National Qualifications 2023

2023 Biology

Advanced Higher

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

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)		Transmission/infection (of humans) occurs in the water. **OR** Some stages of the parasitic life cycle take place in the water. **OR** (Schistosoma) requires water snail to complete life cycle. **OR** Water snail is an (intermediate) host. **OR** There is an (intermediate) host in the water.	**1**	NOT: Infection from drinking/ingesting infected water Accept: Description of a stage of the life cycle. Another organism in life cycle = intermediate host Accept correct reference to named larval forms. Ignore reference to the type of host.
	(b)		Collection/examination/sampling of faeces/stools/urine.	**1**	
	(c)		1.5 (tablets)	**1**	
	(d)	(i)	Increase in intensity results in decreasing cure rate.	**1**	Accept: Effectiveness = cure rate EPG = Intensity
		(ii)	Agree: Most children (have light infection intensity and) have no increase in cure rate with double dose. **OR** Disagree: Overall cure rates are higher with a double dose. **OR** Disagree: Cure rate with double dose is higher for moderate and heavy pre-treatment intensity.	**1**	Ignore numerical data given by the candidate. For 'agree' accept: Decrease = no increase

Question			Expected response	Max mark	Additional guidance
1.	(e)		Months 1 and 12	**1**	
	(f)	(i)	Becoming re-infected (within 18 months) decreases cognitive ability. **OR** The longer the time before re-infection the higher the cognitive ability.	**1**	Cognitive test scores are higher as infection-free period/re-infection time period increases. Test score = cognitive ability. Accept: Greater difference in test scores
		(ii)	These variables/they could affect the (cognitive) test scores/results/ dependent variable.	**1**	
		(iii)	To increase infection-free period. **OR** Prevent reinfection within 18 months **OR** Prevents reinfection allowing more (energy) investment in cognitive development/function.	**1**	Idea of: Staying uninfected for longer.

Question			Expected response	Max mark	Additional guidance
2.	(a)	(i)	• (In stage 2) No (human) antibodies to bacteria (in serum) so no binding (to assay plate). • (In stage 3) antibody specific to human antibodies will not bind/will be washed away. • (In stage 4) (If antibody to human antibody is not present there will be) no colour change (when the substrate is added.) **(Any 2)**	**2**	Accept: In stage 2 no antibodies present to bind. Accept: Second antibody/monoclonal antibody/antibody added at stage 3 = antibody specific to human antibody.
		(ii)	Fluorescence **OR** Chemiluminescence **OR** Radioactive/radioisotope	**1**	
	(b)	(i)	SDS–PAGE gives (all) proteins a negative charge. **(1)** SDS-PAGE denatures proteins. **(1)** Smaller proteins migrate further/ faster (than larger proteins in an electric field). **(1)** **(Any 2 from 3)**	**2**	
		(ii)	Transferred/blotted to a solid medium/nylon (membrane)/ nitrocellulose.	**1**	

Question			Expected response	Max mark	Additional guidance
3.	(a)		Kinase	**1**	
	(b)		Binds to a protein.	**1**	eEF-2 = protein
	(c)		Causes conformational change.	**1**	Accept: Change in shape
	(d)	(i)	It may (also) prevent protein synthesis in humans. **OR** The drug could (also) affect/bind to human eEF-2. **OR** Drug could have a similar effect in humans. **OR** Drug might not only target the yeast.	**1**	Idea of: (Both yeast and) humans have the protein – so translation could be disrupted in both.
		(ii)	Humans do not have amino acid sequence that sordarin binds to. **OR** There has been a change in some amino acids (in the eEf-2 protein) at the (specific) binding site, (so unlikely to bind.)	**1**	Accept: Won't bind = unlikely to bind

Question			Expected response	Max mark	Additional guidance
4.	(a)		Review (article)	**1**	
	(b)		Identical/sugar pill minus remedy.	**1**	Treatment = remedy
	(c)	(i)	The patient would be at (increased) risk of another heart attack. **OR** The patient may be harmed/might die/be worse off. **OR** There is no evidence that homeopathic remedies work (so the patient might be harmed.)	**1**	
		(ii)	Small sample size. **OR** No independent replicate.	**1**	Accept: Only three patients used.
		(iii)	Multifactorial (studies).	**1**	
		(iv)	• Patients were also given conventional medicines. • Patients were given different (numbers of) homeopathic remedies/conventional medicines. • Don't know if effect/recovery was due to conventional/ homeopathic treatment. **(Any 1)**	**1**	NOT: There are uncontrolled confounding variables OR confounding variables related to sample selection. Drugs = medicines.
		(v)	Sample/patients might not be representative. **OR** Patients might (be more likely to) respond to the therapy as they believed in homeopathy. **OR** Might result in a greater placebo effect (because they believed in homeopathy). **OR** More likely to misreport symptoms/ improvement (because of family ties.)	**1**	Idea of: Placebo effect due to family connections.

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	Sodium (ions)	**1**	
		(ii)	(Protein Z is the sodium/potassium pump and) hydrolyses ATP. **OR** Creates/maintain the concentration gradient of sodium ions/Na^+/X	**1**	Electrochemical = concentration
	(b)		1. Passive transport 2. down a concentration gradient (across a membrane). 3. Through/requires (specific/ transmembrane) proteins. Binding/conformational change in transporters. 4. (water-filled) Pores in channels. 5. Channels/transporter **Max 3**	**3**	NOT: along Pt 4 and Pt 5: Ignore incorrect example of a substance transported. Pt 6: only award if Pt 4 and 5 not awarded.
	(c)		(When glycogen converted to glucose in liver) the glucose cannot diffuse into blood/out of the liver.	**1**	Idea of: glucose not crossing the membrane.

Question			Expected response	Max mark	Additional guidance
6.	(a)	(i)	(Death signal) molecules from lymphocytes. **OR** Binding of lymphocytes **OR** The absence of growth factors.	**1**	NOT: Lymphocytes alone.
		(ii)	Caspases	**1**	
	(b)	(i)	(Proliferation of digit cells) is more important in mice than in chickens.	**1**	
		(ii)	(So would need) more/to continue cell proliferation to form webs/ wings. **OR** Idea of: There is more proliferation than cell death allowing formation of webs/ wings.	**1**	Accept: More interdigital cells required to form the wings.
	(c)		Metamorphosis **OR** to remove damaged/diseased/ tumour/cancer/infected cells.	**1**	

Question			Expected response	Max mark	Additional guidance
7.			1. Viruses contain DNA/RNA/nucleic acid. 2. (DNA/RNA packaged) in a protein coat. **OR** Viruses have antigens/proteins on their (outer) surface. 3. Some viruses surrounded by (phospho)lipid/membrane. 4. (Phospholipid) derived from host cell. 5. Retroviruses contain reverse transcriptase. **Max 4 from points 1-5** 6. Parasitism is a symbiotic interaction. 7. Parasite gains (benefit in terms of energy/nutrients) at the expense of its host. 8. Virus can only replicate inside a host/cell (which is harmed). **OR** Viruses are obligate parasites.	**5**	Accept: Diagrams with correct labelling Pt 3: Envelope = phospholipid membrane Pt 5. Accept: description of the action of reverse transcriptase. Pt 7. virus = parasite Pt 8: Accept: Virus requires a host (cell) to survive.

Question			Expected response	Max mark	Additional guidance
8.	(a)		Common species not sensitive enough to change and rare species are too sensitive. **OR** Range of tolerance too wide for (very) common species and too narrow for (very) rare species.	**1**	A change in the environmental factor causes too small a change in abundance for a common species or too large a change for rare species.
	(b)		TREND: As water flow rate decreases mayflies/stoneflies/caddis flies decrease. **OR** As water withdrawal increases mayflies/stoneflies/caddis flies decrease. **OR** Mayflies/stoneflies/caddis flies decrease and non-insect invertebrates increase. **(1)** EXPLANATION: Idea of: Mayflies/stoneflies/caddis flies are susceptible and non-insect invertebrates are favoured – linked to the change in water condition. **(1)**	**2**	**Award 1 mark for:** Mayflies/stoneflies/caddis flies are susceptible and non-insect invertebrates are favoured Water extraction/flow rate only needs to be referred to once.
	(c)		(Use data) to identify how much water can be removed before (species) abundance is affected. **OR** (Use data) to identify how low the flow rate can be before (species) abundance is affected.	**1**	Numbers = abundance Accept: When indicator species numbers begin to decrease water should stop being removed.

Question			Expected response	Max mark	Additional guidance
9.	(a)		Genetic bottleneck/founder effect **(1)** (causing) unpredictable/random changes in allele frequencies/gene pool. **OR** alleles lost/misrepresented/over-represented/under-represented. **(1)**	**2**	Accept: • Smaller group/(rapid) decrease in population • Going from a large population to a smaller one. NOT: • Genes = alleles • Reference to natural selection/ non-random process
	(b)		variance in allelic frequency: N= 50 0.0025 N= 10 0.0125 **(1)** Genetic drift higher in 10 (than in 50). **OR** Genetic drift higher in smaller populations **(1)**	**2**	Award 1 mark for incorrect calculation with statement correct for that calculation 2.5×10^{-3} 1.25×10^{-2}
	(c)		Males with larger horns have better success in male-male rivalry **(1)** (so) get a mate/access to females/to reproduce. **OR** More likely to pass (favourable) traits/alleles to offspring. **(1)**	**2**	Win more fights/an advantage = better success IGNORE: Reference to female choice.

Question			Expected response	Max mark	Additional guidance
10.	(a)	(i)	Has male and female reproductive organs/gametes. **(1)** Idea of: (But) not at same time. **(1)**	**2**	Accept: One after the other/change sex/ going from one sex to the other
		(ii)	Reduces conflict/competition **OR** Most successful alleles increase in frequency/passed on.	**1**	
		(iii)	Parasitic infection/competition/ temperature	**1**	Accept: Resource availability
	(b)		1. High energy cost producing many gametes 2. (Many) gametes lost/predated 3. Low chance of fertilisation 4. No/limited parental care 5. Few offspring survive **Any 3**	**3**	Pt 3: Accept not fertilised. Pt 4: NOT investment = care. Pt 5: Accept: many offspring predated.
11.	(a)		Horizontal gene transfer.	**1**	
	(b)		Venom proteins (in the centipedes) not present in ancestors. **OR** Compare the proteins of the venom to that of the ancestors (to look for differences).	**1**	Compare venom proteins to bacteria and fungi proteins. Amino acid sequence = protein
	(c)		(Cooler climates have) lower parasite density/diversity. **OR** (Cool climates) disadvantageous to parasites. **(1)** Less need for variation (by sexual reproduction to combat parasites). **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
12.	(a)	(i)	Interspecific competition	**1**	
		(ii)	Competitive exclusion	**1**	
	(b)		As the proportion of sightings of pine martens increases, sightings of grey squirrels decreases **OR** When pine marten (sightings) are low, grey squirrel (sightings) are high. **OR** When pine marten (sightings) are 20%, grey squirrel (sightings) are 40%. **AND** When pine marten (sightings) are 45%, grey squirrel (sightings) are 8%.	**1**	Percentage = proportion. Ignore incorrect data if there is a correct general statement. Accept: +/- 1% tolerance. Accept: less than 10% = 8%
	(c)		Idea of: Avoid an underestimate of population size. **OR** Idea of: Count the ones that are not seen.	**1**	Accept: Improves accuracy (of results).

Question			Expected response	Max mark	Additional guidance
12.	(d)		Red squirrels and pine martens have co-evolved **OR** Red squirrels have had chance/time to adapt to pine marten (predation) **OR** Grey squirrel and pine marten not co-evolved **OR** Grey squirrels have had no chance/ time to adapt to pine marten predation **(1)** Red squirrels (have been) under selection pressure from pine marten. **OR** Grey squirrels not under selection pressure from pine marten. **(1)**	**2**	Evolved together for a long time.
	(e)		Introduce pine martens to areas where red squirrels are rare. **OR** (Restore pine marten populations by:) • Restoring pine marten habitat • Reforestation in pine marten areas • Enforcing protection of pine marten • Banning hunting/shooting of pine marten.	**1**	NOT: Introduce pine martens alone. Only one from list required.

Question			Expected response	Max mark	Additional guidance
13.	**A**		1. Diagram/description of generalised structure of an amino acid. 2. (Amino acids only) differ in (structure of) R group. 3. **TWO from:** Types of R groups are acidic/ basic/polar/hydrophobic 4. (Different) R groups give different hydrogen-bonding capacity/chemical reactivity **MAX 2 from Pts 1 to 4** 5. Primary structure (of a protein) is the order of amino acids (in a polypeptide/protein) 6. (Amino acids) linked by peptide bonds **OR** Diagram showing peptide bond 7. Secondary structure from hydrogen bonding (between amino acids) 8. Along backbone **OR** not between R groups 9. α-helix, β (–pleated) sheet and turns are types of secondary structure 10. Tertiary structure is folding of polypeptide/3-D shape of protein 11. Tertiary structure stabilised by interactions between R groups 12. TWO from: • Hydrophobic interactions • Ionic bonds • London dispersion forces • Hydrogen bonds • Disulphide bridges	**9**	Pt 5: sequence = order Point 8 accept between peptide bonds

Question			Expected response	Max mark	Additional guidance
13.	**A**		13. Disulphide bridges are covalent bonds between R groups containing sulfur/cysteines **MAX 6 from Pts 5 to 13** 14. Quaternary structure is the (spatial) arrangement of subunits (in proteins) **OR** Quaternary structure (in proteins) with more than one subunit/multi-subunit 15. Prosthetic group is a non-protein component 16. (Prosthetic group) necessary for function/tightly bound **MAX 1 from Pts 14 to 16**		

Question			Expected response	Max mark	Additional guidance
13.	**B**		1. Resting membrane potential is no net flow of ions across membrane 2. Neurotransmitter released into synapse/initiate response. **OR** vesicles containing neurotransmitter fuse with membrane 3. Neurotransmitters bind to specific/their receptors (at synapse) 4. Neurotransmitter receptors are ligand-gated (ion) channels **OR** Binding of neurotransmitter opens (ligand-gated) channels 5. Sodium ions enter neuron/cell **OR** Sodium ions move down electrochemical/concentration gradient 6. Initial depolarisation of plasma membrane 7. sufficient ion movement/ membrane depolarised beyond a/reaches threshold 8. Opening of voltage-gated sodium channels triggered 9. **More** sodium ions enter cell **OR** further depolarisation 10. sodium channels close/ inactivated 11. (Then voltage-gated) potassium channels open 12. Potassium ions move out of cell **OR** Membrane repolarises 13. Resting membrane potential restored **OR** Ion gradients re-established by sodium-potassium pump	**9**	Pt 5: Idea of direction NOT: potassium rapid/large change in membrane potential = further depolarisation. Pt 12: Accept membrane potential becomes more negative/inside of the cell becomes more negative.

Question			Expected response	Max mark	Additional guidance
13.	**B**		14. Depolarisation of a patch/region of membrane causes neighbouring regions (of membrane) to depolarise **OR** Wave of electrical excitation/ depolarisation along (neuron's) membrane 15. When action potential/wave of depolarisation reaches end of neuron a response in connecting cell stimulated		

[END OF MARKING INSTRUCTIONS]

