National Qualifications 2022

2022 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.

(o) Incorrect spelling is given:

- if the correct word is recognisable then give the mark
- if the word can easily be confused with another biological term then do not give the mark, eg ureter and urethra
- if the word is a mixture of other biological terms then do not give the mark, eg mellum, melebrum, amniosynthesis.

(p) Marks are awarded only for a valid response to the question asked. For example, in response to questions that ask candidates to:

- **identify**, **name**, **give**, or **state**, they need only name or present in brief form;
- **describe**, they must provide a statement or structure of characteristics and/or features;
- **explain**, they must relate cause and effect and/or make relationships between things clear;
- **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between things;
- **calculate**, they must determine a number from given facts, figures or information;
- **predict**, they must suggest what may happen based on available information;
- **evaluate**, they must make a judgement based on criteria;
- **suggest,** they must apply their knowledge and understanding of Biology to a new situation. A number of responses are acceptable: marks will be awarded for any suggestions that are supported by knowledge and understanding of Biology;
- **account for,** they must give a reason or reasons for a particular action, event, observation, change, or state**.**

Marking instructions for each question

Section 1

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

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)		• Epithelial tissue/skin/physical barrier blocks the entry of parasites. • (Hydrolytic) enzymes in mucus/ saliva/tears/secretions destroy bacterial cell. • Low pH environments/secretions denature proteins of/destroy pathogens. • Signalling molecules/inflammatory response (increase blood flow) results in (more) cells of the immune system (at the area of infection). • Phagocytes engulf and digest/ destroy pathogens. • Natural killer cells destroy/induce apoptosis in infected cells. **(Any 1)**	**1**	Pathogen/bacteria = parasite. Antigen ≠ parasite. Example of low pH environment: stomach/vagina/sweat glands. Accept – histamine/cytokines as signalling molecules.
	(b)		No effect.	**1**	Accept: Remains the same.
	(c)	(i)	It decreases.	**1**	NOT: Statement referring to either mild or severe alone. NOT: Big decrease for severe, small decrease for mild. NOT: Incorrect reference to Mvac.
		(ii)	Younger children/they will have been exposed to fewer pathogens/ antigens. **OR** They will be (more likely to be) exposed to **new** antigens (during the time interval) (resulting in an increase in antibody diversity).	**1**	Disease = infection = pathogen Idea of:exposure to new pathogens.

Question			Expected response	Max mark	Additional guidance
1.	(d)	(i)	32.58/32.6/33	**1**	
		(ii)	**<u>IQR:</u>** The IQR is smaller in M mild than M sev **(1)** IQR M mild at 0.83 to 0.64/range of 0.19 **AND** IQR M sev at 0.74 to 0.50/range of 0.24 **(1)** **OR** **<u>(Full) Range:</u>** Range is greater in M mild than M sev **(1)** Range M mild at 0.88 to 0.27/range of 0.61 **AND** Range M sev at 0.89 to 0.38/range of 0.51. **(1)**	**2**	<u>Note to markers:</u> Variability is acceptable – it will relate to the comparative statement for either IQR or full range. Accept converse statements. Not: average = median. When discussing Full Range: • Max one mark if response mentions error bars. Award responses that demonstrate recognition of the asymmetrical distribution of the data (1 mark) with appropriate numerical support (1 mark).
		(iii)	Antibody **types** are lost (after measles infection) Because the memory cells that produced them are no longer present.	**1**	diversity/variety = type

Question			Expected response	Max mark	Additional guidance
2.	(a)		Excludes/prevents (microbial) contaminants. **OR** Only required cells grow/are cultured/present/ensures a pure culture. **OR** Prevents (accidental) release of (harmful) micro-organisms.	**1**	Accept prevents contamination.
	(b)		1.2×10^5	**1**	Accept correct number expressed in different ways eg 120 000/12×10^4
	(c)	(i)	A (Dead cells take up the stain). (A) has the highest proportion/percentage of stained cells (which are dead).	**1**	Accept: higher ratio of stained to unstained. Accept: A had killed a higher percentage/proportion of cells.
		(ii)	Colony count (after serial dilution). **OR** Dilution plating.	**1**	Accept suitable description Not: cell count/flow cytometry/ fluorescence microscopy.
		(iii)	(Disruption of the cell membrane) would allow leakage of materials into/out of the cell. **OR** Disruption could (be severe enough to) lead to lysis of the cell. **OR** Leads to loss of function/structure of membrane proteins.	**1**	Accept: increases permeability. Accept: lysis = bursting.

Question			Expected response	Max mark	Additional guidance
3.	(a)		Hydrogen bonds.	**1**	
	(b)		Non-protein group **AND** essential for function/carrying/ binding oxygen **OR** tightly bound.	**1**	
	(c)		(Changes in) binding of (oxygen) at one site/subunit affects the binding of (oxygen) at the remaining sites/subunits.	**1**	Do not award for an incorrect directional relationship.
	(d)	(i)	Reduces the affinity (of haemoglobin) for oxygen. **OR** Requires a higher O_2 pressure to reach 100%/same saturation.	**1**	Binding must be linked to affinity. NOT: Reference to rate/time/longer/ slower.
		(ii)	(Higher concentration of 2,3-DPG) would reduce affinity for oxygen further/shift curve further to the right. **AND** Haemoglobin would then be able to release oxygen more easily (to tissue).	**1**	Idea of haemoglobin giving up oxygen **more** easily. Accept: reduce binding Must be comparative.

Question			Expected response	Max mark	Additional guidance
4.	(a)		Hydrolysis of ATP.	**1**	Accept description or correct chemical equation.
	(b)		Voltage-gated (ion channels).	**1**	
	(c)	(i)	(Electrochemical gradient) is a combination of the concentration gradient. **AND** The electrical gradient (across the plasma membrane). **OR** Potential/charge difference (across the plasma membrane)/membrane potential.	**1**	Voltage = potential difference.
		(ii)	(Potassium ions have a positive charge so will flow into the cell) Because the effect of the electrical potential difference is **greater** than that of the concentration gradient.	**1**	Accept converse. Accept alternative descriptions of electrical potential difference. IDEA OF: • electrical gradient is "stronger" than the chemical gradient • opposing gradients/forces Example: Moving down the electrical gradient despite going against the concentration gradient.

Question			Expected response	Max mark	Additional guidance
5.			1. example: oestrogen/testosterone 2. diffuse (directly) through/across phospholipid bilayer/membrane 3. bind to specific intracellular receptors **OR** specific receptors are in the cytosol/nucleus 4. receptors are transcription factors 5. hormone-receptor complex binds to specific/target DNA (sequences) 6. called hormone response elements/HREs 7. (binding of) hormone-receptor complex affects the rate of transcription/gene expression 8. transcription/expression of **many** genes affected (by one hormone). **Any 5**	**5**	Pt 3. Specificity can be implied eg A steroid binds to its receptor. Pt 5. Accept description of hormone-receptor complex. Pt 7 - No double penalty if hormone-receptor complex not mentioned at Pt 5.

Question			Expected response	Max mark	Additional guidance
6.	(a)		1. Neurotransmitters bind to ligand-gated (ion) channels **OR** neurotransmitter receptors are ligand-gated (ion) channels 2. (binding) allows an influx of positive/sodium ions **OR** the membrane depolarises 3. if sufficient ion movement occurs/the threshold is reached 4. (If threshold is reached) voltage-gated sodium (ion) channels open 5. resulting in further depolarisation **(Any 3)**	**3**	Ignore additional irrelevant information. NOT: K^+ ions <u>Pt5:</u> depolarisation waves ≠ further depolarisation NOT: just change in membrane potential. NOT: hyperpolarisation.
	(b)	(i)	As mambalgin concentration increases (from 1 to 7 units) ion flow through the ASICs/channels (relative to controls) decreases **OR** As the concentration increases the activity (relative to control) decreases.	**1**	Accept converse.
		(ii)	(Mambalgin binds to ASIC channels and) prevents them opening/being stimulated **OR** (Mambalgin) acts as an antagonist (to ASIC channels) **OR** (Mambalgin binds to ASIC channels and) results in insufficient ion flow **AND** Cannot initiate an action potential **OR** Cannot sufficiently depolarise the membrane **OR** Cannot stimulate receptors.	**1**	Accept: (Mambalgin) prevents binding of neurotransmitter.

Question			Expected response	Max mark	Additional guidance
7.	(a)	(i)	(Tumour cell lines) divide indefinitely/are immortal/can exceed Hayflick limit/have an unlimited number of divisions.	**1**	indefinitely = continuously NOT: uncontrolled/unregulated growth alone.
		(ii)	Can see the effect (of the virus) on the whole organism/all parts of the body/systems of the body. **OR** Idea of (reduces the likelihood of erroneous conclusions due to) not all components being present in a cultured cell.	**1**	NOT: can see side effects Accept: examples of missing components
	(b)	(i)	DNA repair stimulated/cell cycle arrested/apoptosis/programmed cell death.	**1**	NOT: cell death alone Accept: triggers a caspase cascade
		(ii)	Rb acts at the G1 checkpoint to prevent progression to S phase/next stage of the cell cycle **OR** (Active) Rb inhibits the transcription of genes that code for proteins needed for DNA replication/S phase. **(1)** If Rb is inhibited (by Tag) the cell will not be held at G1/will progress to S phase where the cell should be held at the checkpoint. **(1)**	**2**	Accept: exemplification of the conditions that would cause this to happen eg Rb has not been sufficiently phosphorylated.
	(c)	(i)	(Vaccination gives a) reduction (in CIN).	**1**	
		(ii)	Non-vaccinated people also seem to be protected **OR** Incidence of CIN also dropping in non-vaccinated.	**1**	Ignore reference to specific years.

Question			Expected response	Max mark	Additional guidance
8.	(a)		(Critical) evaluation by experts in the (relevant) field.	**1**	Review ≠ evaluation. Idea of: Reading and commenting on = evaluation.
	(b)	(i)	(Testing with) glucose/ carbohydrate/sugar (solution).	**1**	
		(ii)	So that all the bananas would be the same age/same ripeness/reduced genetic variation/same time in transit/same conditions prior to experimentation.	**1**	
	(c)		Determine the glucose/ carbohydrate/sugar in an unknown solution **OR** Determine the concentration in banana (extract solution).	**1**	Must be in the context of this experiment.
	(d)		Insoluble starch/carbohydrate will (only) be in the pellet/not be in the supernatant **OR** Only soluble carbohydrates will be present in the supernatant **OR** Allow insoluble carbohydrates to be removed.	**1**	Accept: cellulose = insoluble carbohydrate.
	(e)		Same mass of banana added to same volume of water.	**1**	
	(f)		Fresh (Anthrone) solution/different bananas/different time.	**1**	Ignore reference to equipment
	(g)		No control of • volume of extract • storage conditions • temperature (of experiment) • centrifuge speed/time • volume of anthrone solution used **(Any 1)**	**1**	NOT: • Sample size • Volume of water Ignore reference to controls.

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>9.</td><td>(a)</td><td>(i)</td><td>Classification guides/biological keys/identification apps
OR
DNA/Protein/RNA analysis.</td><td>1</td><td>Accept:
Taxonomic key/dichotomous key.

Accept:
Genome analysis.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Form/shape/structure (of organisms/parts of organisms).</td><td>1</td><td>NOT:
• function
• features/characteristics
• Physical appearance</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>DNA/RNA/Protein sequences
OR
Protein structure.</td><td>1</td><td>Accept: bioinformatics/genome sequences.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><td>Red deer are more closely related to reindeer than elk.</td><td></td></tr><tr><td>Cattle are closer relatives of fallow deer than giraffes</td><td>✓</td></tr><tr><td>Pere David’s deer and red deer have evolved at the same rate</td><td></td></tr></table></td><td>1</td><td></td></tr>
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Question			Expected response	Max mark	Additional guidance
10.	(a)		Reproduction from a female (gamete) without fertilisation **OR** Reproduction from unfertilised eggs.	**1**	Take care not to accept definitions that could be applied to all forms of asexual reproduction. Example – reproduction in organisms that lack fertilisation. IGNORE Reference to offspring being identical.
	(b)		Winged/flying/dispersing aphids transfer viruses to new hosts/plants (when dispersing) **OR** Winged/flying/dispersing aphids transmit viruses.	**1**	Accept: moving to a new host. Pathogen/disease/parasite = virus. Idea of: Aphids move to a new plant and infect it.
	(c)	(i)	Decreased (crop production) **AND** Increased feeding **OR** Increased infection of **new** crops **OR** Increased transmission (of virus/pathogen/infection).	**1**	
		(ii)	Increased variation to adapt to changing environment/increasing temperatures/increase in parasitism.	**1**	Accept: adapt = evolve faster NOT: Increased variation alone NOT: Adapt to climate change alone Idea of: selection pressure related to named abiotic/biotic factors that have changed due to climate change.

Question			Expected response	Max mark	Additional guidance
11.	(a)		Any arrangement that has 3 different treatments in each row and each column.	**1**	
	(b)		Allowed a reduction in the number of/fewer animals (used).	**1**	
	(c)	(i)	Same: • size/body mass (approx) • sex • area for experiment/pasture/ field • feeding/watering regimes • pattern of stripes • time of year • rainfall/temperature/wind speed/wind direction/humidity • presence of dung **(Any 1)**	**1**	NOT: Conditions alone.
		(ii)	Black stripes/BB has no effect/no (significant) difference on the number of biting flies compared to control **OR** (Significant) decrease in number of biting flies brought about by white stripes/BW.	**1**	NOT: BW decreases more than BB or that both decrease.
	(d)		Idea of choice given to biting flies w.r.t. landing areas; eg painted stripes on a surface. **(1)** **Compare** numbers/landing preferences (on the two surfaces). **(1)**	**2**	Description of a choice-chamber style experiment with same treatments.

Question			Expected response	Max mark	Additional guidance
12.	(a)		Increased size allows increase in biomass/growth/reproduction of parasites **OR** Additional resources not used in reproduction available for the parasite **OR** If snails are bigger, may be predated more, allowing more transmission **if** the predator is another host.	**1**	Nutrients = resources
	(b)		Infected snails move into low tide zone/deeper water/further from the shore **OR** Infected snails do not travel as far along the shore/from the release point **OR** Infected snails submerged every high tide.	**1**	Move up = further from the shore
	(c)		(Change in growth/behaviour of snails) may change predation/ food webs/resource use/competition (thus altering the niche).	**1**	Accept examples for the snails of changes in the use of resources/food webs/predation/competition.
	(d)		1. A sample of the population is captured and marked (M). 2. Sample is released. 3. After an interval of time, a second sample (C) is captured. 4. Number of (marked) individuals recaptured (R) (is counted). 5. Population/N = MC/R. **Any 3**	**3**	Accept descriptions with specific reference to snails. Pt.3 allowed to mix fully with (rest of) population = after an interval of time Do not award point 5, if letters are incorrectly assigned to steps in the procedure. eg Sample of the population is captured and marked = R.

Question			Expected response	Max mark	Additional guidance
13.	(a)	(i)	0.14	**1**	Must be to 2 dp
		(ii)	decrease (in frequency).	**1**	
	(b)		Intimate/close relationship **AND** between (individuals of) different/ two/co-evolved species	**1**	Accept: frequent interaction Not: co-exist
	(c)		The organism where the parasite reaches sexual maturity.	**1**	Host = organism Parasite produces gametes/ undergoes meiosis/sexual reproduction takes place = sexual maturity.

Question			Expected response	Max mark	Additional guidance
14.	**A**	(i)	1. Mating systems based on how many mates an individual has during one breeding season. 2. Monogamy: the mating of a **pair** of animals to the exclusion of all others. 3. Polygamy: individuals (of one sex) have more than one mate. 4. Polygyny: one male mates **exclusively** with a group of females. 5. Polyandry: one female mates with a number of males. **(Any 3 from 1-5)** 6. Listing all four system names without definitions.	**3**	Must be implied that BOTH partners are exclusive. Pt 6: only awarded if Pts 2, 3, 4, and 5 not awarded.

Question			Expected response	Max mark	Additional guidance
14.	**A**	(ii)	a. Animals use courtship rituals to attract a mate b. (Courtship behaviour can be a result of species-specific) sign stimuli **and** fixed action pattern (responses) c. Sexual selection increases chance of mating d. Sexual dimorphism a product of sexual selection e. (In sexually dimorphic species) females are generally inconspicuous **OR** (In sexually dimorphic species) males usually have more conspicuous markings/structures/ behaviours **OR** (In some species there is) reversed sexual dimorphism f. Female choice involves females assessing honest signals g. (Honest signals) indicate alleles that increase male fitness/the chances of survival of offspring h. (Honest signals) indicate a low parasite burden (suggesting a healthy individual) i. (In lekking species) males gather to display at a lek (where female choice occurs) j. Dominant males occupy centre of lek* **OR** Subordinates and juveniles at the fringes as 'satellite' males. **(Any 6 from 10)**	**6**	Reproduction ≠ attract a mate Pt. e – allow a description eg Male has brightly coloured feathers NOT: males display honest signals Pt i – If site of display not referred to as a lek then must mention lekking species.

Question			Expected response	Max mark	Additional guidance
14.	**B**	(i)	1. Natural selection is non-random 2. (Natural selection) acts on/requires genetic variation in population 3. Variation (in traits)/new alleles arise as a result of mutation/new sequences of DNA 4. Mutations can be beneficial/harmful (to the fitness of an individual) 5. Population produces more individuals than the environment can support 6. Individuals with favourable alleles/that are better adapted are more likely to survive and reproduce/produce offspring **OR** Individuals with favourable alleles/that are better adapted have higher fitness 7. Increase in frequency of advantageous alleles **OR** decrease in frequency of deleterious alleles **(4 from 7)**	**4**	Pt 2: NOT: due to/caused by variation

Question			Expected response	Max mark	Additional guidance
14.	**B**	(ii)	a. (Genetic drift occurs when) chance/random events cause unpredictable/random fluctuations in allele frequencies (from one generation to the next) b. (Genetic drift) is more important in/more likely to affect small populations c. Alleles are more likely to be lost from the gene pool (in small populations) d. Population bottlenecks occur when a population is reduced (for at least one generation) e. Founder effects occur through the isolation of a few members of a population (from a larger population) f. Gene pool/allele frequency of new population is not representative of original g. Alleles may be under-represented/over-represented. **(Any 5 from 7)**	**5**	Pt. a examples of chance events acceptable (eg Natural disaster) Change = fluctuation Idea of random change

[END OF MARKING INSTRUCTIONS]