2224 – 6002M

Markscheme

May 2024

Biology

Higher level

Paper 2

17 pages

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 = **72 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**		2015;		**1**
1.	**b**		***Comparing biomass without voles present:*** a. bunch grass biomass and rhizome biomass are similar/not significantly different without voles; ***Comparing biomass with voles present:*** b. bunch grass biomass is higher than rhizome biomass with voles; ***Comparing the changes in biomass due to presence of voles:*** c. decrease with rhizome grasses but only a slight decrease/less decrease no (significant) change/ with bunch grasses;	*Remember that this question refers only to 2013.* *c. Both parts of the answer are required.*	**2 max**
1.	**c**		rhizome grass as lower biomass/less when voles are present;		**1**
1.	**d**		1.1 (m^3) (*accept answers from 1 or 1.0 to 1.2*);		**1**
1.	**e**		*A. splendens/*bunch grass reduced by/with voles in this study but bunch grass not reduced/increased /only rhizome grass reduced by/with voles in the previous study/OWTTE;	*Allow answers stating that voles ate/consumed bunch grass instead of reducing it.*	**1**
1.	**f**		a. plants do not have to be dried/killed; b. habitat/ecosystem/environment not changed/damaged/harmed (as much); c. volume shows how much area/height/space is occupied/how large the plant is overall/OWTTE; d. allows repeated measurement of the same plants; e. allows change/increase in volume / growth to be measured/monitored;	*Reject vague answers such as 'more reliable'.*	**1 max**

Continued…

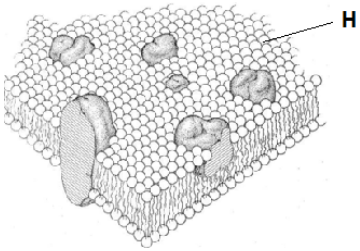
Question 1 continued.

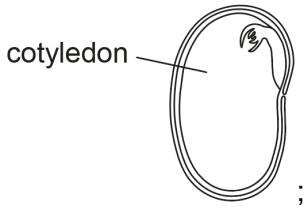
Question			Answers	Notes	Total
1.	**g**		20;	*Percentage is specified in the question, so % is not required in the answer.*	**1**
1.	**h**		more visits with more cover (by *A. splendens*)/positive correlation;	*Reject proportional, directly proportional, directly correlated, positive relationship and positive linear.*	**1**
1.	**i**		a. increase (without voles) due to photosynthesis/growth / due to roots not being eaten; b. decrease (with voles) due to voles feeding on roots/shoots/leaves/grass/*A. splendens*;		**1 max**
1.	**j**		a. low area/cover as this has lower mortality; b. low area/cover due to less shrikes/predation; c. low area/cover as this has higher feeding frequency;		**1 max**

Continued…

Question 1 continued.

Question			Answers	Notes	Total
1.	**k**		a. Award one mark if the answer states that the conclusion is supported by the research/data/graphs/studies **OR** the answer states that voles can modify their ecosystem, with an example of how the research/data/graphs/studies shows this; b. voles reduce the volume/area of *A. splendens* (2nd/4th data); c. voles reduce root biomass/kill roots of *A. splendens* (4th data); d. voles don't eat bunch grass (1st data) yet reduced the bunchgrass *A. splendens* (2nd data); e. lower mortality with lower area covered by *A. splendens* (5th data); f. fewer shrikes/shrike visits with less *A. splendens* (3rd data); g. less predation/mortality due to shrikes with less *A. splendens* (5th data); h. higher vole feeding frequency with lower area covered by *A. splendens* (5th data);	*Reject answers stating that voles adapt to their ecosystem (for example by changing diet) rather than change it.* *Accept correlations given as the converse of the stated mark point, for example more shrike visits with more A. splendens* for marking point f.	**4 max**

Question			Answers	Notes	Total
2.	**a**		 ; [Source: Martin, L., 2022. Discovering the Structure of the Plasma Membrane. [online] Available at: https://archive.org/details/cnx-org-col10470/page/n19/mode/2up [Accessed 13 April 2023]. Source adapted.]	*Label on any phospholipid head.*	**1**
2.	**b**		<u>proteins</u> in the phospholipid bilayer/embedded versus sandwich of phospholipids and <u>proteins</u>/proteins on outside/<u>proteins</u> on top and bottom of membrane (in Davson-Danielli);		**1**
2.	**c**		a. active transport / ATP used/hydrolyzed to provide energy for pumping/conformation change; b. transfers across membrane against concentration gradient / creates concentration gradient; c. sodium ions/Na^+ out and potassium ions/K^+ in; d. in axons; e. creates a resting potential/membrane potential so that action potentials can take place;	*b. Reject 'across the concentration gradient.*	**3 max**

Question			Answers	Notes	Total
3.	**a**	**i**	anaphase / anaphase I;	*Do not accept anaphase II.*	**1**
3.	**a**	**ii**	anther/stamen;	*Mark the first answer given.* *Do not allow filament.*	**1**
3.	**b**		a. pollination is the transfer of pollen from anther/stamen to stigma; b. fertilization is the fusion of male and female gametes / fusion of gametes to form a zygote/diploid cell;		**2**
3.	**c**	**i**	 ;		**1**
3.	**c**	**ii**	a. contains food reserves/food store/nutrients/protein/carbohydrate; b. used during germination; c. used for growth of the embryo (plant) / for root development / for shoot development;		**2 max**

Question			Answers	Notes	Total
4.	**a**		a. number of repeats (may) differ between individuals / is inherited (by children); b. separation/bands produced by gel electrophoresis; c. multiple sites/tandem repeats needed/used to produce a (unique) profile/fingerprint; d. pattern/combination of bands (on gel)/of tandem repeats is unique to individuals; e. used in forensics/criminal investigations/paternity testing;		**2 max**
4.	**b**		child 1/the boy as neither parent has 12 tandem repeats on chromosome 5;		**1**
4.	**c**		a. is a non-coding/non-transcribed section of DNA/bases; b. transcription starts/is initiated at the promoter; c. region for binding (to DNA) of RNA polymerase ***OR*** region for RNA polymerase to separate the DNA strands; d. located upstream of the gene/coding sequence; e. helps to control/regulate gene expression;		**2 max**

Question			Answers	Notes	Total
5.	**a**		*X*: ulna; *Y*: biceps (muscle);	*Accept bicep instead of biceps.*	**2**
5.	**b**		a. work in opposition to each other/cause opposite movements **OR** when one muscle contracts the other relaxes; b. biceps bends the elbow/flexes the arm/pulls the (fore)arm upwards / is the flexor; c. triceps straightens/extends the arm/is the extensor;		**2 max**
5.	**c**		multiple nuclei (per cell/muscle fiber) **OR** large/long;		**1**
5.	**d**		a. cardiac muscle is myogenic/can contract without nerve stimulation; b. sinoatrial/SA node acts as pacemaker/initiates each heartbeat; c. initiated with an action potential; d. signals/impulses (from SA node) propagated across atria/ventricles; e. action potential/signal/impulse stimulates contraction; f. cardiac (muscle) cells/SAN regulated by nerves and epinephrine;		**3 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
6.	**a**		a. evaporation of water / water molecules separate / water changes to vapour/gas; b. hydrogen bonds broken by heat / thermal energy; c. heat removed from body/skin with evaporation/breaking of hydrogen bonds; d. water's high (latent) heat of evaporation makes it efficient (at removing heat)/OWTTE;	*d. Do not accept specific heat capacity.*	**3 max**
6.	**b**		a. ADH (secreted) if body/blood is dehydrated/hypertonic/solute concentration too high; b. more aquaporins / aquaporins open (in collecting duct); c. collecting duct more permeable to water/reabsorbs more water (from filtrate/urine); d. water reabsorbed by osmosis/water reabsorbed because medulla is hypertonic; e. (reabsorbed) water passes (from filtrate) to blood / blood solute concentration reduced; f. less water lost in urine / smaller volume of (more concentrated) urine; g. negative feedback / less/no ADH secreted when blood solute concentration returns to normal;		**5 max**

continued…

Question 6 continued

Question			Answers	Notes	Total
6.	**c**		a. root takes up water by <u>osmosis</u>; b. root hair cells increase surface area (for uptake); c. active transport of salts/ions/minerals into root increases uptake of water; d. water enters <u>xylem</u> (vessels) in root/ water transported up plant in <u>xylem</u>; e. water lost by transpiration/evaporation from leaves; f. low/negative (hydrostatic) pressure generated in leaves/xylem (vessels); g. water moved up in xylem by transpiration pull/tension/suction; h. cohesion/hydrogen bonding between water molecules (so water column does not break); i. root pressure/active transport of ions into (root) xylem can move water up in xylem; j. <u>capillary action</u> due to <u>adhesion</u> of water molecules to xylem wall (can refill xylem); k. xylem vessels reinforced/strengthened by wood/lignin (to prevent collapse);		**7 max**

Question			Answers	Notes	Total
7.	**a**		a. replication is forming new DNA/strands from existing DNA/strands; b. nucleotides added to exposed bases/to exposed strand/to bases on the template strand; c. complementary base pairing (between free nucleotides and template/existing strands); d. both strands/lagging and leading strands of the (parent) DNA act as templates/OWTTE; e. one newly synthesized strand and one original/conserved strand (in daughter molecules);	*c. Reject base pairs added rather than bases.*	**3 max**

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Question 7 continued

Question			Answers	Notes	Total
7.	**b**		a. meiosis produces haploid (nuclei)/gametes **OR** meiosis breaks up combinations of genes/alleles / segregation of alleles during meiosis; b. crossing over/crossover/chiasmata formation; c. alleles/DNA/genetic material/genes exchanged between homologous chromosomes (by crossing over) **OR** recombination / recombinants / chromosome with new allele combination (by crossing over); d. random orientation of bivalents/pairs of homologous chromosomes (in metaphase I) **OR** random/independent assortment of chromosomes; e. different combinations of chromosomes (possible because of random orientation); f. alleles/genes/DNA from two different parents brought together during fertilization; g. random fusion of gametes/female gamete could be fertilized by any of the male gametes ***OR*** random mating / any female can potentially mate with any male;	*c. Do not allow between sister chromatids.* *f. and g. Allow if clearly shown using a Punnett square.*	**5 max**

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Question 7 continued

Question			Answers	Notes	Total
7.	**c**		a. speciation is a new species forming from an existing species/splitting of a species; b. speciation depends on reproductive isolation/no interbreeding between populations; c. gene pools of populations are separate/no gene flow between populations; d. temporal isolation if two populations breed at different times/valid example; e. behavioral isolation if breeding prevented by differences in behaviour/valid example; f. geographical isolation if populations live in different areas / are separated by a physical barrier/valid example; g. differences in mutations/genetic drift between isolated populations; h. differences between environments cause different <u>selection</u> pressures/<u>natural selection</u>; i. allele frequencies of isolated populations diverge; j. evolutionary divergence/different evolutionary paths/different adaptation; k. populations have become separate species when they are too different for successful interbreeding/for interbreeding to produce fertile offspring **OR** polyploidy can cause (instant) reproductive isolation;		**7 max**

Question			Answers	Notes	Total
8.	**a**		a. β-glucose; b. linked by glycosidic bonds; c. by condensation reactions/ removal of the elements of water; d. only 1-4 (glycosidic) bonds / unbranched molecule/polymer; e. up-down-up/alternating orientation of glucose units so molecule is straight ***OR*** cross-linking between cellulose molecules / formation of microfibrils;	*Accept all mark points if clearly shown with a diagram.* *d. Do not accept 'linear' instead of 'unbranched'.*	**3 max**
8.	**b**		a. increased carbon dioxide/greenhouse gases increase greenhouse effect; b. increase in temperature in the oceans with global warming; c. coral bleaching/loss of symbiotic *Zooxanthellae/*algae (due to temperature increase); d. reduced supply of nutrients from photosynthesis (for the coral); e. bleaching reduces coral growth/can kill corals; f. increased carbon dioxide dissolves in the oceans; g. lowers pH/increases acidity of the ocean / reacts with water to form carbonic acid; h. coral skeletons dissolve/corals cannot make skeletons/corals cannot absorb carbonate;		**5 max**

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Question 8 continued

8.	**c**		a. light-independent reactions in the stroma of the chloroplast; b. using energy/ATP from light-dependent reactions; c. Calvin cycle (carries out the light-independent reactions); d. (cycle) begins with a 5C compound/ribulose bisphosphate/RuBP; e. CO_2 from the atmosphere is fixed / CO_2 is joined to RUBP / RUBP is carboxylated; f. catalyzed by RuBP carboxylase/Rubisco; g. two 3C compounds/glycerate-3-phosphate/G3P produced (from RuBP); h. glycerate-3-phosphate is reduced / glycerate-3-phosphate is converted to triose phosphate; i. using electrons/hydrogen (atoms) from NADPH /by oxidation of NADPH; j. two triose phosphate (molecules) used to form a glucose (phosphate)/sugar molecule; k. some triose phosphate molecules used to make more/regenerate RuBP;		**7 max**