

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		differences are significant because standard errors/error bars are smaller than difference between means OR differences are significant because (values) with the standard errors/error bars do not overlap;	<i>Do not award the marking point for correlation.</i> <i>Do not accept weak statements about mean values being different.</i>	1
1.	b		a. decreasing (towards the end) of the Triassic; b. increase between Triassic and Jurassic / increase at the start of the Jurassic period;		2
1.	c		positive correlation OR higher stomatal density with higher (mean maximum) temperature;	<i>Do not accept “positive relationship” or “directly proportional”.</i> <i>For the second option accept WTTE.</i>	1

Question			Answers	Notes	Total
1.	d		a. in hotter habitats more stomata for more cooling OR in hotter habitats more stomata for more transpiration; b. in hotter habitats more stomata to incorporate more carbon dioxide OR in hotter habitat more stomata for more/faster rate of photosynthesis; c. rainfall/water availability/humidity/wind/light intensity/other factors affect stomatal density;	<i>Mp a. and b. accept converse.</i> <i>Mp c: Do not accept “temperature”.</i>	2 max
1.	e		175 stomata mm ⁻² ;	<i>Accepted range 170 -177</i> <i>Units required.</i>	1
1.	f		reduce water loss/transpiration (while still obtaining enough CO ₂ for photosynthesis);		1
1.	g		a. (hypothesis not supported) in wheat/Triticum because no clear trend observed (in graph) OR (hypothesis not supported) in wheat/Triticum because similar values (for stomatal densities) at both CO ₂ levels; b. (hypothesis supported) in wild grasses/Aegilops because of lower stomatal densities in elevated CO ₂ ;	<i>Do not accept “correlation”.</i> <i>Mp b: accept converse.</i>	2

Question		Answer	Notes	Total
1.	h	a. some species may adapt/evolve higher stomatal density (and others evolve lower density); Rise in carbon dioxide concentration: b. fossil evidence from end of Triassic suggests stomatal density would decrease with rising atmospheric CO₂ (first table) OR fossil evidence from <u>start</u> of Jurassic suggests stomatal density would increase with rising atmospheric CO₂ (first table) OR fossil evidence from Jurassic period does not provide clear trend (it increases and then decreases) (first table); c. (second graph) suggests that stomatal density will decrease in response to rising atmospheric CO₂ in wild grasses/<i>Aegilops</i> OR (second graph) suggests no change in stomatal density in response to rising atmospheric CO₂ in wheat/<i>Triticum</i>; Increasing global temperatures: d. (first graph/ investigation in South Australia) suggests that stomatal density will increase in response to rising global temperatures (in <i>Dodonaea viscosa</i>); e. fossil evidence from end of Triassic suggests stomatal density would decrease with higher global temperatures (first table) OR fossil evidence from <u>start</u> of Jurassic suggests stomatal density would increase with higher global temperatures (first table) OR fossil evidence from Jurassic period does not provide clear trend (it increases and then decreases) with higher global temperatures (first table);	<i>Mp a: requires reference to “adapt” or “evolve”.</i> <i>Reference to evidence must be presented (either whether it is from fossils or from graphs or by naming the species or the investigation).</i>	4 max

Question			Answer	Notes	Total
2.	a		genetic material/DNA entering/being injected into the bacterium/host OR attachment of the bacteriophage to the bacterium/host;	<i>Do not accept “attachment” on its own.</i>	1
2.	b		a. energy supply / respiration; b. nutrition/supply of chemical substances/amino acids/nucleotides; c. protein synthesis / transcription / translation /synthesis of (protein) capsid; d. catalysis of reactions/supply of enzymes; e. DNA replication / replication of viral genetic material;	<i>Do not accept “replication of virus” or “assembly of virus” or “metabolic reactions”.</i>	2 max
2.	c		a. shared genetic code / presence of genetic material/DNA/RNA indicates evolution from living cells OR viruses are (obligate) parasites/need a host cell to replicate indicating (convergent) evolution from living cells; b. diversity of viruses/viral structure suggests multiple/several origins OR diversity of viruses/viral structures suggests viruses have arisen by various/different (progressive and regressive) routes;	<i>Mp b: Diversity of structures may refer to different types of capsids, genetic material, enzymes, envelopes, etc. Different types of viruses also accepted.</i>	2

Question			Answer	Notes	Total
3.	a		a. rainfall/precipitation / humidity /water availability; b. (soil) pH; c. temperature; d. soil nutrients/fertility/salinity; e. forest fires; f. light intensity;	Accept first two answers only. Do not accept carbon dioxide concentration.	2 max
3.	b		a. differences between their ecological niches / (realized) niches do not (entirely) overlap; b. neither species will be (competitively) excluded from all sites; c. both species can survive (in Britain);	Do not accept that one species excludes/outcompetes the other.	2 max
3.	c	i	16;		1
3.	c	ii	16 because to produce fertile offspring both parents (are likely to) have the same chromosome number OR 32 because both parents are producing diploid gametes/ fusion of 2 diploid gametes/ allopolyploidy;	A correct reason must be stated. Do not accept answers making reference to half the genetic information coming from each parent. Do not accept polyploidy on its own or vague statements about each parent providing 16 chromosomes.	1
3.	d		deter herbivores OR prevent eating of leaves OR toxic chemicals secreted to the soil to deter the growth of neighbouring plants / allelopathy;		1

Question			Answer	Notes	Total
4.	a		a. auxin; b. cytokinin;	<i>Mpb: Do not allow cytokines.</i>	2
4.	b		a. the tip of the shoot detects where light is coming from / where the source of light is; b. auxin moved/diffused (from the lighter) to the darker side OR auxin accumulates on the darker side; c. auxin acidifies the cell walls; d. loosening cross links between cellulose molecules; e. auxin stimulates cell growth/elongation; f. more growth in the shoot on the darker side; g. (the shoot) grows/curves/bends towards the light OR positive phototropism;	<i>Mpg: Do not accept “moves”.</i>	3 max
5.	a		a. autotrophs make carbon compounds from simple inorganic substances /CO ₂ and H ₂ O OR autotrophs make their own food OR autotrophs use light energy/photosynthesis/chemosynthesis; b. heterotrophs obtain carbon compounds from other organisms OR heterotrophs (need to) feed on other organisms;		2 max
5.	b	i	gas X: carbon dioxide; process: respiration;		2

Question			Answer	Notes	Total
5.	b	ii	secondary <u>consumer</u> ;	<i>Do not accept “third trophic level”</i>	1
5.	c		a. sheep emit methane / carbon dioxide; b. methane / carbon dioxide is a greenhouse gas OR methane / carbon dioxide causes/contributes to global warming;		2
5.	d		a. sheep protected from predation so higher population densities (than in natural ecosystems) OR trampling (can affect soil structure/porosity/nutrient content); b. (in addition to grazing sheep feed by) browsing; c. on tree/shrub/woody plant seedlings; d. scrub/forest/woodland not developed OR areas remain as grassland; e. climax community not reached OR plagioclimax community developed;	<i>Mp b: Do not award for statements that sheep feed on grass / grazing.</i>	3 max

Question			Answer	Notes	Total
6.	a		a. small subunit of ribosome slides along (the mRNA in a 5' to 3' direction) scanning for AUG/the start codon; b. initiator tRNA/ Met-tRNA/ tRNA with the anticodon complementary to AUG/start codon <u>binds</u> to AUG/ the start codon; c. large subunit binds <u>to the small subunit</u> ;	<i>Allow clear annotated diagram.</i> <i>Do not award a point for “the small subunit binds to the mRNA molecule” as this is part of the stem question.</i> <i>Mp b: the answer must refer in some way to the tRNA that initiates the translation.</i>	2 max
6.	b		a. A site is for the binding of (the next) tRNA carrying an amino acid; b. E site is for exit of tRNA without the amino acid/ after its amino acid has been detached / added (to the polypeptide);	<i>Mp a and Mp b: reference to the amino acid is required.</i>	2
6.	c		a. to match/link/bind the/its <u>anticodon</u> to the <u>codon</u> on mRNA; b. by complementary base pairing; c. bringing the correct/corresponding amino acid (to the growing polypeptide chain);		2 max
6.	d		proteasome;	<i>Do not accept “proteases”.</i>	1

Section B

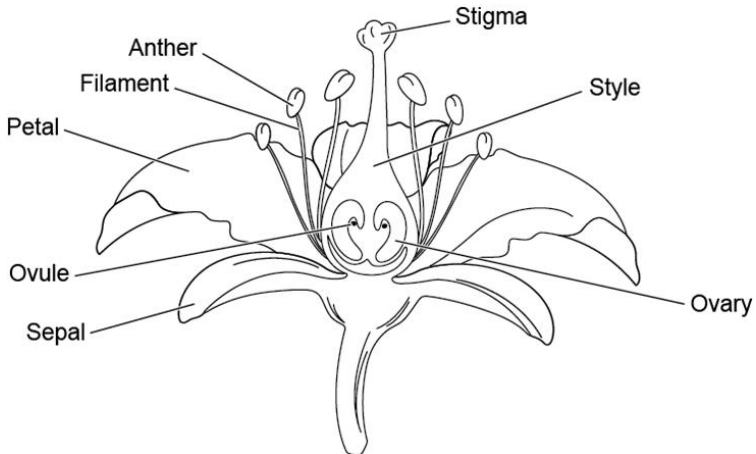
Clarity of communication: [1]

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
7.	a		a. valves (close to) prevent backflow/only allow blood to flow in one direction; b. close when pressure beyond the valve is higher than pressure upstream of the valve; c. valves in veins; d. atrioventricular valves in the heart; e. semilunar valves in the heart;	<i>Allow clearly annotated diagrams</i> <i>Mp b: OWTTE</i> <i>Mp d: Allow tricuspid and bicuspid or mitral valve.</i> <i>Mp e: Allow pulmonary and aortic valve.</i>	3 max

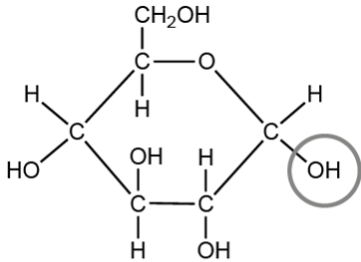
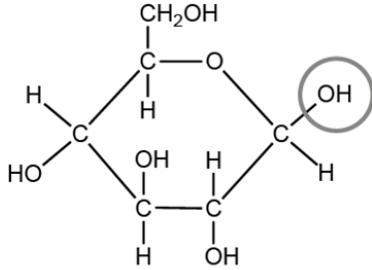
Question			Answer	Notes	Total
7.	b		a. structure of the pre and postsynaptic membranes/neurons is different/<i>OWTTE</i> OR neurotransmitters always pass in the same direction from the presynaptic neuron to the postsynaptic neuron only; b. nerve impulse/action potential/depolarization reaches the end of the presynaptic neuron; c. presynaptic membrane/neuron has (voltage-gated) calcium channels OR (voltage gated) calcium channels in the presynaptic neuron open; d. calcium (ions) enter/diffuse into presynaptic neuron (when an action potential/impulse/depolarization arrives); e. vesicles of neurotransmitter move to / fuse with the (presynaptic) membrane; f. neurotransmitter released from the presynaptic neuron OR neurotransmitter released into the synaptic gap/cleft; g. by exocytosis; h. neurotransmitter diffuses across the synaptic gap; i. postsynaptic membrane/neuron has receptors for neurotransmitter OR neurotransmitter binds to receptor in the postsynaptic membrane/neuron; j. binding of neurotransmitter causes opening of sodium/ion channels in the postsynaptic membrane OR binding of neurotransmitter causes sodium ions to enter the postsynaptic neuron; k. (binding of neurotransmitter) causes postsynaptic potential/action potential/nerve impulse in postsynaptic neuron; l. neurotransmitter broken down/degraded (by enzymes)/ removed / diffused out of synaptic gap/cleft / pumped back into presynaptic neuron;	<i>Allow clearly annotated diagram.</i>	7 max

Question			Answer	Notes	Total
7.	c		a. DNA nucleotides/strands have 5' and 3' terminals; b. 5' terminal ends in a phosphate OR 3' terminal ends in a deoxyribose; c. strands of a DNA molecule are anti-parallel/<i>OWTTE</i>; d. double helix splits/separates (by helicase) into two template strands; e. replication takes place in a 5' to 3' direction OR DNA polymerase can only add the phosphate/5' of a nucleotide to a deoxyribose/3' OR DNA polymerase can only assemble new strands in a 5' to 3' direction; f. continuous replication on the leading strand OR replication in the same direction as/towards the replication fork on the leading strand; g. discontinuous replication on the lagging strand OR replication in the opposite direction/away from the replication fork on the lagging strand; h. Okazaki fragments formed on the lagging strand; i. DNA ligase seals the Okazaki fragments together (to create a continuous strand);	<i>Allow clearly annotated diagrams</i>	5 max

Question			Answers	Notes	Total
8.	a		a. anthers drawn AND labelled as producers of <u>male gametes</u>; b. ovules/ovary drawn AND labelled as producers of <u>female gametes</u>; c. stigma AND style clearly drawn AND labelled; d. filament clearly drawn AND labelled; e. petals/sepals clearly drawn AND labelled; 	<i>Mp a: "reference to anthers being the producer of the male gamete can be accepted if the corresponding reference is included in accompanying text"</i> <i>Mp b: "reference to ovules/ovary being the producer of the female gamete can be accepted if the corresponding reference is included in accompanying text"</i>	4 max

Question			Answers	Notes	Total
8.	b		a. meiosis (is a source of / generates variation); b. gametes produced using meiosis; c. random orientation of bivalents/homologous chromosomes/chromosome pairs (in first metaphase) OR independent assortment of (unlinked) genes /homologous chromosomes; d. segregation of genes/(paired) alleles on different chromosomes OR alleles segregate so each gamete contains only one allele for each trait; e. crossing over (in first prophase) is a source of variation; f. (crossing over) makes new combinations of (linked) alleles on chromosomes; g. <u>random</u> fertilization is a source of variation; h. fusion of gametes/fertilization makes new combinations of genes/alleles OR offspring inherit half the (genetic) information/chromosomes from each parent; i. cross-breeding promotes variation; j. cross-breeding brings together gametes/genes/from unrelated/distantly related parents; k. self-incompatibility mechanisms increase variation/ensure cross-breeding;	<i>Mp f: accept labelled drawings of crossing over</i>	7 max

Question			Answer	Notes	Total
8.	c		a. both result in the splitting of one (pre-existing) species into two (or more separate) species OR both result in the formation of new species; b. both require reproductive isolation; c. both require differential/divergent selection/differences in selection pressures/different adaptations to develop; d. allopatric speciation occurs because of geographical separation/barriers; e. sympatric speciation happens without geographical separation/barriers; f. sympatric speciation occurs due to behavioural / temporal differences/separation;		4 max

Question	Answer	Notes	Total
9. a	Structure: [3 max] a. correct drawing of alpha glucose OR hydroxyl group on C1 orientated/angled down/downwards in alpha glucose; b. correct drawing of beta glucose OR hydroxyl group on C1 orientated/angled up/upwards in beta glucose; c. alpha glucose has hydroxyl groups on C1 and C4 on the same side while beta has them on opposite sides; d. alpha glucose polymerized to starch/glycogen; e. beta glucose is polymerized to cellulose; Function: f. alpha glucose/starch/glycogen used for <u>energy</u> use/storage; g. beta glucose/cellulose used for cell wall structure / provides tensile strength;  alpha  beta	Accept symbol α for alpha and β for beta. <i>Mp a and Mp b: Hexagonal rings accepted without the C atoms, but –OH groups must be shown. No need to label the number of C atoms.</i> <i>Mp c can be awarded from a correct drawing of both alpha and beta glucose clearly showing –OH groups in C1 and C4.</i> <i>Mp d and e. Even though the word “polymer” is not underlined, there must be some reference to starch and cellulose consisting of chains/many units/ or mention to the links of alpha and beta glucose respectively. Or WTTE.</i> <i>Mp g: Do not accept “structural function” on its own.</i>	4 max

Question			Answer	Notes	Total
9.	b		a. homeostasis is the maintenance of the internal environment (of an organism); b. using/by negative feedback (loops); c. insulin/glucagon are produced/secreted by the pancreas/islets of Langerhans; d. insulin/glucagon are transported in the blood (plasma); e. insulin/glucagon act on target cells; f. hypothalamus/pancreas monitors/detects blood glucose levels; g. if (blood glucose) concentration is (too) high insulin is secreted; h. from <u>beta</u> cells; i. insulin stimulates glucose uptake by (body) cells; j. insulin stimulates conversion of glucose to glycogen by liver/muscle cells; k. if (blood glucose) concentration is (too) low glucagon is secreted; l. from <u>alpha</u> cells; m. glucagon stimulates conversion/breakdown of glycogen to glucose (in liver cells); n. glucagon stimulates the release of glucose into the blood;	Accept symbol α for alpha and β for beta.	7 max
9.	c		a. phosphorylation (of glucose) OR phosphate group added to glucose forming glucose-6-phosphate (and posterior conversion of glucose-6-phosphate into fructose-1,6-biphosphate); b. lysis/split into two three-carbon sugars/monosaccharides/triose-phosphate; c. oxidation/removal of hydrogen atoms (from triose phosphate/ three-carbon sugars); d. NAD reduced / reduced NAD/NADH produced; e. ATP formation/ ATP produced / phosphate removed (by ADP from each three-carbon sugar; f. each step in the pathway is catalyzed by (a different) enzyme;	Mp b: Accept glyceraldehyde-3-phosphate or G3P.	4 max