

Mark Scheme (Results)

Summer 2024

Pearson Edexcel A Level GCE
In Biology A Salters Nuffield (9BN0)
Paper 03: General and Practical Applications 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.

Question number	Answer	Additional guidance	Mark
1(a)	An answer that makes reference to the following: • when a species {moves / spreads / grows} into a new area (1)	ALLOW to immigrate into a (new) area ALLOW any term that indicates an area e.g. environment / habitat ALLOW other terms in place of species e.g. plant / animal / organism ALLOW pioneer species being first to live in an area IGNORE dominant species in an area / species outcompeting other species in an area	(1)

Question number	Answer	Additional guidance	Mark
1(b)	An answer that makes reference to three of the following: • IAA {accumulates on / diffuses / moves to} shaded side (of shoot) (1) • (IAA) regulates the activity of transcription factors (1) • causing cell elongation (1) • bending the shoot towards the light (1)	ALLOW auxin for IAA ALLOW plant for shoot ALLOW causing plant to grow towards the light ALLOW other words for bending e.g. leaning IGNORE move towards / point towards	(3)

Question number	Answer	Additional guidance	Mark
1(c)(i)	An explanation that makes reference to two of the following: • to ensure any response is due to the mutated or non-mutated allele (1) • because heterozygotes have the non-mutated and the mutated allele (1) • one of the alleles may be recessive (and will not be expressed in heterozygous plants) /one allele may be dominant hiding effect of recessive allele (1) • the alleles may be {codominant / incompletely dominant} (1)	ALLOW they are a controlled variable / to make results valid / increases validity ALLOW gene for allele in MP2 ALLOW heterozygotes have two different (tir1) alleles ALLOW so effect of each allele can be investigated ALLOW (heterozygotes) may still make enough tir1 protein	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
1(c)(ii)	An answer that makes reference to the following: • correct answer (1)	43 / 42.9 / 42.86 / 42.857 42.8571 IGNORE any sign	Choose an item. (1)

Question number	Answer	Additional guidance	Mark
1(c)(iii)	An answer that makes reference to two of the following: • (tir1) mutation caused a decrease in the response to IAA (1) • plants with mutation produce fewer (lateral) roots (1) • because IAA binding to its receptor is required to stimulate growth of (lateral) roots (1)	ALLOW mutation causes IAA receptor to stop working / is incorrect shape	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
2(a)	• correct diameter measured (1) • correct area calculated and recorded as a whole number (1)	<u>Example of calculation</u> 19 / 19.0 283 / 284 ALLOW 18.5 / 19.5 for diameter ALLOW area calculated from 18.5 / 19.5 given as a whole number IGNORE units in table Correct answer with no working gains full marks	(2)

Question number	Answer	Additional guidance	Mark
2(b)	A description that makes reference to three of the following: • wear gloves (that can be disposed of) (1) • after transfer of disk sterilise tweezers (1) • keep exposure of bacteria in Petri dish to environment to a minimum (1) • after transferring disks clean workspace (1)	ALLOW wash hands after transferring the disk ALLOW description of method e.g. flaming of forceps e.g. only lift lid slightly / keep time lid is removed (from Petri dish) to a minimum ALLOW work in a containment cabinet	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
2(c)	An explanation that makes reference to the following: • plot a graph (1) • results {not close to the line of best fit / that do not fit the trend} (could be) anomalous (1) OR • repeat (the experiment) (1) • results outside standard deviation (could be) anomalous (1)		Choose an item. (2)

Question number	Answer	Additional guidance	Mark
3(a)(i)	An answer that makes reference to the following: • thylakoid (membrane) (1)	ALLOW grana / granum / thylakoids ALLOW on thylakoids DO NOT ACCEPT thylakoid space	Choose an item. (1)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	• correct calculation of gradient (1) • correct answer to two significant figures (1)	Answer between 25 and 28 to any number of significant figures 25 / 26 / 27 / 28 Correct answer without working gains both marks	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
3(a)(iii)	A description that makes reference to the following: • absorb light (1) • transfer (light) energy to electrons (1) • provides (high energy) electrons to the electron transport chain (1)	IGNORE colour of light ALLOW photoactivation of chlorophyll ALLOW photoionisation ALLOW use (light) energy to excite electrons	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
3(b)	A description that makes reference to the following: • RUBISCO is an enzyme (1) • RUBISCO combines carbon dioxide with RuBP (1) • to form {GP / glycerate 3-phosphate} (1)	ALLOW RUBISCO fixes carbon / ALLOW RUBISCO catalyses the reaction between CO_2 and RUBP}	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
4(a)	An explanation that makes reference to the following: • fewer trophic levels in humpback whale (community) / whales are secondary consumers while sharks are tertiary consumers (1) • energy is lost at each trophic level / transfer of energy between trophic levels is inefficient (1) • therefore more energy is available (in the humpback whale) to be stored as biomass (1)	ALLOW converse argument for shark ALLOW 4 trophic levels for shark and 3 for whale ALLOW description of how energy is lost between trophic levels e.g. each trophic level uses energy in respiration	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
4(b)(i)	An answer that makes reference to the following: • GPP = NPP + R / NPP = GPP – R (1)	ALLOW description in words	(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that makes reference to four of the following: • use different temperatures (1) • control of a relevant variable (1) • measure oxygen **produced** in the light (to estimate NPP) • measure oxygen **used** in the dark (to estimate respiration) (1)	ALLOW sensible temperatures or temperature range (e.g. -5 to 40°C) e.g. abiotic: pH / light intensity / salt concentration of water / mass or volume of water / mass e.g. biotic: age / type / species of phytoplankton / ALLOW determine NPP from change in mass of phytoplankton	Choose an item. (4)

Question number	Answer	Additional guidance	Mark
4(c)(i)	Choose an item. • 0.86 : 1	ALLOW value between 0.8 : 1 and 0.92 : 1 ALLOW values between 1 : 1.09 and 1 : 1.25	Choose an item. (1)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	An answer that makes reference to two of the following: • more {oxygen taken up /carbon dioxide released} at lower temperature (1) • {more / higher rate of} respiration at {lower temperature / 14 °C} (1) • (mostly) aerobic respiration taking place (1) • using respiratory substrates other than {carbohydrates / glucose} (1)	ALLOW ratio of carbon dioxide produced to oxygen consumed is constant /carbon dioxide produced directly proportional to oxygen consumed / positive correlation between oxygen uptake and carbon dioxide production ALLOW example e.g. using fats / proteins as respiratory substrates ALLOW incomplete {aerobic respiration / oxidation of glucose}	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
5(a)(i)	• attach to {CD4 receptor / T helper cell} (1)	ALLOW other terms for attach	Choose an item. (1)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An answer that makes reference to the following: • because the virus {buds off from cell surface / is surrounded by (the host) cell membrane} (1)	ALLOW because lipid membrane is {taken / formed} from the host cell (membrane) IGNORE comments about immune recognition IGNORE exocytosis	Choose an item. (1)

Question number	Answer	Additional guidance	Mark
5(b)	An answer that makes reference to three of the following: • hydrolysis (1) • of peptide bond(s) (1) • at parts of polyprotein recognised by the protease (1)	 IGNORE other bonds ALLOW complementary to the active site	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
5(c)(i)	An answer that makes reference to the following: • correct slope calculated for the graph (1) • correct value calculated from y = mx + c (1)	<u>Example of calculation</u> e.g. 2 ÷ 5 = 0.4 2.1 ÷ 5 = 0.42 2 ÷ 4.9 = 0.408 ALLOW correct fractions 2.8 / 2.86 / 2.9 / 2.94 / 3 IGNORE units Correct answer without working gains both marks	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	An answer that makes reference to the following: • substrate concentration should be {in excess / not limiting} (1) • so that enzyme works at its maximum rate (1) • concentrations of different enzymes should be the same to allow a comparison (1)	 ALLOW enzyme and substrate concentrations should be the same (in each experiment) to allow comparison (of different enzymes)	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
6(a)(i)	An explanation that makes reference to the following: • MDMA binds to serotonin receptors (on the pre-synaptic membrane) (1) • preventing the (re-)uptake of {serotonin / neurotransmitter} (by presynaptic knob) (1) • so more serotonin binds to (receptors on) post synaptic membrane (1) • therefore more action potentials are triggered (in the post synaptic neurone) / therefore increasing the rate of transmission of nerve impulses (1)	ALLOW causing serotonin transport molecules to work in reverse ALLOW more impulses generated	Choose an item. (4)

Question number	Answer	Additional guidance	Mark
6(a)(ii)	An answer that makes reference to three of the following: • MDMA increased the number of button pushes (compared to the control) (1) • {on day 1 / initially} mice chose the MDMA button (approximately) 4 times more often than the control button (1) • after day 6 the number MDMA button presses increased (1) • by day {8 / 9 / 10} MDMA button presses had {(approximately) doubled but the control remained the same / were approximately 7 times the control} (1)	ALLOW the difference between control and MDMA group is 8 pushes ALLOW the difference between control and MDMA group is 16 pushes ALLOW 72% increase from day 6 to day 10 for MDMA	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
6(b)(i)	An answer that makes reference to the following: • movement of a substance against a concentration gradient (1) • requiring {energy / ATP} (1)	ALLOW movement of a substance from an area of low concentration to an area of high concentration ALLOW named substances e.g. ions / molecules / particles	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An explanation that makes reference to the following: • if sodium ions are taken into the cell the solute concentration increases inside the cell (1) • water (molecules) move into the cell by osmosis (1) • (movement of water into the cell) increases the cell volume (1)	ALLOW converse argument ALLOW decreasing water potential inside the cell	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
6(b)(iii)	An explanation that makes reference to two of the following: • space available to the brain is fixed / (swollen) brain cells take up more of the available space} (1) • (therefore) reducing space available for blood vessels (1) • vasoconstriction narrows arterioles (1) • (vasoconstriction) reduces {blood flow / pressure} in the brain (1)	IGNORE arteries / capillaries ALLOW 'blood vessels'	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
6(b)(iv)	An explanation that makes reference to the following: • reduced blood flow to (brain) cells (1) • therefore reducing the supply of {oxygen / glucose} required for respiration (1)		Choose an item. (2)

Question number	Indicative content
*7	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **Judgments from data** Latency • cold water (treatment) increased latency of motor neurone (CAP) • all treatments increased latency of sensory neurone (CAP) Duration • cold water (treatment) increased duration of motor neurones (CAP) • cold water (treatment) increased duration of sensory neurone (CAP) Amplitude • ice massage and ice pack decrease amplitude of sensory neurone (CAP) • cold water (treatment) had no / little effect on amplitude (CAP) Conduction velocity • all three treatments decreased conduction velocity in sensory neurone (CAP) • cold water treatment produced small decrease in conduction velocity in motor neurones Linkages based on own biological knowledge and understanding • increased latency of neurone may result in {fewer impulses / longer time to generate action potential} • decreased conduction velocity of neurone may result in fewer impulses • reduced amplitude may indicate fewer impulses being transmitted {across synapses / along neurones} • increased duration of motor neurone CAP may result in prolonged muscle contraction • increased duration of neurone CAP may result in delayed repolarisation (of neurones) Conclusions • {all 3 treatments / ice pack / ice massage} are likely to reduced sensory nerve conduction and would reduce pain • cold water treatment is likely to be effective at reducing (motor and sensory neurone) conduction and will be effective at reducing the cramping and reducing the pain • comments on limitations of the study

Level	Mark	Descriptor
0	**0**	No awardable content
1	**1 – 3**	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.
2	**4 - 6**	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.
3	**7 - 9**	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.

Question number	Answer	Additional guidance	Mark
8(a)	An explanation that makes reference to three of the following: • eye lens protein is present in all {vertebrates / mammals / sloths} (1) • amino acid sequences is determined by (lens protein) {gene / DNA sequence} (1) • (over time / occasionally) mutations occur (in the gene) that result in a change in the amino acid sequence (1) • differences in amino acid sequence can be used to place sloth into different phylogenetic branches (1)	ALLOW eye lens proteins are easily {obtained / purified / sequenced} ALLOW more differences in amino acid sequence the less closely related the sloths are ALLOW (the more similarities in amino acid sequence) the more closely related ALLOW sloths with same amino acid changes belong to same part of phylogenetic tree	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
8(b)	A description that makes reference to four of the following: • collect DNA samples from the algae (1) • amplify the DNA using PCR (1) • cut the DNA using restriction enzymes (1) • {separate the fragments / analyse the DNA} using electrophoresis (1) • banding pattern would match one of four distinct banding patterns (1) OR • isolation of appropriate named {protein / gene} (1) • sequence the {amino acids in protein / bases in gene} (1) • determine {number / location} of {differences / similarities} in the sequence (1) • place in phyla based on {similarities / differences} with other algae from the four phyla (1)	ALLOW description of electrophoresis ALLOW DNA profiling e.g. ribosomal protein	Choose an item. (4)

Question number	Answer	Additional guidance	Mark
8(c)	A description that makes reference to four of the following: • use of carbon dioxide absorber (1) • control temperature (1) • record spirometer trace (1) • description of how to obtain **rate** of oxygen consumption from trace (1) • reference to (using) mass of sloth (1) • comment on need to convert oxygen consumption to kilo joules (1)	 e.g. NaOH / KOH / soda lime ALLOW spirometer produces a {trace / graph} ALLOW description of trace e.g. peaks and troughs / graph of tidal volume e.g. find slope of peaks / change in height of peaks divided by time	Choose an item. (4)

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that makes reference to three of the following: • different viruses have {different proteins / different antigens} (1) • antibodies are specific to antigens (1) • the virus is specific to sloths if antibodies to the virus are only found in sloths (1) • the virus is incidental to sloths if antibodies to the virus are found in other species (1)		Choose an item. (3)

Question number	Answer	Additional guidance	Mark
8(e)	An answer that makes reference to two of the following: • plant material is difficult to digest (1) • (slow digestive process) allows time for digestive enzymes to work (1) • (slow digestive process) ensures maximum possible absorption of nutrients (1)	ALLOW difficult to break down {plant cell (walls) / cellulose / lignin / plant fibres} ALLOW allows more nutrients to be {absorbed / obtained}	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
8(f)	An explanation that makes reference to three of the following: • sloths have a relatively large surface area to volume ratio (1) • temperature changes a lot in the upper canopy (1) • thermoregulation uses (a lot of) energy (1) • an example of a thermoregulatory process that requires energy (1)	 ALLOW the sloth is a small mammal ALLOW temperature changes a lot in sloths habitat ALLOW homeostasis uses a lot of energy e.g. contracting erector muscles / generating metabolic heat / shivering / sweating / panting	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
8(g)	An answer that makes reference to the following: • behavioural		Choose an item. (1)

Question number	Answer	Additional guidance	Mark
8(h)	An answer that makes reference to three of the following: • tendons are non-elastic structures (1) • using a lattice of tendons reduces the number of muscles involved in gripping (1) • muscle contraction requires {energy / ATP} / using tendons reduces energy expenditure (1) • tendons do not fatigue (like muscles) (1)	 ALLOW tendons do not contract and relax / tendons do not stretch ALLOW do not need to use muscles as much ALLOW energy is not used to maintain a grip ALLOW using tendons conserves energy ALLOW reduces muscle fatigue	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
8(i)	An answer that makes reference to two of the following: • different primary structure (1) • {more / stronger / different} bonds between {R-groups / amino acid side chains} (1) • remain active over a broader pH range / not denatured by low pH (1)	 ALLOW different tertiary structure ALLOW denature at lower pH	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
8(j)	An explanation that makes reference to two of the following: • populations of species that occupy the same habitat (1) • that benefit from the {host / sloth} (without harming it) (1)	 ALLOW groups of species ALLOW live on the sloth / sloth is the habitat ALLOW area / location for habitat ALLOW examples of benefit e.g. food / shelter / protection from predators	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
8(k)	A description that makes reference to three of the following: • method of isolation of populations described (1) • reduces chance of reproduction between populations (1) • results in reduced gene flow between populations (1) • (forming) populations with different gene pools (1)	 e.g. different food sources / different feeding times / mating rituals / different genitalia ALLOWS moths were reproductively isolated ALLOW moths unable to breed with each other	 (3)

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