

Markscheme

May 2026

Biology

Higher level

Paper 2

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Subject Details: Biology HL Paper 2 Markscheme

Candidates are required to answer **all** questions in Section A and **two** out of **three** questions in Section B. Maximum total = **80 marks**.

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. An alternative answer is indicated by “**OR**”. Either answer can be accepted.
5. An alternative markscheme is indicated under heading **ALTERNATIVE 1** etc. Either alternative can be accepted.
6. Words in brackets () in the markscheme are not necessary to gain the mark.
7. Words that are underlined are essential for the mark.
8. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
9. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
10. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
11. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.
12. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

Section B

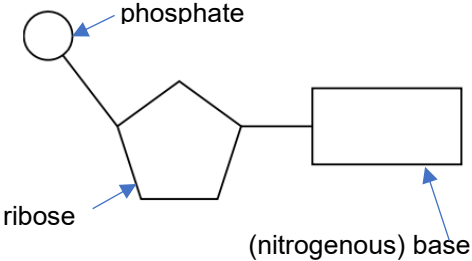
Extended response questions – quality mark

- Extended response questions for HLP2 each carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.
- **[1]** for quality is to be awarded when:
 - the candidate's answers are clear enough to be understood without re-reading.
 - the candidate has answered the question succinctly with little or no repetition or irrelevant material.
- It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- Candidates that score very highly on the content marks need not necessarily automatically gain **[1]** for quality (and *vice versa*).

Section A

Question			Answers	Notes	Total
1.	a		bicarbonate/ HCO_3^- ;		1
1.	b		negative correlation OR as aqueous carbon dioxide increases, carbonate ions decrease;	<i>Accept vice versa. Do not accept negative relationship or inversely proportional unless explained.</i>	1
1.	c		temperature/upwelling/photosynthesis/run off from rivers/respiration/decomposition;	<i>Accept verified first example.</i>	1
1.	d		11.8/11.76;		1
1.	e		long time in the future/not known how fast CO_2 levels are rising/humans may make changes;		1
1.	f		current seawater pH / pH7.5-8.5 / current seawater pCO_2 / ppm/concentration CO_2 levels;	<i>Reject neutral pH, distilled water.</i>	1
1.	g		Similarity: a. both increase coverage in control; Differences (max 2): b. non-calcifying increases more in control; c. non-calcifying increases in acidic conditions, but calcifying reduces; d. calcifying has significant differences and non-calcifying does not OR error bars overlap for non-calcifying and do not for calcifying;		3 max

Question			Answers	Notes	Total
1.	h		a. as <u>atmospheric</u> CO₂ rises the pH of the oceans will lower; b. acidification causes loss of coverage/decrease of most reef species; c. only the non-calcifying corals/algae are not/less affected OR 4 species are significantly affected; d. lower pH causes exoskeleton to break down/less carbonate; e. can lead to coral bleaching OR reduction in biodiversity of reef;	<i>Reference to non-calcifying corals/algae needed for 1st alternative of mark c.</i>	3 max

Question			Answers	Notes	Total
2.	a		a. <u>ribose</u> drawn as a pentagon and labelled; b. base linked correctly (to C1) of ribose and labelled; c. phosphate linked correctly (to C5) of ribose and labelled; 	<i>Diagram using circles, pentagons and rectangles to represent phosphates, ribose sugar and base</i> <i>Allow a named/abbreviation of a base.</i> <i>Any base other than thymine/T.</i> <i>Do not accept deoxyribose or pentose sugar.</i>	3
2.	b		condensation;		1
2.	c		a. <u>RNA polymerase</u> binds at the promoter region of DNA; b. DNA is unwound/strands are separated by <u>RNA polymerase</u>; c. complementary base pairing with example/base pairing with an example; d. new nucleotides condensed/joined together by <u>RNA polymerase</u>; e. 5' to 3' direction;	<i>RNA polymerase must be mentioned at least once for mp a,b and d.</i>	3 max
2.	d		a. removal of introns; b. splicing/joining together of exons (to form mature mRNA); c. addition of 5' caps AND 3' polyA/adenine tails;	<i>Mp c. both needed.</i>	2 max

Question			Answers	Notes	Total
3.	a		(protein) capsid OR <u>protein</u> coat;		1
3.	b		a. lytic (cycle); b. destruction of the infected cell/cell lyses OR no incorporation of viral DNA into cell DNA/genome;		2
3.	c		<u>obligate parasite</u> ;		1
3.	d		a. as viruses need a host to replicate in/are parasitic, viruses evolved after cells; b. share same genetic code (as all other living organisms) suggesting viruses evolved from cells OR retroviruses are like (retro)transposons in cells, suggests that viruses are remnants of genetic material that moved between cells; c. viruses are extremely diverse which suggests several different origins/convergent evolution;		2 max

Question			Answers	Notes	Total
4.			<i>Differences (max 2)</i> a. animal cells have centrioles, fungi do not; b. fungi have permanent vacuoles, animal cells do not / have temporary vacuoles; c. animal cells may have cilia, fungi do not; d. animal cells have lysosomes, fungi do not. <i>Similarities (max 2)</i> e. both have plasma membrane; f. both have membrane bound organelles; g. both have 80s ribosomes;	<i>Do not allow cell wall, cytoskeleton or cytoplasm.</i> <i>Allow a suitable example of a membrane bound organelle like nucleus or mitochondrion for mark f.</i>	4 max
5.	a		melatonin; adrenal; osmoregulation OR water <u>re</u>absorption;	OWTTE for osmoregulation.	3
5.	b		a. low blood sugar glucagon released; b. by <u>alpha/α</u> cells of pancreas; c. <u>liver</u> converts/hydrolyzes glycogen to glucose; d. glucose released into bloodstream (from the liver); e. pancreas detects higher levels and stops secretion OR negative feedback;	Do not accept 'break down' for c in place of 'hydrolyzes' or 'converts'.	3 max

Question			Answers	Notes	Total
6.	a		mutation;		1
6.	b		zoonoses/zoonotic;		1
6.	c		a. plague is a selective pressure; b. resistant/CCR5Δ32 individuals are not killed/survive by the plague/individuals without the mutation die OR (resistant) individuals have a selective advantage / unequal success; c. the individuals with this variation/resistance reproduce; d. mutation/gene is passed on to the offspring / the offspring will be resistant to the disease;		3 max

7.	a		heterozygous;		1									
7.	b		dominant always expressed AND recessive only expressed in homozygous OR dominant only one allele needed to be expressed whereas two recessive alleles needed to be expressed;		1									
7.	c		a. Punnett grid; b. 25%; <table border="1"><tr><td></td><td>D</td><td>d</td></tr><tr><td>D</td><td>DD</td><td>Dd</td></tr><tr><td>d</td><td>Dd</td><td>dd</td></tr></table>		D	d	D	DD	Dd	d	Dd	dd	Accept ¼ for mark b. Accept 3:1 if it is specified that '1' refers to PKU.	2
	D	d												
D	DD	Dd												
d	Dd	dd												

Question			Answers	Notes	Total
7.	d		a. haemophilia is a sex-linked disorder OR allele is found on the X chromosome; b. allele is recessive; c. males only have one X chromosome / XY; d. males only have one copy of allele; e. males cannot be heterozygous / always have symptoms if they have the allele;		2 max

Section B

Clarity of communication: [1]

The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question			Answers	Notes	Total
8.	a		a. globular protein; b. 4 polypeptides/2 alpha and 2 beta polypeptides/quaternary structure; c. has a non-protein/prosthetic/haem group OR conjugated protein; d. haem group contains iron;	Accept a labeled drawing for marks b and d	3 max

Question			Answers	Notes	Total
8.	b		a. more/higher (concentration) carbon dioxide (in respiring tissues); b. CO₂ lowers the pH (of the blood); c. CO₂ combines with water to form carbonic acid / $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$; d. carbonic acid dissociates into hydrogen carbonate ions and hydrogen ions / $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$; e. hydrogen ions bind to haemoglobin/low pH changes shape of haemoglobin, causes the release of oxygen; f. CO₂ binds to haemoglobin, causing the release of oxygen; g. haemoglobin's affinity for oxygen is reduced; h. haemoglobin gives up its oxygen more readily in the respiring tissues/where it is needed; i. the dissociation curve shifts to the right (when CO₂ levels increase); j. at any given partial pressure of O₂, the percentage saturation of haemoglobin is lower at higher levels of CO₂; k. correctly labelled axes on a sketch of the graph illustrating Bohr shift; l. correctly drawn and labelled lines on a sketch of the graph illustrating Bohr shift;		8 max

Question			Answers	Notes	Total
8.	c		a. biconcave disc; b. cause increase in surface area of plasma membrane; c. large SA:V ratio increases gas exchange; d. flexible/pliable/flattened/rounded membrane to squeeze through capillaries (smaller in diameter than rbc); e. haemoglobin combines (reversibly) with oxygen; f. no nucleus allows more space to carry haemoglobin;		4 max

Question			Answers	Notes	Total
9.	a		a. cholesterol and fatty acids influence membrane fluidity; b. unsaturated fatty acids increase fluidity in low temperatures/colder climates; c. saturated fatty acids decrease fluidity in high temperatures/warmer climates; d. cholesterol modulates/regulates membrane fluidity; e. separates fatty acids/ prevents stiffening/freezing at low temperatures; f. fills gaps between fatty acids/stabilizes membranes at higher temperatures;		3 max
9.	b		a. piercing mouthparts to enter phloem/suck plant juices; b. chewing mouthparts/teeth to crush/grind up fibrous plant material; c. metabolic adaptations for detoxifying toxins; d. adapted digestive system/long digestive tracts/specialised stomachs/large caecum in some herbivores; <i>Plants:</i> e. spikes/thorns/hairs to prevent animals grazing; f. other physical structures example; g. toxic compounds in seeds and leaves to prevent feeding by animals; h. have stings to cause burning/pain/bad taste;		5 max

Question			Answers	Notes	Total
9.	c		a. low rainfall/long droughts so water conservation is an issue; b. (very) hot during the day and (much) colder at night OR need to be able to withstand large daily temperature fluctuations; c. named species; <i>Allow common names</i> d. adaptation 1; e. how adaptation 1 works; f. adaptation 2; g. how adaptation 2 works; h. adaptation 3; i. how adaptation 3 works;	<i>Accept only the first animal (if more than one is offered)</i> <i>Accept only the adaptations that pertain to abiotic factors.</i> <i>Accept first 3 adaptations</i> <i>Other examples that might be used such as meerkats, Arabian oryx, jerboa, scorpion, rattle snake (the animal selected doesn't have to be a mammal).</i> <i>Example:</i> <i>c. fennec fox;</i> <i>d. large ears highly vascularized/radiate heat;</i> <i>e. increased area for cooling without losing water by sweating/panting;</i> <i>f. kidney adaptation with long loop of Henle/very large dense kidneys;</i> <i>g. to reabsorb/conserves more water;</i> <i>h. lives in a burrow/underground den during the day</i> OR <i>is nocturnal, only coming out of burrow at night;</i> <i>i. avoids hottest daytime temperature;</i> <i>(other adaptations could be long thick coat, hair covering pads of feet, pale-coloured coat);</i>	7 max

Question			Answers	Notes	Total
10.	a		a. water moves into the cell (from the hypotonic solution) by <u>osmosis</u> ; b. down the concentration gradient / from higher to lower water potential / from low solute concentration to high solute concentration; c. (as water enters) pressure is exerted on the cell wall; d. the pressure potential develops/becomes positive; e. the cell becomes turgid/more turgor pressure;		4 max
10.	b		a. resting potential is approximately -70 mV; b. active transport/active process / requires (the hydrolysis of) ATP; c. controlled by sodium-potassium pumps OR the sodium-potassium pump is a transmembrane protein (antiport); d. 3 Na ⁺ ions out for every 2 K ⁺ ions pumped in; e. concentration/electrochemical gradient (established); f. the cell interior is (relatively) negative compared to the extracellular environment;	<i>Accept a drawing for mp f if charges of intracellular and extracellular regions are labeled correctly</i>	4 max

Question			Answers	Notes	Total
10.	c		a. electron transport chain performs chemiosmosis/chemiosmosis generates ATP; b. major source of ATP production / final step in aerobic respiration; c. receives energy/electrons from Krebs cycle/glycolysis/link reaction; d. from oxidation reactions (of respiratory substrates) / forms reduced NAD; e. electrons are carried by reduced NAD / reduced NAD releases electrons to transport chain; f. energy released as electrons pass from carrier to carrier (in the chain); g. release of energy actively transports/pumps protons/H ⁺ ; h. protons pumped into intermembrane space from the matrix; i. creates proton gradient; j. protons diffuse back/move down the concentration gradient (across inner membrane); k. protons pass through ATP synthase; l. flow of protons provides energy for generating ATP (through oxidative phosphorylation); m. electrons transferred to oxygen at end of electron transport chain; n. oxygen accepts free protons to form water;		7 max