National Qualifications 2024

2024 Biology

Advanced Higher

Question Paper Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

General marking principles for Advanced Higher Biology

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must **always** be assigned in line with these general marking principles and the detailed marking instructions for this assessment.

(b) Marking should always be positive. Marks should be awarded for what is correct and not deducted for errors or omissions.

(c) If a specific candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you should seek guidance from your Team Leader.

(d) There are no half marks awarded.

(e) Where a candidate makes an error in the first part of a question, credit should normally be given for subsequent answers that are correct with regard to this original error. Candidates should not be penalised more than once for the same error.

(f) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units) on its own.

(g) Larger mark allocations may be fully accessed whether responses are provided in continuous prose, linked statements or a series of discrete developed points.

(h) In the detailed marking instructions, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.

(i) In the detailed marking instructions, words separated by/are alternatives.

(j) A correct answer can be negated if:
- an extra, incorrect, response is given;
- additional information that contradicts the correct response is included.

(k) Where the candidate is instructed to choose one question to answer but instead answers both questions, both responses should be marked and the better mark awarded.

(l) The assessment is of skills, knowledge and understanding in Biology, so marks should be awarded for a valid response, even if the response is not presented in the format expected.
For example, if the response is correct but is not presented in the table as requested, or if it is circled rather than underlined as requested, give the mark.

(m) Unless otherwise required by the question, use of abbreviations (eg DNA, ATP) or chemical formulae (eg CO_2, H_20) are acceptable alternatives to naming.

(n) If a numerical answer is required and units are not given in the stem of the question or in the answer space, candidates must supply the units to gain the mark. If units are required on more than one occasion, candidates should not be penalised repeatedly.

Marking instructions for each question

Section 1

Question	Response	Mark
1.	B	**1**
2.	C	**1**
3.	B	**1**
4.	B	**1**
5.	A	**1**
6.	C	**1**
7.	D	**1**
8.	B	**1**
9.	D	**1**
10.	C	**1**
11.	A	**1**
12.	A	**1**
13.	D	**1**
14.	B	**1**
15.	D	**1**
16.	A	**1**
17.	C	**1**
18.	B	**1**
19.	C	**1**
20.	A	**1**

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)		Information from these organisms can be applied to other (more difficult to study) species. **OR** (A model organism) can be easily studied . **OR** (A model organism) has been well studied.	**1**	NOT: Conflation of model organisms with another term (eg. Indicator species)
	(b)		75	**1**	Accept any answer that, when rounded, would give 75.
	(c)	(i)	As the concentration (of ammonia) increases, attraction increases until 0.7% then decreases.	**1**	Accept converse. Must make the link between PI and attraction once. Decreases at 1.4% is acceptable.
		(ii)	Idea of flies attracted to all of these compounds/them.	**1**	Accept: Comparison to water. NOT: Comparison to CO_2
	(d)		(More flies located in the control chamber than the odour chamber so) flies repelled by carbon dioxide.	**1**	Response must indicate a behaviour. Idea of: move away from CO_2/odour chamber NOT: Not attracted to CO_2
	(e)	(i)	(Binding of odorant to ligand-gated channel) changes its conformation **OR** opens the channel/ions flow into cell.	**1**	IGNORE: Reference to down-stream events (eg G protein/phosphorylation cascades) NOT: Transport of odour molecules into cell
		(ii)	In flies with mutation/Orco MUT/ $Orco^-$: response to odour/grape juice is reduced/fewer flies respond **(1)** (Because) less Ca^{2+} **enters** (through OR/channel) **(1)**	**2**	When calmodulin can't bind = Orco MUT land = respond Accept: responses from the viewpoint of WT flies.

Question			Expected response	Max mark	Additional guidance
2.	(a)	(i)	by heat/chemicals/alcohol/UV/ Gamma/γ (radiation)	**1**	Autoclaving/flaming/using a Bunsen burner = heat Disinfectant = chemical
		(ii)	eliminate unwanted/contaminant microbes/bacteria/microorganisms	**1**	Prevent entry/remove = eliminate
	(b)	(i)	7.0×10^6 or 7 000 000	**1**	Accept: correct value in any correct form.
		(ii)	use a vital stain (to distinguish living cells then use a haemocytometer/ count by microscopy.)	**1**	stain to distinguish living cells = vital stain
3.	(a)		Hydrophobic interactions involving R groups/transmembrane domains. **OR** Hydrophobic interactions involving interior of membrane. **OR** Hydrophobic R groups/part of the protein interacting with hydrophobic part of the membrane.	**1**	IGNORE: Correct reference to hydrophilic interaction with phospholipid heads.
	(b)	(i)	increasing temperature increases diffusion rates **(1)** the effects of temperature decreases as the number of transmembrane domains increases **(1)**	**2**	NOT: Responses suggesting time. Idea of: the difference gets less as the number of transmembrane domains increase. Accept converse.
		(ii)	Movement of proteins less affected by (changing) temperature . **OR** Membrane stability less affected by (changing) temperature. **OR** (The idea of) maintaining the functional position of transmembrane proteins within cell membranes.	**1**	

Question			Expected response	Max mark	Additional guidance
4.	(a)		Reduces the effect/influence of confounding variables. **OR** (Idea of) uncontrolled/confounding variables affect all groups to the same extent.	**1**	Accept: Allows/accounts for confounding variables (Randomisation means) confounding variables do not need to be controlled. Accept: description using a named confounding variable Accept: Reduces/eliminates bias NOT: Selection bias
	(b)		An inorganic fertiliser (at recommended dosage). **OR** Another fertiliser that is known to work.	**1**	
	(c)	(i)	Mix the three batches together before applying. **OR** Idea of: Each batch should be used over each sub-zone.	**1**	

Question			Expected response	Max mark	Additional guidance
4.	(c)	(ii)	63	**1**	1.5 + 3.0 + .75 = 5.25 L/zone (for 1×, 2×. 0.5×) 4 zones = 21L 3 treatments = 63L
	(d)	(i)	(Nettle slurry will have) no effect on potato yield/plant height/leaf number/leaf length/growth. **OR** Nettle slurry concentration will have no effect on potato yield/plant height/leaf number/leaf length/growth.	**1**	No significant difference/will not increase = no effect
		(ii)	Idea of: • fertiliser mixing • not having clear boundaries between treatments **OR** Plants on the edge (of the subplot) are more likely to be affected by pests/bad weather/ wind damage.	**1**	
	(e)		(Significant effect was observed on foliage so) may be suitable for other crops. **OR** They only tested potatoes (so can't draw conclusions/infer about other crops.).	**1**	Accept: Independent replication was not carried out. NOT: Small sample size

Question			Expected response	Max mark	Additional guidance
5.	(a)		disulphide (bridge/bond)	**1**	
	(b)		Idea of **series** of kinases activating/phosphorylating the next in the sequence	**1**	A protein that phosphorylates = kinase
	(c)		1. Type 1 diabetes is lack of/ reduced insulin (production) 2. No signal molecule/insulin to bind to receptor 3. Type 2 diabetes is loss of (insulin) receptor sensitivity/function/ response 4. (result in) failure/lack of recruitment of Glut-4 in fat/ muscle cells 5. impaired glucose uptake/ transport into fat/muscle cells **(Any 3)**	**3**	Pts 1 & 3: If no mention of Type 1 or Type 2 diabetes, one mark can still be awarded. pts 4 & 5: fat / muscle cells **only** required once to award both points. Pt 5: no = impaired
6.	(a)	(i)	• (A single photoexcited rhodopsin) activates hundreds of/many molecules of G-protein/ transducin • Each activated G-protein activates one molecule of PDE • each active PDE molecule breaks down thousands of/many cGMP molecules (per second).	**2**	Award one mark for: at least two correct events in the sequence. Award one mark for: at least two numbers correct.
		(ii)	Loss/degeneration in **colour** vision.	**1**	Perception = vision
	(b)	(i)	Retinal required for production of/ part of rhodopsin (in rod cells). **OR** Retinal needs to combine with opsin to form photoreceptor (proteins).	**1**	Accept: Won't be able to make rhodopsin.
		(ii)	(VAD would result in a) compromised immune system/more infections/ worsening of infections. **(1)** Which would also result in less vitamin A being absorbed. **(1)**	**2**	NOT: A lack of white blood cells alone

Question			Expected response	Max mark	Additional guidance
7.			1. (scientific findings) published/shared so work can be repeated/verified/built upon 2. Publication in journals/articles/papers 3. Peer review by scientists/experts in relevant field 4. (to) assess/evaluate scientific quality of submitted manuscript 5. (peer review) make recommendations about suitability for publication 6. Review articles summarise current knowledge/findings in a (particular) field. 7. (Findings also) shared by seminars/talks/posters at conferences/media 8. Increasing public understanding **OR** Reducing misrepresentation of science.	**4**	Pt 1: Sharing may be implied Pt 4: Examples of assessment of scientific quality (eg. errors/ethics/procedures) Pt 8: Idea of stopping/reducing the spread of misinformation/fake news about science.

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	Ethogram	**1**	
		(ii)	Idea of allows the data collection between sample periods/observers/ populations/studies to be compared **OR** Idea of reduces the variability of the interpretation of behaviour **OR** Idea of reduces misidentification/misnaming/incorrect categorisation of behaviours	**1**	
		(iii)	Applying human activity/emotions/traits to other animals/non-human	**1**	
	(b)		1. (Analysing each individual in a pack separately means that the observer) • did not get distracted • did not miss behaviours • didn't confuse animals • didn't miss any individuals (in the pack). **(1)** 2. (Two scientists analysing the footage means that) • results can be compared • findings can be backed up • findings aren't only one person's opinion • One scientist can spot an error in the other scientist's work. **(1)**	**2**	NOT: Independent replication NOT: Avoids bias alone
	(c)		**Frequency** (Frequency is) the number of times a behaviour occurs within the observation period. **Duration** (Duration is) the length of time each behaviour occurs during the observation period.	**1**	Only one is required. If a box is not ticked, the term must be given in the description to award the mark.
	(d)		They spend the **majority** of the time/ most of their time moving and resting.	**1**	Accept: They spend a higher percentage of time moving and resting than all of the other behaviours **combined**. They spend more of their time moving and resting than all of the other behaviours **combined**.

Question			Expected response	Max mark	Additional guidance
9.	(a)	(i)	Hermaphrodite	**1**	
		(ii)	More/increased chance of fertilisation.	**1**	Not: Reproduction alone.
		(iii)	• Males are unable to produce offspring • Only half of each parent's genome is passed on to offspring • Disrupting successful parental genomes **(Any 2)**	**2**	Accept: Reproduce = produce offspring Accept: Only half of the population can reproduce Not: • Higher energy cost put into producing eggs • More parental care • Difficulty finding a mate • Paradox of the existence of the male.
	(b)	(i)	Large/larger colonies are **more likely** to produce larvae through asexual reproduction than smaller colonies. **OR** Small/smaller colonies are **more likely** to produce larvae through sexual reproduction than larger colonies. **OR** Both small and large colonies are more likely to use asexual reproduction.	**1**	

Question			Expected response	Max mark	Additional guidance
9.	(b)	(ii)	Larger colonies (are more successful, therefore they) use asexual reproduction to conserve a successful genome. **OR** Colonies are larger due to rapid increase in size due to asexual reproduction. **OR** Younger colonies reproduce sexually/produce more gametes. **OR** Small colonies use more sexual reproduction as they require more variation.	**1**	Idea of: Link a benefit of asexual reproduction with being large. Parthenogenesis = asexual reproduction Accept converse. Accept converse.
		(iii)	(Data are more reliable for) larger colonies **AND** Because data points are close(r) to the line (of best fit).	**1**	Accept: Less spread of data/less scatter of data from the line/less variation in results. Accept: Stronger correlation for large colonies. NOT: Precision alone/sample size

Question			Expected response	Max mark	Additional guidance
10.	(a)	(i)	Replication of the phage/viral genome.	**1**	Ignore: Reference to enzymes. DNA/RNA = genome
		(ii)	(A parasite) gains benefit in terms of nutrients at the expense of the host.	**1**	Resources/energy = nutrients Harm/negative impact on = at expense of
	(b)		Bacteria develop resistance to bacteriophages. **OR** Idea of adaptation to avoid extinction/reduce harm etc.	**1**	Evade = develop resistance to NOT: Develop immunity OR antibodies Accept: Description of an adaptation.
	(c)		TREATMENT: 1. Idea of similarities between host and parasite metabolism makes it difficult to find drug compounds that only target the parasite 2. Antigenic variation has to be reflected in the design of vaccines 3. (Some) parasites are difficult to culture (in the laboratory) making it difficult to design vaccines / study parasite CONTROL: 4. parasites spread due to overcrowding/tropical climates 5. Poor sanitation allows parasite to spread 6. Vectors (spreading parasites) are difficult to control **(MAX 2)**	**3**	Pt 3: accept produce Pt 4, 5 & 6: the disease = parasites transmission = spread

Question			Expected response	Max mark	Additional guidance
11.	(a)	(i)	(non-random) selection of alleles that increase the individual's chances of mating/producing offspring/reproduction.	**1**	Increase in frequency = selection NOT: Responses that address female choice only Traits/characteristics/genetic material = alleles
		(ii)	(Idea of) female choice acts as a selection pressure on male characteristics. **OR** females choose/prefer/select males with the big(gest) forehead patch. **(1)** (This results in the male looking physically different) because these characteristics are not selected for in the female. **OR** only selected for in the male. **OR** This results in the forehead patches increasing in size over time. **(1)**	**2**	NOT: Male-male rivalry
		(iii)	Honest signal	**1**	

Question			Expected response	Max mark	Additional guidance
11.	(b)	(i)	At low temperatures (the forehead patch size) is selected for. **OR** At high temperatures (the forehead patch size) is no longer selected for/selected against. **(1)** Low temperature is a low-risk environment. **OR** High temperature is a high-risk environment. **(1)**	**2**	below 11.5°C = low(er) temperature above 11.5°C = high(er) temperature Accept: Any number between 11°C-12°C. Accept: As the breeding ground temperature increases the risk increases.
		(ii)	The males won't have a forehead patch/patch decreases. **OR** Species/population decline linked to reproduction going down. **OR** Population numbers increase in high-risk environments as less being eaten.	**1**	Idea of: patch is getting smaller/disappearing/less frequent

Question			Expected response	Max mark	Additional guidance
12.	(a)		Typha latifolia grows in depths between -30 cm and 80 cm. Typha angustifolia grows between 15 cm and 120 cm depth.	**1**	production = grows 15 +/- 2
	(b)		Interspecific (competition)	**1**	
	(c)	(i)	Figure - 1c Justification: (shows niche) in the absence of competition/*T.l*	**1**	Accept: Shows the plant species growing alone. Competitor = *T.l*
		(ii)	*T.l* has similar distribution whether grown alone or with *T.a* **OR** *T.a* is excluded from shallower depths due to competition / when two are grown together. **OR** T.a grows in a narrower range due to competition/when the two are grown together	**1**	
	(d)		r-selected/*T.a:* • smaller • shorter generation time • less energy input per offspring • produces more offspring • matures more rapidly • shorter lifespan • reproduce earlier • offspring lower survival **(Any 2)**	**2**	Accept: statements from viewpoint of K-selected/T.d At least one statement must be comparative. NOT: Parental investment

Question			Expected response	Max mark	Additional guidance
13.	**A**		1. Synthesis/translation begins on cytosolic ribosomes 2. Signal sequence is a short stretch of amino acids **OR** Signal sequence is at one end 3. Signal sequence halts translation 4. (Signal sequence directs) ribosome to dock with ER/to form RER 5. Translation continues after docking 6. Protein inserted into **membrane** of ER 7. Vesicle (containing protein) buds off 8. Vesicles move to Golgi apparatus 9. Proteins move through the Golgi 10. (Movement through Golgi) by vesicles budding off one disc and fusing to the next (in the stack) 11. Post-translational modification occurs in the Golgi 12. Major modification is the addition of carbohydrate/glycosylation 13. Various sugars added in (multiple) Steps 14. Vesicles leave the Golgi apparatus and transfer (the protein) to the membrane 15. Vesicles move along microtubules	**9**	Pt 2: N-terminus = at one end. Pt 4: Docks with RER Pt 6: NOT lumen Pt 7: Must be clear this is from ER Pt 12: Most common = major modification

Question			Expected response	Max mark	Additional guidance
13.	**B**		1. Checkpoints at G1, G2, M 2. Cyclins accumulate (during cell growth) 3. Cyclins combine with and activate cyclin-dependent kinases (CDKs) 4. Active CDKs phosphorylate proteins that regulate progression through the cell cycle/act at checkpoints 5. If phosphorylation reaches a threshold/sufficient phosphorylation progression to next stage/through a checkpoint occurs 6. Retinoblastoma protein (Rb) is a tumour suppressor 7. Rb acts at G1 checkpoint 8. Rb inhibits transcription of genes encoding proteins needed for DNA replication 9. Rb phosphorylated by (G1) cyclin-CDK/active (G1) CDK 10. Phosphorylation inhibits Rb 11. When Rb is inhibited/ phosphorylated DNA replication takes place/cell cycle progresses (from G1 to S) 12. DNA damage activates p53 13. (p53) can arrest the cell cycle/ cause cell death/apoptosis 14. Proto-oncogenes code for proteins that control/stimulate cell division 15. Proto-oncogenes can mutate to form oncogenes 16. Oncogenes encode proteins that deregulate the cell cycle/ promote the formation of tumours	**9**	Pt 2-4: Accept in context of named checkpoint Pt 4 & Pt 5: not Rb alone.

[END OF MARKING INSTRUCTIONS]