Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2022

Biology

Higher level

Paper 2

16 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. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a semicolon (;) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative word is indicated in the "Answers" column by a slash (*/*). Either word can be accepted.

6. An alternative answer is indicated in the "Answers" column by "***OR***". Either answer can be accepted.

7. An alternative markscheme is indicated in the "Answers" column under heading **ALTERNATIVE 1** *etc*. Either alternative can be accepted.

8. Words inside brackets ( ) in the "Answers" column are not necessary to gain the mark.

9. Words that are underlined are essential for the mark.

10. The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

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.

Section A

Question			Answers	Notes	Total
1.	a		5 °C;	*Units required. Accept answers in the range 4.5 to 5.5 °C*	1
1.	b		*Accept one similarity:* a. both rise and then fall / both fall with hibernation and rise with activity b. both reach minimum during hibernation and maximum during activity; c. both lowest in January/February / both rise from January/February; *Accept one difference:* d. one peak of ambient temp but body temp has two peaks / OWTTE; e. body temp remains maximal for longer/plateaus whereas ambient peaks; f. body temperature is always higher than ambient temperature; g. ambient range is greater than body temperature range / OWTTE;		2 max
1.	c		a. decreased/slower heart rate because bears less active/use less energy; b. less (cell) respiration / lower (rate of) metabolism; c. less oxygen/glucose required / less CO_2 produced/needing to be removed; d. less muscle contraction/muscles require less blood; a. e. conserves energy;		2 max
1.	d		porosity increased in humans and decreased in bears;	*Both needed*	1
1.	e		6 %;	*Accept answers in the range 6.0 to 6.5 %. Percentage sign required*	1

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**f**		a. to allow comparison of bears and humans; b. bears have a different life span to humans / bears do not live to 80 years; c. because they age at different rates;		**1 max**
1.	**g**		a. resorption/breaking down occurs and formation/rebuilding occurs; b. at similar rates / more resorption at most times; c. no/little (overall) change (in bone mass); d. lag between bone resorption rising and formation rising / OWTTE; e. bone resorption rising towards end as formation dropping / OWTTE;		**2 max**
1.	**h**		a. more resorption than formation; b. PICP/bone formation (always) lower (than in bears); c. ICTP/bone resorption (always) higher (than in bears); d. ICTP above PICP by a greater amount in humans (than in bears);		**1 max**
1.	**i**		250 % *(Allow 240 to 260%)*		**1**
1.	**j**		a. (hypothesis supported by) positive/direct correlation/direct relationship (between parathyroid hormone and osteocalcin) *OR* osteocalcin rises as parathyroid hormone rises/vice versa; b. no evidence for causal link / causal link cannot be assumed / correlation does not prove causation; *OR* no evidence that parathyroid hormone causes change in osteocalcin; *OR* other factors may cause change in osteocalcin;		**2**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**k**		*Accept one reason for the studies being helpful*: a. (helps us understand how)) bears avoid osteoporosis; b. bone structure of bears and humans is similar / both are mammals; c. suggests that hormones/osteocalcin/parathyroid hormone might be a (preventative) treatment; *Accept one reason for the studies not being helpful*: d. humans do not hibernate / are not inactive for long periods; e. humans live for much longer;		**2 max**

2.	**a**		0.87	*Accept values from 0.8 to 0.9*	**1**
2.	**b**		a. short-term reading could show global temperatures falling while the trend is rising; b. fluctuations from year to year may not show long-term trend;		**1 max**
2.	**c**		a. short wave radiation from sun passes through atmosphere/is not absorbed by CO_2; b. infrared/long wave (radiation)/heat emitted from/released from (surface of) Earth; c. CO_2 in the atmosphere absorbs infrared/long wave (radiation) / heat cannot pass through the greenhouse gases; d. this results in warm/increased temperatures on Earth/global warming;		**3 max**

Question			Answers	Notes	Total
3.	a		0 mV;	*Accept answers in the range of –10 mV to +10 mV. Units required.*	1
3.	b		sodium channels (start to) open; depolarization/(axon) begins to depolarize; action potential occurs;		1 max
3.	c		Na^+/sodium ions diffuse into the axon/neuron in the first half/part of *t*; K^+/potassium ions diffuse out of the axon/cell/neuron in the second half/part of *t*;		2
3.	d		a. (impulses) passed to another neuron at a synapse/across synaptic gap/cleft; b. (depolarization causes) Ca^{2+}/calcium ions to diffuse into the (presynaptic) neuron/axon; c. neurotransmitter released / neurotransmitter crosses synaptic gap; d. (neurotransmitter) binds to receptors on postsynaptic neuron/membrane; e. if the threshold potential is reached an action potential occurs/sodium gates open (in the postsynaptic neuron);		3 max
4.	a		quaternary / fourth level;		1
4.	b		a. alpha helix / α helix b. type of secondary structure / second level of protein structure; c. maintained by hydrogen bonds; d. between C=O group and an N–H group;		2 max
4.	c		a. decoding/translation (of the genetic code/RNA base sequence); b. carries/brings one amino acid/a specific amino acid/the amino acid (corresponding to codon/anticodon); c. tRNA has an anticodon which pairs with mRNA/is complementary to a codon (on mRNA);		2 max

Question			Answers	Notes	Total
5.	**a**		cause opposite movements / pull in opposite directions / when one <u>contracts</u> the other <u>relaxes</u>;		**1**
5.	**b**		a. flexor/flexion; b. bends/flexes the leg/limb/joint;		**2**
5.	**c**		insect muscle is attached inside (the skeleton) and human muscle outside (the skeleton); insect muscle is attached to exoskeleton and human to endoskeleton/bones;		**1 max**
5.	**d**		a. calcium released from sarcoplasmic reticulum; b. calcium binds to troponin; c. causes tropomyosin to move; d. uncovers binding sites; e. myosin heads bind to the actin forming cross bridges;		**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. hydrogen bonds hold water molecules together/make water molecules cohere; b. evaporation requires breaking of hydrogen bonds / heat needed to break hydrogen bonds c. water has a high heat of vaporization/high latent heat; d. evaporation of water/sweat removes heat from/cools the skin/body;		**3 max**

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
6.	**b**		a. water (vapor) lost by <u>transpiration</u>/through <u>stomata</u>; b. transpiration/loss of water from leaves causes transport of water (in xylem); *Temperature:* c. faster/more water loss/transpiration/transport in hotter weather; d. more <u>heat</u> for evaporation; *Humidity:* e. slower/less water loss/transpiration/transport in more humid weather; f. faster diffusion of water (vapor) out of the leaf/through the stomata with low humidity outside; *OR* no evaporation if air is saturated with water vapor/with 100% humidity; *Wind* g. faster/more water loss/transpiration/transport in windy/windier weather; h. wind/air movement carries away water vapor from around the leaf/stomata; i. high winds can cause stomatal closure and so reduce transpiration; *Drought* j. drought causes stomata to close so reduces loss/transport;		**5 max**

(continued…)

(Question 6 continued)

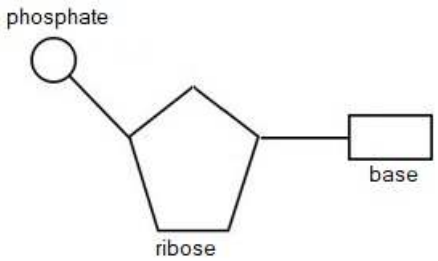
Question			Answers	Notes	Total
6.	**c**		a. thirst; b. more water drunk / more water reabsorbed from feces (in the colon/large intestine); c. osmoreceptors in the hypothalamus detect dehydration/high solute concentration in blood; d. ADH secreted; e. by the pituitary gland; f. ADH signals to collecting duct/DCT (cells) to increase permeability to water; g. more aquaporins (in plasma membranes of collecting duct/distal convoluted tubule cells); h. more water reabsorbed from filtrate (in collecting ducts/distal convoluted tubules); i. reabsorption by osmosis / reabsorption due to medulla being hypertonic; j. reabsorbed water passes into the blood/reduces the solute concentration of blood; k. smaller volume/more concentrated/hypertonic urine formed; l. less sweating;		**7 max**

Question			Answers	Notes	Total
7.	a		a. unspecialized/undifferentiated stem cells can divide/differentiate along different pathways; b. (stem cells are accessible as they) come from embryos/bone marrow/umbilical cord blood/adult tissue; c. (stem cells) can regenerate/repair/regrow diseased/damaged tissues in people; d. valid specific example; e. drugs can be tested on stem cells (in laboratories to see if they are harmful);		**3 max**
7.	b		a. mice/rabbit/small mammal injected with one type of antigen; b. cells from the spleen/antibody-producing cells are removed; c. plasma cells that produce antibodies (are used); d. myeloma/tumor cells that divide endlessly (are used); e. fusion of plasma cells with tumor/myeloma cells / fusion produces hybridoma cells; f. selection of hybridoma cells / medium used that only allows growth of hybridoma cells; g. fused cells/hybridoma cells are cultured/grown in tissue culture/grown in a fermenter; h. (hybridoma) cells divide endlessly and produce the desired antibodies;		**5 max**

(continued…)

(Question 7 continued)

Question			Answers	Notes	Total
7.	**c**		a. electron transport chain performs chemiosmosis / chemiosmosis generates ATP; b. receives energy/electrons from oxidation reactions/from Krebs cycle/glycolysis; c. receives electrons from reduced NAD/NADH/reduced FAD/FADH; d. energy released as electrons pass from carrier to carrier (in the chain); e. release of energy (from electron flow) coupled to proton pumping; f. protons pumped into intermembrane space; g. creates proton gradient; h. protons diffuse back/move down the concentration gradient (across membrane); i. protons pass through ATP synthase; j. protons return to the matrix; k. flow of protons provides energy for generating ATP; l. electrons transferred to oxygen at end of electron transport chain;		**7 max**

Question			Answers	Notes	Total
8.	a		 a. <u>ribose</u> drawn as a pentagon and labelled; b. <u>base</u> linked correctly (to C_1) of ribose and labelled; c. <u>phosphate</u> linked correctly (to C_5) of ribose and labelled;		**3**
8.	b		a. DNA sample is collected from the child and its (potential) parents; b. from saliva/mouth swab/blood/other body cells; c. PCR used to amplify/produce more copies of the DNA; d. short tandem repeats/genes consisting of a repeating sequence of bases repeats copied/used; e. number of repeats varies between individuals; f. unlikely that two individuals have same number of repeats for every gene included; g. gel electrophoresis used to separate DNA fragments according to length/number of repeats; h. gel electrophoresis generates a unique pattern of bands i. DNA profile is the pattern of bands / diagram showing pattern of bands as in a DNA profile; j. all bands in the child's profile must be in one of the parents' profiles / OWTTE;		**5 max**

(continued…)

(Question 8 continued)

Question			Answers	Notes	Total
8.	**c**		a. environment affects height; b. nutrition/malnutrition affects growth rate / other example of environmental factor affecting height; c. genes/alleles affect height / height is partly heritable; d. polygenic / many genes influence height; e. continuous variation; f. normal/bell-shaped distribution of height; g. some alleles (of these genes) increase height and some reduce it; h. many possible combinations of alleles of these genes; i. specific gene mutations/alleles cause dwarfism/extreme height; j. meiosis generates variation (in height); k. mutations generate variation (in height); l. males tend to be/are on average taller than females; m. loss of height during aging;		**7 max**

References: