National Qualifications 2025

2025 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.

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

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)	(i)	Sexual dimorphism	**1**	
		(ii)	Males that win fights are more likely to mate with/win females. **OR** Males that win fights are more likely to pass on their alleles (to the next generation).	**1**	win = gain access to. genes ≠ alleles.
	(b)		The width of the dactyl of regenerated claws is smaller (than those of original claw). **OR** The dactyl of regenerated claws are longer (than those of original claws).	**1**	L1 = width of the dactyl. thickness/thinness = width. L2 = length of the dactyl. **NOT**: reference to general size.
	(c)	(i)	Bigger claws are stronger.	**1**	**ACCEPT**: As claw size increases, strength increases. reverse argument.
		(ii)	**Greater** increase in muscle mass (as claw size increases) in original claws.	**1**	**IGNORE**: stronger correlation.
		(iii)	(Regenerated claws) that are the same size as the original claws are weaker.	**1**	Idea of: the crabs cannot tell the difference between the size of the two claws, but strength of regenerated claws is lower.
	(d)	(i)	Original and regenerated claws have the same oxygen consumption for **the same mass of tissue.** **(1)** but the regenerated claws have less muscle and so a lower oxygen consumption (per claw). **(1)**	**2**	**ACCEPT**: converse. **ACCEPT**: ref to **3B** data alone eg Original claw has a higher total claw oxygen consumption than regenerated claw (which is a higher metabolic cost).
		(ii)	Idea of: As likely to succeed in prefight assessment.	**1**	

Question			Expected response	Max mark	Additional guidance
2.	(a)		Linear	**1**	**NOT:** 'non-logarithmic'.
	(b)		To provide a baseline in the absence of/without the test compound. **OR** To calibrate the colorimeter.	**1**	Baseline = reference. **NOT**: negative control. Idea of: taking account of the background colour before the test compound is added.
	(c)		Precise: values are close (enough) together. **OR** Not precise: values are not close (enough) to each other.	**1**	**IDEA OF**: All of the values are within 0.02 units of each other. **NOT**: Consistent alone.
	(d)		**Any 2 from** • calculate a mean for each known concentration • plot the values to produce a standard curve • use the standard curve to read off/determine concentration of the unknown solution	**2**	average = mean. calibration = standard. curve = graph. Accept description of production of a standard curve for pt2. **standard curve** must be mentioned at least once for 2 marks.
	(e)		Turbidity	**1**	

Question			Expected response	Max mark	Additional guidance
3.	(a)		(Increasing temperature) disrupts the interactions between R groups. **(1)** Protein begins to unfold. **(1)**	**2**	Idea of: bonds within tertiary structure.
	(b)		**Any 3 from** 1. receptors are transmembrane (proteins) 2. receptor (protein) changes conformation 3. signal is transduced across the (plasma) membrane 4. mechanisms of transduction: **Any 1 from** • G-protein • phosphorylation (cascades) • opening of ion channels	**3**	
	(c)		63 (mg)	**1**	

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	Proteome	**1**	
		(ii)	**Any 1 from** • metabolic activity (of the cell) • cellular stress • response to signalling molecules • diseased versus healthy cells	**1**	Infected = diseased.
	(b)	(i)	(More nucleotides are) required to produce new/more DNA/RNA. **AND** For lymphocyte proliferation (following exposure to pathogens).	**1**	DNA synthesis = new/more DNA/RNA. multiplication = division = proliferation. cell = clonal population = lymphocyte.
		(ii)	**IDEA OF:** Fewer new lymphocytes due to reduced DNA synthesis in them. **OR** Drug is more effective at inhibiting than CTP, so fewer lymphocytes are produced.	**1**	**ACCEPT**: prevents DNA synthesis in lymphocytes (so treats autoimmune disease).
	(c)	(i)	As CTP concentration increases enzyme activity decreases (sharply). **AND** then remains stable/at zero. **(1)**	**1**	stops = remains at zero.
		(ii)	**ADVANTAGEOUS**: Correctly selected supporting data. **(1)** Increased CTPS activity increases (CTP) production. **(1)**	**2**	**NOTE:** for one CTP concentration, two values of CTPS activity (y-axis) needed, or difference calculated. CTP concentration must be identifiable from data, but not needed to be stated. production is higher = advantageous.

Question			Expected response	Max mark	Additional guidance
5.			1. phosphate added/ phosphorylation by kinases 2. phosphate removed/ dephosphorylation by phosphatases 3. (terminal) phosphate transferred from ATP to (specific) R Group 4. addition/removal of phosphate changes conformation of the protein 5. (this) leads to change of function/ functional change 6. adding a phosphate adds negative charge **OR** removing a phosphate removes negative charge 7. changing ionic interactions 8. **many proteins controlled by** phosphorylation cascades	**5**	Pts 1 + 2 – if phosphatases and kinases mentioned but not described then 1 mark only. Notes: Na^+/K^+ pump reference must be as an example of a protein. Pt 5 needs to be general statement. Pt.5 activation/inhibition = change of function.

Question			Expected response	Max mark	Additional guidance
6.	(a)		Binds to specific DNA sequences/ hormone response elements (HREs). **(1)** Alters the rate of transcription. **(1)**	**2**	target = specific. increase/decreases/initiates = alters the rate.
	(b)		No receptor produced. **OR** Testosterone cannot bind to a receptor. **OR** No HRC formed. **OR** No binding to HREs. **(1)** No production of NKX3.1 **OR** No production of protein that promotes tumour growth. (**1**)	**2**	**NOTE:** QRS prevents/stops presence of testosterone receptor. transcription factor = HRC/receptor. fewer = no.
		(c)	**Any 1 from** • different intracellular signals/pathways • different signal transduction pathways • different genes switched on/off (different cell types)	**1**	
		(d)	Oestrogen	**1**	Accept any other correct example eg progesterone.

Question			Expected response	Max mark	Additional guidance
7.	(a)	(i)	**FIRST CONFORMATION:** High affinity sodium (ions). Low affinity potassium (ions). **AND** **SECOND CONFORMATION:** Low affinity sodium (ions). High affinity potassium (ions). **(2)** **OR** **One mark for:** Change of conformation increases affinity for sodium ions, and decreases affinity for potassium ions. **(1)** **OR** High affinity for Na^+ conformational change causes low affinity for Na^+. **(1)** **OR** Low affinity for K^+ conformational change causes high affinity for K^+. **(1)**	**2**	Converse gains a mark.
		(ii)	Sodium (ion concentration) increases. **AND** Potassium (ion concentration) decreases.	**1**	
	(b)	(i)	Co-evolution	**1**	
		(ii)	Allows predation/feeding on monarch butterflies/caterpillars. **AND** Without being harmed (by cardenolides).	**1**	**ACCEPT:** birds feeding on milkweed. affected = harmed.

Question			Expected response	Max mark	Additional guidance
8.	(a)		(Anthropomorphism/misinterpreting behaviour) can lead to invalid conclusions.	**1**	**NOT**: false.
	(b)		People take part freely and are aware of what's involved/risks/ significance/implications.	**1**	
	(c)	(i)	**POSITIVE: Any from** • familiar/same voice as used during training • dogs will recognize the voice during trials removing that as a reason for dogs not responding/responding incorrectly **OR** **NEGATIVE: Any from** • (possible confounding variable) as owners may not all give verbal requests in exactly the same way • familiarity of voice rather than word used	**1**	For both points: variations in voice/tone = familiarity.
		(ii)	Could be a confounding variable.	**1**	Idea of consistency across the sample rather than individual dogs.
	(d)	(i)	Small error bars. **OR** Low variability (around the mean).	**1**	**NOT**: close.
		(ii)	All dogs were trained in the **same** way.	**1**	**ACCEPT**: description of protocol.
	(e)		Record the direction of the head tilt (to see if it is consistent over time). **(1)** **Only** use the GWL dogs. **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
9.	(a)	(i)	**Likelihood** of **harm** arising from a hazard.	**1**	
		(ii)	**Any 1 from** • appropriate clothing/footwear/ equipment or example • means of communication • flotation aid (if observing near/on water) • training in handling of wild animals	**1**	
	(b)	(i)	**Ear tags:** can identify specific animals when sampling/observing. **OR** **GPS trackers:** • can record data of movement patterns • can locate remotely • can locate animals at all times/if they disperse/if they might have unexpected movement	**1**	
		(ii)	**Any 1 from** • observing rare behaviours • allow 24 hour coverage • avoid people having to observe at dawn/dusk • observing behaviours beavers might not undertake if people around eg breeding/emergence of kits/young • reduce the time people spent observing • eliminate any effects of observers on behaviour/environment • observe **individuals** that are shy/elusive • re-watch footage/behaviour	**1**	**NOT:** • just 'observing' alone • direct observations • reference to risk

Question			Expected response	Max mark	Additional guidance
9.	(c)		Systematic (sampling)	**1**	
	(d)		Increased variation **(1)** increases likelihood of (population) being able to adapt in future. **OR** Deleterious alleles less likely to be expressed. **(1)**	**2**	**NOT**: diversity. increased survival/fitness of offspring.

Question			Expected response	Max mark	Additional guidance
10.	(a)		Individuals who could digest milk/lactose would have an increas**ed** chance of survival. **(1)** **More** likely to (reproduce and) pass favourable allele to offspring. **OR** Great**er** fitness. **OR** (Reproducing) great**er** proportion of population with the allele. **(1)**	**2**	**NOTE:** in terms of allele persisting or not. drink = digest. selective advantage = increased. chance of survival. At least one comparative statement required for 2 marks. Award 1 mark if both points are made without a comparative statement.
	(b)		**IDEAS OF**: Compare DNA (sequences) over time to identify a rapid increase in allele frequencies. **OR** Compare DNA (sequences) for an increase in allele frequency over a short time.	**1**	change = increase.

Question			Expected response	Max mark	Additional guidance
10.	(c)		**Any 3 from** 1. changes in allele/genotype frequency suggest evolution is occurring **OR** allele/genotype frequencies remain constant in the absence of evolutionary influences/selection 2. equation $p^2 + 2pq + q^2 = 1$ (to calculate genotype frequencies) 3. **Any 1 from** • p^2= frequency of homozygous dominant genotype • q^2= frequency of homozygous recessive genotype • 2pq= frequency of heterozygous genotype 4. *p* represents the frequency of dominant allele **OR** *q* represents the frequency of the recessive allele 5. Maintaining HW equilibrium requires (**Any 1 from**) • random mating • no mutation • large population size • no gene flow	**3**	**MAX 2 POINTS from pts2-4.** **Pt.5** breeding = mating.

Question			Expected response	Max mark	Additional guidance
11.	(a)		Monogamy	**1**	
	(b)		Females lay/produce eggs **and** incubate. **(1)** Males provide food (for chicks). **(1)**	**2**	**NOT**: hunting/provides for…. Alone.
	(c)	(i)	(Much) greater survival of (particularly male) parents the following winter. Accept comparative data. **(1)** **IDEA OF**: **Over their lifetime** they can produce more chicks/broods. **(1)**	**2**	Note: answer should be about survival of parents, not chicks. **ACCEPT**: only commenting on one parent.
		(ii)	Reduced (individual) food supply. **OR** Reduced growth rates of nestlings. **OR** Increased competition between nestlings. **OR** Male hunting more, so less protection for chicks.	**1**	**NOTE:** context of affecting chicks. **IDEA OF**: per chick. nutrients = food. **NOT:** resources.

Question			Expected response	Max mark	Additional guidance
12.	**A**	(i)	Meiosis I 1. diploid gametocytes undergo meiosis 2. chromosomes comprise two (genetically identical) chromatids (joined at centromere) 3. chromosomes condense 4. homologous chromosomes pair up 5. chiasmata form (at point of contact) between non-sister chromatids (of homologous pair) 6. (sections of) DNA exchanged **OR** crossing over occurs 7. (crossing over) results in new combinations of these alleles **OR** crossing over produces (genetically different) recombinant chromosomes 8. spindle fibres attach to homologous pairs and pairs line up at the equator 9. orientation of pairs of homologous chromosomes is random **OR** independent assortment takes place 10. chromosomes of each homologous pair separated and move towards opposite poles 11. cytokinesis occurs and two (daughter) cells produced **Any 7**	**7**	Penalise only once for first chromosome/chromatid mix up. **Pt.1** gamete mother cell = germline cell = gametocyte. **Pt.3** **NOT**: DNA condenses. **Pts. 8, 10** Homologous pair must be mentioned at least once for both marks to be awarded. **Pt.8** metaphase plate = equator. **Pt.9** random = independent. **ACCEPT**: description of positioning irrespective of their maternal and paternal origin. **Pt.10** ends = poles. **NOT**: sides.

Question			Expected response	Max mark	Additional guidance
12.	**A**	(ii)	Meiosis II a. cells (produced in meiosis I) undergo a second division b. sister chromatids (of each chromosome) separated c. four haploid cells/four gametes formed **Any 2**	**2**	**Pt.a** idea of: further/next division.

Question			Expected response	Max mark	Additional guidance
12.	**B**	(i)	Life cycle of Plasmodium 1. infected mosquito bites a human 2. mosquito is a vector 3. *plasmodium*/parasite enters human bloodstream 4. asexual reproduction in liver **then** red blood cells 5. red blood cells release gametocytes (into bloodstream) 6. **another** mosquito takes blood meal from/bites infected human 7. gametocytes enter mosquito 8. gametocytes mature into male and female gametes **OR** (plasmodium) reaches sexual maturity (in mosquito) 9. sexual reproduction in mosquito **OR** mosquito is definitive host 10. mosquito (can then) infect/transmit to **another**/**new** human host **Any 6**	**6**	**Pt.1** takes blood meal/drinks from = bites. **Pts. 5, 7, 8** "gametocytes" needed once.

Question			Expected response	Max mark	Additional guidance
12.	**B**	(ii)	Modification of hosts by parasites to increase transmission. a. (parasite alters host's): • foraging • movement • sexual behaviour • habitat choice • anti-predator behaviour b. (another example from list above) c. host behaviour part of parasite's extended phenotype d. suppression of host's immune system (by parasite) e. modify host size f. modify reproductive rate **Any 3**	**3**	**Pt.a** **ACCEPT**: described example. **NOT**: behaviour alone. **Pt.d** weakening = suppression. **NOT**: evasion / antigenic variation.

[END OF MARKING INSTRUCTIONS]