Pearson Edexcel

Mark Scheme (Results)

November 2021

Pearson Edexcel GCE
In Biology (9BI0/03)
Paper 3: General and Practical Principles in Biology

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Additional Guidance	Mark
1 (a)(i)	An answer that makes reference to the following: • one cell drawn with correct shape / proportion (1) • clear lines used to represent correct shape of cell, with no shading of any feature (1)	Must be a drawing not a diagram	**(2)**

Question Number	Answer	Additional Guidance	Mark
1 (a)(ii)	An explanation that makes reference to three of the following: • companion cells for ATP production (1) • because sieve tubes are for transport of organic molecules (1) • because energy is needed for transport (both up and down the stem) (1) • sieve tubes have no organelles, so less barriers to transport (1)	Allow named organic molecule eg {sugar / sucrose} Allow energy needed for active transport (of sugars) Allow sieve tubes have {sieve plates / plasmodesmata} so less barriers to transport	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An answer that makes reference to the following: • so that some organelles are clearly visible (1)	**Accept** converse Allow named organelles	**(1)**

Question Number	Answer	Additional Guidance	Mark
2 (a)	An answer that makes reference to at least one similarity and one difference: **Similarities** • both contain {nerve cells / neurones} (1) • both contain synapses (1) **Differences** • PNS is divided into somatic and autonomic systems, but CNS is not (1) • only the PNS has sensory input and motor output (1) • only the CNS carries out processing of information (1)	Allow both carry nerve impulses Allow both use neurotransmitters Allow PNS contains sympathetic and parasympathetic systems, but CNS does not	**(3)**

Question Number	Answer	Additional Guidance	Mark
2 (b)(i)	An answer that makes reference to the following: • (the cerebellum is for) {balance / coordination (of muscles) / posture} (1)	Allow {motor memory / learning complex motor skills}	**(1)**

Question Number	Answer	Additional Guidance	Mark
2 (b)(ii)	An answer that makes reference to the following: • cerebrum (1)	 Allow {cerebral cortex / motor cortex / cerebral hemisphere}	**(1)**

Question Number	Answer	Additional Guidance	Mark
2 (b)(iii)	An explanation that makes reference to two of the following: • the damage is to the left side of the cerebellum (1) • so movement of the right arm is no longer automatic / co-ordinated (1) • therefore the soldier compensates by having to think about it (1)	 Allow no impulses from cerebellum to (right) arm Allow impulses pass from cerebrum to right arm (to move arm)	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(a)	A description that makes reference to five of the following: • equal mass and shape of carrot tissue cut (1) • carrot tissue submerged in (boiling tubes with) known volume of water (1) • placed in water baths at stated range of temperatures for a stated length of time (1) • contents {filtered / decanted} (1) • absorbance measured / colour charts used (1) • graph plotted / statistical analysis of results (1) • appropriate step to ensure validity (1)	Allow use of cork borer and same length Allow {same surface area / equal cubes} Allow 5 – 100^{0}C (must be at least 5 temps), for 5 – 30 mins Allow transmission measured Allow all tissue from same {carrot / age of carrot} Allow repeats at each temperature and {mean / SD} calculated	**(5)**

Question Number	Answer	Additional Guidance	Mark
3(b)	An answer that makes reference to the following: • conversion of mg to g (1) • division by 750 and calculation of percentage (1)	1265.25 mg = 1.26525 g (0.1687 g in 100g) = 0.17 (%) Correct answer with no working gains 2 marks Otherwise correct answer to wrong power of 10 gains 1 mark Correct answer with wrong number of decimal place gains 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	An answer that makes reference to the following: • Prpr (1)	Allow $C^{Pr}C^{pr}$	**(1)**

Question Number	Answer	Additional Guidance	Mark
3 (c)(ii)	an answer that makes reference to the following: • number of each calculated (1) • number of each phenotype identified (1)	26:52:26 / 26:51:26 / 1 : 2 : 1 26 dark purple, 52 light purple, 26 white	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(c)(iii)	An answer that makes reference to the following: • O – E calculated for each phenotype (1) • square the values for O-E and divide by E (1) • χ^2 calculated (1)	Example calculation 5, 1, -6 0.961538462, 0.019231, 1.38462 2.37 / 2.4 / 2.365 Correct answer with no working gains full marks Allow ecf for expected numbers from cii	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(c)(iv)	An explanation that makes reference to the following: • critical value (at p = 0.05) is 5.991 (1) • calculated value is less than the critical value (1) • p > 0.05 so the conclusion is likely to be valid (1)	 Allow correct number indicated in table Allow 2.37 is less than 5.991 (gets mp1 &2) p> 0.05 / 5% that differences between observed and expected are due to chance (so it is valid) Allow p> 0.05 so purple colour is controlled by a single gene with two codominant alleles	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An explanation that makes reference to three of the following: • (biodiversity is low) because there are few species (1) • because there is a lot of trampling (1) • because animals are disturbed (by noise) (1) • because grass is mown (makes it difficult for other species to establish themselves) (1)		**(3)**

Question Number	Answer	Additional Guidance	Mark
4 (a)(ii)	An answer that makes reference to the following: • calculation of N(N-1) (1) • calculation of sum of n(n-1) (1) • calculation of D (1)	Example calculation 8556 1058 8.1 / 8.09 / 8.087 Correct answer with no working gains full marks	**(3)**

Question Number	Answer	Additional Guidance	Mark
4 (a)(iii)	An answer that makes reference to six of the following: • quadrats not placed at random (1) • {size / number} of quadrats not mentioned (1) • plants sampled at various intervals, animals at regular intervals (1) • {animals observed / no mention of how animals are counted} (1) • animals may {hide / move away / be counted twice} (1) • {only path sampled / inner area of woodland not sampled} (1) • not all animals identified to species level (1) • survey done at only one {time of year / time of day} (1)	Allow size of sample area not mentioned Allow description of pitfall traps, sweep nets, mark release recapture etc. could be used	**(6)**

Question Number	Answer	Additional Guidance	Mark
4 (b)	An explanation that makes reference to the following: • biodiversity decreases (1) • one relevant reason given (1)	Allow • because honeybees will compete with natural pollinators (for pollen / nectar / food) (1) • because populations of wild pollinators decrease (1) • because many wild pollinators will also provide food for other species (so they decline due to lack of food) (1)	**(2)**

Question Number	Answer	Additional Guidance	Mark
5 (a)	An explanation that makes reference to five of the following: • carbon dioxide is absorbed through the stomata and water is lost (1) • recognition of two patterns of stomatal distribution (1) Trees (beech, oak, sycamore) plus pea & sunflower • plants {with leaves lying flat / have most stomata on the lower surface} to reduce water loss from direct sunlight (1) Frogbit • {upper surface in contact with air, lower surface with water / (therefore the) frogbit has all the stomata on the upper surface because it is not short of water} (1) Daffodil & maize • leaves are {upright / exposed to equal amounts of light} so have stomata on both surfaces (1)	Allow {more on upper / more on lower / equal distribution} Allow stomata on lower surface allow {carbon dioxide to enter / gas exchange} Allow it needs to absorb carbon dioxide from the air	**(5)**

Question Number	Answer	Additional Guidance	Mark
5 (b)(i)	An answer that makes reference to the following: • rate at low light intensity and high light intensity estimated (1) • percentage increase calculated (1)	Acceptable range of rates 1.2 to 1.5 4.5 to 5.5 Acceptable range = 200 – 358% Correct answer with no working gains full marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
5 (b)(ii)	An explanation that makes reference to the following: • temperature because it affects the rate of transpiration (1) • humidity because it affects the rate of transpiration (1)	accept other relevant factors eg. windspeed availability of water	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	An explanation that makes reference to the following: • citrate binds to another site on the enzyme, activating the enzyme (1) • so that the structure of the enzyme is changed (1) • so that active site binds more effectively to the substrate (1) • an increase in fatty acyl CoA molecules inhibits the substrate binding to the active site (1) • due to competitive inhibition (1)	Accept citrate and fatty acyl CoA molecules act together to regulate the activity of the enzyme	**(5)**

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	An explanation that makes reference to two of the following: • fewer fatty acids will be made (1) • so that less fat is stored (1) • because the enzyme is being inhibited despite being activated by citrate (1)	Allow (less fat stored so) fat reserves used	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)	An explanation that makes reference to two of the following: • an inhibitor of the bacterial enzyme may not affect the human one (1) • description of effect of treatment eg fatty acids not made so {less respiration / bacteria die} (1) • so that there will be fewer side effects if used as a treatment for infections (1)	Allow enzymes are specific Allow is an effective antibiotic	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(a)	An answer that makes reference to the following: • osmosis is occurring (1) • at 3%, water has left the red blood cells (by osmosis) (1) • at 0.5% and 0.3%, water has gone into the cells (by osmosis) (1) • at 0.5% and 0.3% the cells have burst (and cannot be seen) (1) • 0.7% is close to the water potential of the cells' cytoplasm (1)	Allow correct reference to {hypertonic / hypotonic / isotonic} solution or to water potential Allow at 3% water leaving RBC by diffusion Allow water potential of cells' cytoplasm is between 0.7 and 1%	**(4)**

Question Number	Answer	Additional Guidance	Mark
7(b)	An explanation that makes reference to the following: • the osmotic potential of the red blood cells is equivalent to 3% glucose or 6% sucrose (1) • because the molecular mass of sucrose is twice that of glucose (1) • because it is the number of molecules that determine the osmotic potential, not % concentration (1)	Allow twice the concentration of sucrose is needed to have the same effect Accept sucrose as a disaccharide whereas glucose is a monosaccharide	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(c)(i)	An answer that makes reference to the following: • hypothalamus		**(1)**

Question Number	Answer	Additional Guidance	Mark
7(c)(ii)	An explanation that makes reference to four of the following: • sweating occurs causing loss of water from the blood (1) • therefore the water potential of the blood falls (1) • osmoreceptors are stimulated (1) • causing the pituitary gland to secrete {antidiuretic hormone / ADH} (into the blood) (1) • causing the {collecting ducts / kidney tubules} in the kidney to reabsorb more water (into the blood) (1)		**(4)**

Question Number	Answer	Additional Guidance	Mark
8(a)	An answer that makes reference to six of the following: • make extract of pineapple juice (1) • same {volume of skimmed milk / volume of pineapple juice extract} (1) • {use colorimeter to measure changes in absorbance with time / beaker over a black cross and time to disappear} (1) • calculation of initial rate (1) • at a range of temperatures using a water bath (1) • pH controlled using buffer (1) • plot graph of initial rate against temperature (1)	Allow other appropriate methods Allow use colorimeter to measure transmission Allow measure absorbance every 30s Allow 10 – 80^{o}C (must be at least 5 temps)	**(6)**

Question Number	Answer	Additional Guidance	Mark
8 (b)(i)	An answer that makes reference to two of the following: • Gram positive bacteria have more peptidoglycan than Gram negative bacteria (1) • Gram positive stains {purple / blue} (with Gram stain), but Gram negative do not stain {purple / blue} (with Gram stain) (1) • Gram positive contains {teichoic acid / lots of murein} but Gram negative do not (1) • Gram positive have no {periplasmic space / outer membrane} but Gram negative do (1)	Allow Gram positive have a thicker cell wall than Gram negative Allow Gram positive stains {purple / blue} (with Gram stain), but Gram negative stain red (with Gram stain) Allow Gram positive have low {lipid / phospholipid} content but Gram negative have high {lipid / phospholipid} content	**(2)**

Question Number	Answer	Additional Guidance	Mark
8 (b)(ii)	An answer that makes reference to the following: • conversion of micrometres to mm (1) • calculation of speed (1)	Example calculation 1µm = 0.001 mm 0.001 x 100 = 0.1 (mm s^{-1}) Correct answer with no working gains full marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
8(b)(iii)	An explanation that makes reference to two of the following: • BvB can kill gram negative bacteria (1) • without side effects for humans (1) • therefore could be useful when treating resistant bacterial infections (1)	Allow bacteria cannot become resistant to BvB	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(a)	An explanation that makes reference to two of the following: • fungi colonise new areas (1) • fungi cause decomposition (1) • so mineral ions are recycled within the ecosystem (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
9(b)(i)	An explanation that makes reference to three of the following:		
	• the numbers are very small causing a genetic bottle neck (1)	Allow reference to founder effect	
	• so that variation in the gene pool may have been reduced (1)	Allow small gene pool	
	• causing increased likelihood of inbreeding effects (1)	Allow inbreeding depression, Allow early offspring may have come from only one male	
	• such as accumulation of disadvantageous mutations (1)	Allow greater chance of receiving two recessive alleles	**(3)**

9(b)(ii)

Level	Marks	
0	0	No awardable content
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

<table>
<tr>
<td rowspan="3">9bii
Applying marking points

These are indicative marking points and other relevant information should be credited

Level 1
1 mark: any point
2 marks: any two points
3 marks: any 3 points

Level 2
4 marks: 4 points, must have + and -
5 marks: 5 points, must have + and -
6 marks: 6 points, must have + and -

Level 3
Points must come from all three sections

7 marks: 7 points, must have + and -
8 marks: 8 points, must have + and –
9 marks: 9 points, must have + and -</td>
<td>Justification for using poison to kill feral cats
1. less potoroos killed (+)
2. potoroos less likely to become extinct (+)
3. feral cats are an introduced species (+)
4. there are very large numbers of feral cats (+)
5. increased fungal spread in ecosystem (by potoroos) (+)
6. introduced species will be killed but native species unharmed (+)
7. biodiversity remains higher if native species not killed (+)
8. sausages are designed to target cats (+)
9. native species less likely to become extinct (+)
10. poison is biodegradable (+)</td>
</tr>
<tr>
<td>Reasons not to kill feral cats with poison
1. pets may be killed (-)
2. other animals may be killed (-)
3. lots of people object to this (petition) (-)
4. sausages could be attractive to wild species as well (-)
5. government could use other methods to reduce population of feral cats (-)
6. suggested other methods eg spaying, shooting (-)
7. killing cats does not deal with threat from foxes (-)
8. plants / kangaroos are killed to make the poison (-)
9. feral cats are behaving naturally and should not be punished for this (-)</td>
</tr>
<tr>
<td>Wider points
1. poison made from native plants so less likely to kill native animals (+)
2. biodegradable poison so action now will not affect animals in the future (+)
3. potoroos require special protection as there are such small numbers / endangered (+)
4. idea of balance needed in ecosystem (+)
5. cats have no natural predators in Australia, so it is justified to kill them (+)
6. ethics of government choosing which species to kill (-)
7. government could continue the breeding programme for potoroos (-)
8. effect on food chain of killing 2m feral cats (positive or negative)
9. feral cats may develop resistance to the poison (-)
10. government could try a small-scale trial to find effects of cull (-)</td>
</tr>
</table>

Question Number	Answer	Additional Guidance	Mark
10(a)	An explanation that makes reference to four of the following: • lichens are pioneer species (1) • they break down surface of rocks to create soil (1) • therefore other plants are able to {grow / be established} (1) • death and decay helps to {create humus / recycle minerals} (1) • therefore providing niches for either plants or animals (1)	Allow soil {becomes deeper / contains more minerals / more fertile} Allow wider variety of plants or animals can live there. Allow description of {trees / shrubs} growing Allow climax community develops	**(4)**

Question Number	Acceptable Answers	Additional Guidance	Mark
10(b)	An answer that makes reference to six of the following: • relevant abiotic factor named (1) • select {sample sites with environmental differences / one site with environmental gradient} (1) • {quadrats / point frame} used {at random /in a transect} (1) • to measure presence or absence of lichens (1) • method used to measure abiotic factor described (1) • t test carried out to measure significant difference (1) • other named variable controlled or measured (1)	eg light intensity, temperature, distance from sea, altitude Allow calculation of percentage cover described Allow correlation test carried out to measure correlation if appropriate Allow standard deviations compared.	**(6)**

Question Number	Answer	Additional Guidance	Mark
11(a)	An explanation that makes reference to six of the following: • grass taken from in or near clover and from an area without clover (1) • standardised mass of grass plants collected (1) • use of known volume of (named) solvent to extract pigment from (known mass of) grass (1) • absorbance measured in colorimeter (1) • red filter used to measure absorbance of green chlorophyll (1) • colorimeter zeroed with solvent (1) • replicates taken and means calculated (1) • t test used to look for significant difference (1) • other relevant factor monitored (1)	Allow lab-based experiment where grass is grown with and without clover Allow use of {sand / pestle and mortar/ food mixer} to grind up grass Allow extract filtered Allow details of chromatography if carried out as an alternative with area or intensity of green spots measured Allow compare standard deviation	**(6)**

Question Number	Answer	Additional Guidance	Mark
11(b)(i)	An answer that makes reference to the following: • (the nitrogen can be incorporated into) protein (1)	Allow {DNA / RNA / organic base / amino acid / named protein / ATP / chlorophyll}	**(1)**

Question Number	Answer	Additional Guidance	Mark
11(b)(ii)	An explanation that makes reference to the following: • enzyme lowers the activation energy (for the reaction) (1) • a large number of ATP molecules is used (1) • because the reaction needs a lot of energy (1) • to compensate for nitrogen being unreactive (1)		**(4)**

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