use of other lower/upper case letters ALLOW ECF ALLOW 1 in 2 / $\frac{1}{2}$ / 1:1 \checkmark DO NOT ALLOW 1:2 |
| | man | | | | | | | | | | | | | | | |
| | D | d | | | | | | | | | | | | | | |
| d | Dd | dd | | | | | | | | | | | | | | |
| d | Dd | dd | | | | | | | | | | | | | | |
| | d | FIRST CHECK THE ANSWER ON ANSWER LINE | 2 (AO2 x 1.2) | | | | | | | | | | | | | |

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| | | | <p>If answer = 839 award 2 marks</p> <p>2517/3 ✓</p> <p>= 839 ✓</p> | | <p>ALLOW 840 or 2521/3 ✓</p> |
| | | | Total | 6 | |
| 63 | a | i | <p>Any two from:</p> <p>pregnancy testing ✓</p> <p>detecting diseases/cancer ✓</p> <p>treating disease/cancer ✓</p> | <p>2 (AO2 x 2.1)</p> | <p>ALLOW specific diseases e.g. malaria</p> <p>ALLOW pathogen identification</p> <p>ALLOW vaccine development</p> <p>ALLOW drug testing</p> |
| | | ii | <p>they divide rapidly / rapid mitosis / divide indefinitely / can produce many cells ✓</p> | <p>1 (AO2.1)</p> | |
| | b | | <p>antigens are different shapes ✓</p> <p>idea that antigen binding site/antibody needs to fit the antigen ✓</p> | <p>2 (AO2 x 1.1)</p> | <p>ALLOW idea of each antigen being specific</p> <p>ALLOW idea of antigen binding site/antibody complementary to antigen</p> <p>IGNORE 'lock and key'</p> <p>IGNORE antibody bind/bonds to antigen (in stem of question)</p> |
| | | | Total | 5 | |
| 64 | a | | <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks)</p> <p>Demonstrates a knowledge of the importance of the blood supply to the heart.</p> <p>AND</p> <p>Applies knowledge to explain why a failure of this blood supply can lead to heart disease.</p> <p>AND</p> <p>Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> | <p>6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)</p> | <p>AO1.1 Demonstrate knowledge and understanding of the importance of the blood supply to the heart muscle.</p> <ul style="list-style-type: none"> • blood in the coronary artery supplies heart muscle • oxygen / glucose is supplied to the muscle • this is needed for the muscle to contract/for respiration <p>AO2.1 Apply knowledge and understanding of the requirements of the heart muscle</p> <ul style="list-style-type: none"> • without oxygen / glucose the heart muscle cannot <u>respire</u> • <u>energy</u> from respiration is needed for the muscle to contract <p>AO3.1a Analyse information and ideas to interpret the effects of lack of LDL receptor protein.</p> <ul style="list-style-type: none"> • without LDL receptor protein there will be more cholesterol in the blood / cholesterol levels will be too high to be removed/broken down |


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| | | <p>Level 2 (3–4 marks) Demonstrates a knowledge of the importance of the blood supply to the heart. AND Applies knowledge to explain why a failure of this blood supply can lead to heart disease.</p> <p>OR</p> <p>Demonstrates a knowledge of the importance of the blood supply to the heart. AND Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p>OR</p> <p>Applies knowledge to explain why a failure of this blood supply can lead to heart disease. AND Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Demonstrates a knowledge of the importance of the blood supply to the heart. OR Applies knowledge to explain why a failure of this blood supply can lead to heart disease. OR Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks</p> | | <ul style="list-style-type: none"> increased build up of cholesterol in the coronary artery will increase the risk of heart disease / decrease blood flow to the heart muscle |
|--|--|---|--|--|


| | | | | | |
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| | | | <i>No response or no response worthy of credit</i> | | |
| | b | | <p>low dose of the drug does not seem to have any effect ✓</p> <p>because the effect is very similar to the placebo ✓</p> <p>high dose of the drug lowers blood cholesterol level most and would be the best way to administer the drug ✓</p> | 3 (AO3 x 3.1b) | |
| | | | Total | 9 | |
| 65 | a | | <p>idea that water is added from (each) lake to a (separate) Petri dish using (sterile) pipette ✓</p> <p>filter paper/antibiotic disc is placed in (the centre of) each dish with the (sterile) forceps ✓</p> <p>Petri dishes are incubated ✓</p> <p>idea that the inhibition zone/clear area/area with no bacteria growth around the discs is measured ✓</p> | 4 (AO4 x 1.2) | <p>ALLOW idea of repeats</p> <p>ALLOW idea of setting up a control</p> |
| | b | | <p>Lake Bellandur– no mark</p> <p>Any two from: more (antibiotic) resistant bacteria / more species of bacteria are resistant to antibiotics / ORA ✓</p> <p>Lower number of bacteria killed by antibiotics / less species of bacteria killed by antibiotics / ORA ✓</p> <p>this lake contains a higher ratio of resistant bacteria compared to bacteria killed by antibiotics✓</p> <p>(antibiotic) resistant bacteria more likely to survive/reproduce with more (antibiotic) pollution ORA ✓</p> | 1 (AO2 x 3.2a) | <p>Incorrect or no lake given then no marks</p> <p>ALLOW bacteria are more resistant (antibiotic) DO NOT ALLOW more resistant to bacteria IGNORE immune</p> <p>ALLOW only 28 species are killed</p> <p>ALLOW idea of natural selection causing increased resistant bacteria with more (antibiotic) pollution</p> |
| | | | Total | 6 | |

| | | | | |
|----|---|--|---------------------------------|--|
| 66 | a | to allow a valid comparison of the results ✓ | 1 (AO3.1b) | |
| | b | correct plots ✓✓ smooth curved line between points ✓ | 3 (AO3 x 2.2) | ALLOW +/- half a square All correct = 2 marks 3 or 4 plots correct = 1 mark DO NOT ALLOW sketchy line / line thicker than half a square |
| | | ii increases up to 10 days/70°C ✓ then decreases ✓ | 2 (AO3.1a) | ALLOW increases up to 9-11 days ALLOW increases by 44°C |
| | | iii FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 39 (°C) award 2 marks 70-31 ✓ = 39 (°C) ✓ | 2 (AO2.2) (AO1.2) | |
| | | iv normal compost is made by aerobic respiration ✓ aerobic respiration releases more energy than anaerobic respiration ✓ | 2 (AO2 x 2.1) | 2 correct ticks = 2 marks 1 correct ticks = 1 mark 3 ticks two correct = 1 mark 3 ticks one correct = 0 marks 4 or more ticks = 0 marks |
| | c | i FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 8 (kg) award 3 marks 1500-1200 OR 300 ✓ 300/40 OR 7.5 ✓ = 8 (kg) ✓ | 3 (AO3 x 2.2) | ALLOW one mark for clear evidence of rounding incorrect answer correctly to the nearest whole number |
| | | ii less carbon dioxide is produced ✓ | 1 (AO3.1b) | ALLOW less contribution to global warming / greenhouse effect / climate change |
| | | Total | 14 | |
| 67 | a | idea that water is added from (each) lake to a (separate) Petri dish using (sterile) pipette ✓ filter paper/antibiotic disc is placed in (the centre of) each dish with the (sterile) forceps ✓ Petri dishes are incubated ✓ | 4 (AO4 x 1.2) | |

| | | | | |
|----|----|---|-------------------|--|
| | | idea that the inhibition zone/clear area/area with no bacteria growth around the discs is measured ✓ | | <p>ALLOW idea of repeats</p> <p>ALLOW idea of setting up a control</p> |
| | b | <p>Lake Bellandur– no mark</p> <p>Any two from: more (antibiotic) resistant bacteria / more species of bacteria are resistant to antibiotics / ORA ✓</p> <p>Lower number of bacteria killed by antibiotics / less species of bacteria killed by antibiotics / ORA ✓</p> <p>this lake contains a higher ratio of resistant bacteria compared to bacteria killed by antibiotics✓</p> <p>(antibiotic) resistant bacteria more likely to survive/reproduce with more (antibiotic) pollution ORA✓</p> | 2 (AO2 x 3.2a) | <p>Incorrect or no lake given then no marks</p> <p>ALLOW bacteria are more resistant (antibiotic) DO NOT ALLOW more resistant to bacteria IGNORE immune</p> <p>ALLOW only 28 species are killed</p> <p>ALLOW idea of natural selection causing increased resistant bacteria with more (antibiotic) pollution</p> |
| | | Total | 6 | |
| 68 | i | set out a grid / sample area (1) | 1 | |
| | i | use random sampling within that area (1) | 1 | |
| | ii | <p>* Please refer to the marking instruction point 10 for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) Explains improved animal sampling techniques. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Explains advantages of plants being sedentary along with the limitations of animal sampling using a quadrat. <i>There is a line of reasoning presented with some structure. The information</i></p> | 6 | <p>AO3.3b: Analyse the information to develop the techniques to improve the sampling techniques</p> <ul style="list-style-type: none"> • use of capture / recapture • use of pitfall traps • use of pooters • plants are sedentary so will not move and as such are easy to count • animals can move away / frightened away • risk of counting animal more than once • missing some animals e.g. burrowing <p>and</p> <ul style="list-style-type: none"> • further limitations of these methods <p>AO1.2: Demonstrate knowledge of sampling techniques and why sampling is carried out</p> |

| | | | | |
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| | | <p><i>presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Provides a basic description of why sampling has to be used and use of or the limitations of the quadrat. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p> | | <ul style="list-style-type: none"> • a basic description of use of capture / recapture pitfall traps and pooters • gives a basic description as to why sampling techniques are used • the habitat is often too large to count everything • saves time / would take too long otherwise |
| | | Total | 8 | |
| 69 | a | quadrat ✓ | 1 (AO 1.2) | <p><u>Examiner's Comments</u></p> <p>The majority of higher ability candidates gained this mark. Those candidates that didn't score couldn't recall the piece of equipment as a quadrat. Common errors included square frame and Punnett square.</p> |
| | b | <p>FIRST CHECK ANSWER ON THE ANSWER LINE If answer = 0.1 (%) award 3 marks</p> <p>10x0.25 or 2.5 (m²)✓</p> <p>2.5 ?00 / 0.001 ✓</p> <p>= 0.1 (%) ✓</p> | 3 (AO 2 x 2.2)(AO 1.2) | <p>ALLOW correct conversion of the fraction of the area sampled into a percentage</p> <p><u>Examiner's Comments</u></p> <p>Just over half of candidates did not achieve any marks for this mathematical application question and lower ability candidates found having to work out the fraction of the field sampled then convert it into a percentage challenging. The candidates benefited if they showed their working out as there was an error carried forward mark for the correct percentage from an incorrect fraction.</p> |
| | | <p>(student A):</p> <p>has taken more samples/quadrats than B ✓</p> <p>ii has sampled all over/spread out/ random over the marsh ORA ✓</p> <p>samples more likely to be representative / not bias / valid ✓</p> | 3 (AO 3.1a x2) (AO 3.2a) | <p>If student B chosen = No marks</p> <p>IGNORE A = 10 and B = 8 samples</p> <p>IGNORE plants more spread out</p> <p><u>Examiner's Comments</u></p> <p>The majority of higher ability candidates achieved at least one mark here, with the most common credited mark that student A's sample was random. Very few candidates appreciated the</p> |

| | | | | |
|----|--|-----|---|---|
| | | | | sample would be more valid/representative, using the accepted language of measurement. |
| | | iii | <p>Any two from: wash hands (after sampling) ✓ not to eat / do not put hands to mouth (whilst sampling) ✓ protective clothing (whilst sampling) ✓ Cover cuts with plasters ✓</p> | <p>2 (AO 3.3b)</p> <p>ALLOW sterilise equipment after use</p> <p>Examiner's Comments Half of candidates achieved one mark on this question. The most common credited response was protective clothing, which was given by candidates analysing the information and making suggestions to improve experimental procedures.</p> |
| | | | Total | 9 |
| 70 | | i | <p>FIRST CHECK ANSWER ON THE ANSWER LINE If answer = 0.1 (%) award 3 marks</p> <p>= 2.5 ✓</p> <p>$\frac{2.5}{2500} \times 100$ ✓ = 0.1 (%) ✓</p> | <p>3 (AO 1.2)</p> <p>(AO 2.2)</p> <p>(AO 1.2)</p> <p>ALLOW ECF on area of quadrats</p> <p>ALLOW ECF</p> <p>Examiner's Comments This AO1.2 and AO2.2 question was generally answered well. Some candidates incorrectly rounded their answer and others did not multiply the area of 1 quadrat by 10, therefore using 0.25 instead of 2.5 in their calculation. Very few candidates scored zero, as often candidates were able to get marks for error carried forward. This emphasises the importance of candidates showing their working out.</p> <p>Exemplar 2</p> <p>$50 \times 50 = 2500$ $0.5 \times 0.5 = 0.25$</p> <p>$\frac{0.25}{2500} \times 100 = 0.01$</p> <p>Percentage =0.01.....% [3]</p> <p> AfL</p> <p>In this exemplar, it shows how ECF was applied to incorrect responses.</p> <p>ECF was applied to the percentage calculation method with incorrect value for the area of the quadrats, then ECF for the percentage calculation value.</p> <p>This highlights how important it is for candidates to show their working out as the candidate would not have scored any marks</p> |

| | | | | | |
|----|--|-----|--|-------------|---|
| | | | | | if all they had put was 0.01 on the answer line, as it would not have been possible to apply ECF. |
| | | ii | <p>Any three from:</p> <p>the second student samples less area / ORA ✓</p> <p>the second student did not sample at random / only sampled in the centre of the marsh / ORA ✓</p> <p>the centre may contain different plants compared to the edges ✓</p> <p>so, idea that the second student's results may be less representative / less accurate / ORA ✓</p> | 3 (AO 3.1b) | <p>ASSUME SECOND SAMPLE IF NOT STATED</p> <p>ALLOW only 5 quadrats taken / less repeats / less sample size / less data collected</p> <p>ALLOW the second student will not have results from all over the marsh / ORA</p> <p>Examiner's Comments</p> <p>The majority of candidates gained some marks on this AO3.1b question, with a minority gaining maximum marks. Most candidates were able to recognise that second student's method was not random and not representative of the entire marsh. Fewer commented on the fact that 5 quadrats cover less area than 10. Very few candidates observed that the plants would probably be different in different areas of the marsh.</p>  <p>AfL</p> <p>Candidates should be prepared to evaluate by processing information, graphs and diagrams before attempting answers, as this will help them construct responses that will cover the marks available in the question.</p> |
| | | iii | <p>make sure the tide is not coming in / make sure that the marsh is stable enough / wash hands after the experiment ✓</p> | 1 (AO 3.3b) | <p>ALLOW be aware of tide timetables/high tides</p> <p>ALLOW be safe as the tide is unpredictable</p> <p>ALLOW avoid falling into deeper marsh/slipping in mud</p> <p>IGNORE references to clothing</p> <p>Examiner's Comments</p> <p>This AO3.3 question targeted practical skills and specifically improvement of experimental procedures. Many candidates misunderstood 'risk assessment' and suggested things that could go wrong with experiment; 'losing the quadrats', 'damaging or killing plants/animals', etc. rather than health and safety.</p> |
| | | | Total | 7 | |
| 71 | | | net (1) | 1 | allow answer ringed, underlined or ticked more than one answer = 0 |
| | | | Total | 1 | |
| 72 | | | B | 1 (AO 1.2) | |
| | | | Total | 1 | |

| | | | | |
|----|----|--|------------------------------|--|
| 73 | | B | 1 (AO 1.2) | |
| | | Total | 1 | |
| 74 | | D ✓ | 1 (AO1.2) | |
| | | Total | 1 | |
| 75 | | to let air / oxygen in ✓ for (aerobic) respiration ✓ | 2 (AO1 x 2.1) (AO1 x 1.1) | DO NOT ALLOW carbon dioxide DO NOT ALLOW anaerobic respiration |
| | | Total | 2 | |
| 76 | | A ✓ | 1 (AO1.1) | |
| | | Total | 1 | |
| 77 | | (no because) her soil has 300 000 bacteria (1) has less than the normal / less than 3 000 000 (1) | 2 | allow one mark for dish 6 being diluted 100 000 times and dish 7 being diluted 1 000 000 times allow 1 mark ecf for yes, her soil has 3 000 000 bacteria which is the same as normal ?Examiner's Comments?? About half the candidates gained marks, with fewer gaining two. When using data to answer questions like this, candidates should be encouraged to make their working out or conclusions clear, and not just simply put down numbers. |
| | | Total | 2 | |
| 78 | i | correct area = 452(mm ²) (2) | 2 | allow 452.2 |
| | i | not resistant (1) | 1 | allow one mark for correct calculation and interpretation using incorrect radius |
| | ii | only one plate used / no replicates (1) | 1 | |
| | ii | only gives limited information ie one of three choices (1) | 1 | |
| | | Total | 5 | |
| 79 | | 10 × 100 000 = 1 000 000 bacteria present in soil sample (1) but no, because 1 000 000 is less than 3 000 000 / less than the figure in the table (2) | 2 | allow 3 000 000 / 1 000 000 = 30 (1) allow no, because there are ten colonies but there should be 30 (2) Examiner's Comments |

| | | | | | |
|----|--|----|---|-------------|--|
| | | | | | Few candidates realised that they needed to multiply 100 000 by 10. |
| | | | Total | 2 | |
| 80 | | i | any higher and the bacteria might be killed / bacterial enzymes denatured (1) | 1 | allow optimum temperature for the bacteria / bacterial enzymes |
| | | i | any lower and the erythromycin would diffuse slower / bacteria would reproduce more slowly so takes longer to get the results (1) | 1 | allow spread out slower |
| | | ii | prevent contamination by other microbes (1) | 1 | not germs / bugs |
| | | | Total | 3 | |
| 81 | | i | viruses are not destroyed/killed by antibiotics ✓ | 2 (AO 2.1) | <p>ALLOW antibiotics are ineffective in treating viruses / antibiotics only kill bacteria</p> <p>DO NOT ALLOW viruses can become antibiotic resistant</p> <p><u>Examiner's Comments</u></p> <p>Candidates found this question one of the most challenging on the paper. Only the higher ability students scored a mark here, with the most common mark awarded for antibiotics only work on bacteria or don't work on viruses. There were a lot of responses which were too vague and not specific. Very few candidates were given the antibiotic resistance mark.</p> <p style="text-align: center;">(?) Misconception</p> <p>Candidates demonstrated confusion between immunity and resistance to antibiotics. Exemplar 3 highlights this misconception</p> <p>Exemplar 3</p> <p><i>1. The patients will become immune to the antibiotics</i> <i>2. Antibiotics will not work and the patient will get worse.</i></p> |
| | | | wants to avoid the spread of antibiotic resistant (bacteria) ✓ | | |
| | | ii | virus sinusitis patient's should be getting better / the symptoms should have disappeared/only last 14 days ✓ any symptoms/infection (after 14 days) is caused by bacteria ✓ | 2 (AO 3.1a) | <p>IGNORE time for bacteria need to grow</p> <p><u>Examiner's Comments</u></p> <p>This question required the candidates to analyse and interpret</p> |

| | | | | | | | | | | | | | |
|--|---|--|--|--|--|--|--|--|--|--|---|--------------|------------------------------------|
| | | | | | the graph. There were some good responses that correctly explained why doctors wait 14 days after infection before giving antibiotics. | | | | | | | | |
| | | | Total | 4 | | | | | | | | | |
| 82 | | | <table border="1"> <tr> <td>bacteria in the compost kill disease causing fungi</td> <td></td> </tr> <tr> <td>the compost is sterile and so is aseptic</td> <td></td> </tr> <tr> <td>the compost provides carbon dioxide for photosynthesis</td> <td></td> </tr> <tr> <td>the compost provides minerals for the plants</td> <td>✓</td> </tr> </table> | bacteria in the compost kill disease causing fungi | | the compost is sterile and so is aseptic | | the compost provides carbon dioxide for photosynthesis | | the compost provides minerals for the plants | ✓ | 1 (AO1.1) | more than one box ticked = 0 marks |
| bacteria in the compost kill disease causing fungi | | | | | | | | | | | | | |
| the compost is sterile and so is aseptic | | | | | | | | | | | | | |
| the compost provides carbon dioxide for photosynthesis | | | | | | | | | | | | | |
| the compost provides minerals for the plants | ✓ | | | | | | | | | | | | |
| | | | Total | 1 | | | | | | | | | |