

# Markscheme

**May 2018**

**Biology**

**Higher level**

**Paper 2**

20 pages

This markscheme is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

## 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 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.
- ♦ 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		$(32 \times 79 =) 2528 \checkmark$		1
1.	b		a. same bat may be recorded more than once $\checkmark$ b. some bats may not fly over [the recording station] <b>OR</b> only bats flying over the station are recorded $\checkmark$ c. two bats flying close/together might be recorded as one $\checkmark$		1 max
1.	c	i	82 / 82.1 / 82.14 (% decline) $\checkmark$		1

*(continued...)*

(Question 1 continued)

Question			Answers	Notes	Total
1.	c	ii	<p><b>Conclusion supported</b></p> <p>(2008 to 2009) <i>M. lucifugus</i> declines more (than <i>L. cinereus</i>)  <b>OR</b>                      (2007 to 2009) <i>M. lucifugus</i> declines whereas <i>L. cinereus</i> increases/fluctuates/did not decline  <b>OR</b>                      more affected than unaffected bats in 2007 and 2008 but more unaffected in 2009 ✓</p> <p><b>Conclusion not supported</b></p> <p>other factors could be causing the difference between the species/the decrease in <i>M. lucifugus</i>  <b>OR</b>                      there will be differences between the two bat species apart from WNS infection  <b>OR</b>                      both species decreased from 2008 to 2009 ✓</p>	<p>Award one mark maximum for an argument supporting the conclusion and one mark maximum for an argument against the conclusion. Marks should only be awarded for statements that make an explicit or clearly implied comparison between the species.</p>	2 max
1.	d		<p>a. more (frequent) interruptions/emergences from hibernation/shorter periods of hibernation/more spikes in temperature (indicating emergence) in infected bats ✓</p> <p>b. more fluctuation in (body) temperature (during hibernation) in infected (than uninfected bats) ✓</p> <p>c. emergences/interruptions become more frequent during the hibernation period in infected bats versus (about) about the same frequency in uninfected ✓</p>		1 max

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	e	a. <u>energy</u> needed to raise body <u>temperature</u> / lost during <u>temperature</u> spikes ✓ b. <u>energy/heat</u> released by/comes from (cell) <u>respiration/metabolism</u> ✓ c. <u>food/fat</u> (stores/reserves) used in (cell) respiration/in generating energy/heat/raising body temperature ✓ d. bats die/starve if fat/energy/food stores used up ✓ e. <u>hibernation</u> conserves food stores/reduces use of energy ✓ f. no/little food available/food harder to find (in winter/during hibernation period) ✓ g. (more) energy/food used when flying/hunting ✓ h. (more) heat loss/hypothermia (in winter/cold weather) ✓ i. higher chance of being killed by predators when flying/emerged from hibernation ✓		3 max
1.	f	later date of death with longer/bigger intervals (between hibernation emergence)/with less frequent interruptions (to hibernation) ✓	<i>The correlation must be described.</i>	1
1.	g	<p><b>Arguments for a causal link</b></p> a. there is a trend/correlation/relationship (shown by the data in the graph) ✓ b. explanations of how more frequent emergence from hibernation could cause earlier death (are plausible)/example of an explanation ✓		2 max
		<p><b>Arguments against a causal link</b></p> c. there is a correlation but this does not show a causal link / correlation does not prove causation d. more data/further research is needed to show the causes ✓ e. there is (much) variation/spread in the data ✓ f. other factors can affect the date of death ✓		

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	h	a. differences in body mass <b>OR</b> differences in reserves/stores of food/energy/fat ✓ b. bats may be predated during a flight / chance events might affect the date of death ✓ c. more effective/stronger <u>immune</u> system/ <u>immunity</u> (in some bats) ✓ d. more resistance to cold (in some bats) ✓ e. larger bats lose heat less rapidly ✓ f. infected at a different/later date ✓		1 max
1.	i	a. higher mortality/more deaths ✓ b. shorter life expectancy/premature death/death before reproduction ✓ c. extinction/reduction in (size of) of bat populations ✓ d. <i>L. cinereus</i> /species of bats not affected by WNS may increase <b>OR</b> <i>L. cinereus</i> /species of bats not affected by WNS may experience less competition ✓ e. infection may affect birth rates/fertility ✓ f. bats will emerge more from hibernation/in winter ✓ g. bats will use up food/energy reserves faster in winter/faster due to (more) interruptions ✓ h. bat (populations) develop/evolve greater resistance to WNS ✓		3 max

Question		Answers	Notes	Total
2.	a	a. hair/fur ✓ b. mammary glands/breasts/(secretion of) milk/lactation ✓ c. sweat glands ✓ d. lungs with alveoli e. placenta (in most mammals) ✓ f. fetus develops in uterus/gives birth to live young ✓	<i>Do not award marks for any answers after the first two given.</i>	2
2.	b	a. (homologous structures have evolved) from a common ancestor ✓ b. divergent evolution/adaptive radiation ✓ c. similarities in forelimb <u>bones</u> (in birds, bats and humans) / description of the similarities in bones ✓ d. different uses/functions ✓	<i>Do not accept (positive) correlation.</i>	2 max

Question			Answers	Notes	Total
3.	a	i	a. unsegmented body (whereas arthropods are segmented) ✓ b. shell (versus exoskeleton in arthropods) ✓ c. <u>muscular foot</u> (which arthropods do not have) ✓ d. no jointed appendages/jointed legs (whereas arthropods have jointed legs/appendages) ✓ e. slimy/mucus-covered / arthropod is not slimy ✓	<i>Do not award marks for any answers after the first two given.</i>	<b>2 max</b>
3.	a	ii	calcium carbonate/CaCO <sub>3</sub> ✓	<i>Do not accept carbon or calcium – the mass of oxygen in calcium carbonate is greater than both these and the chemical component is the compound not its constituent elements.</i>	<b>1</b>
3.	b	i	sex-linked genes are on sex/X chromosome(s)/on chromosome 23 whereas genes with linked loci are on the same autosome/chromosome ✓		<b>1 max</b>

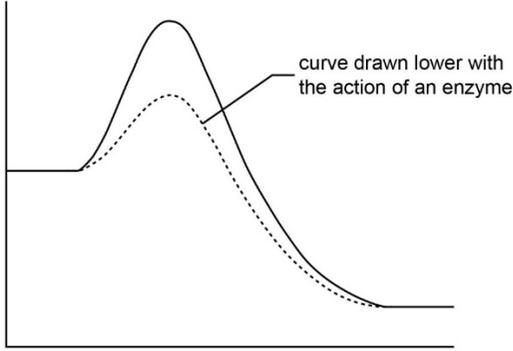
Question			Answers	Notes	Total
3.	b	ii	<p>a. perform a cross/test cross ✓</p> <p>b. (if) double heterozygotes/CcBb are crossed with double homozygous recessives/ccbb</p> <p><b>OR</b></p> <p>Punnett square/genetic diagram showing CcBb crossed with ccbb</p> <p><b>OR</b></p> $\begin{array}{cc} \underline{C} & \underline{B} \\ \hline c & b \end{array} \times \begin{array}{cc} \underline{c} & \underline{b} \\ \hline c & b \end{array}$ <p>c. (then) expected ratio (for unlinked genes) is 1:1:1:1 ✓</p> <p>d. (if) double heterozygotes/CcBb are crossed together</p> <p><b>OR</b></p> <p>Punnett square showing CcBb crossed with CcBb</p> <p><b>OR</b></p> $\begin{array}{cc} \underline{C} & \underline{B} \\ \hline c & b \end{array} \times \begin{array}{cc} \underline{C} & \underline{B} \\ \hline c & b \end{array}$ <p>e. (then) expected ratio (for unlinked genes) is 9:3:3:1 ✓</p> <p>f. no/fewer than expected recombinants if genes are linked</p> <p><b>OR</b></p> <p>fewer pink banded/yellow unbanded if the genes are linked ✓</p> <p><b>OR</b></p> <p>linked genes are expressed together more often than expected ✓</p> <p>g. use chi-square test (for significance of difference) ✓</p> <p>h. linked genes are on the same chromosome/diagram showing this ✓</p>		3 max

Question		Answers	Notes	Total
4.	a	a. I: GUG <b>AND</b> II: CAC ✓ b. III: Val/valine ✓	<i>Both required. Do not accept GAG to GTC.</i>	2
4.	b	a. promotion/repression/regulation of gene expression ✓ b. introns (have functions in regulation of gene expression) ✓ c. telomeres (form caps at the end of chromosomes) ✓ d. coding for tRNAs/rRNAs ✓ e. allows genes/traits/heritable characteristics to be passed to offspring ✓		2 max
4.	c	free ribosomes produce proteins for use inside the cell/cytoplasm whereas bound ribosomes produce proteins for secretion/for use outside the cell/for use in lysosomes ✓		1

Question			Answers	Notes	Total
5.	a	i	cell wall ✓		1
5.	a	ii	metaphase ✓		1
5.	b		<p><b>location of ATP synthase</b>                      a. cristae/inner mitochondrial membrane versus thylakoid membranes ✓  <b>movement of protons</b>                      b. protons moved/pumped as a result of <u>electron</u> flow/<u>electron</u> transport in both ✓                      c. (pumped by the electron transport chain) from the matrix to the intermembrane space versus from the stroma to the thylakoid space ✓                      d. through ATP synthase/synthetase in both (respiration and photosynthesis) ✓                      e. protons move (through ATP synthase/synthetase) down the concentration gradient in both ✓                      f. move (down concentration gradient) from the intermembrane space to the matrix versus from the thylakoid space to the stroma ✓</p>		2 max

(continued...)

(Question 5 continued)

Question		Answers	Notes	Total													
5.	c			3													
			<table border="1"> <thead> <tr> <th></th> <th>Cytoplasm</th> <th>Mitochondrion</th> </tr> </thead> <tbody> <tr> <td>ATP production</td> <td>small gain / 2 per glucose / substrate level / by glycolysis</td> <td>larger gain / more than 30 per glucose / chemiosmosis / by oxidative phosphorylation ✓</td> </tr> <tr> <td>use of oxygen</td> <td>none / ✗ / no</td> <td>required/used (as terminal electron acceptor) / ✓ / yes ✓</td> </tr> <tr> <td>release of CO<sub>2</sub></td> <td>none / ✗ / no</td> <td>waste product /produced (by link reaction and Krebs cycle) / ✓ / yes ✓</td> </tr> </tbody> </table>			Cytoplasm	Mitochondrion	ATP production	small gain / 2 per glucose / substrate level / by glycolysis	larger gain / more than 30 per glucose / chemiosmosis / by oxidative phosphorylation ✓	use of oxygen	none / ✗ / no	required/used (as terminal electron acceptor) / ✓ / yes ✓	release of CO <sub>2</sub>	none / ✗ / no	waste product /produced (by link reaction and Krebs cycle) / ✓ / yes ✓	
			Cytoplasm		Mitochondrion												
		ATP production	small gain / 2 per glucose / substrate level / by glycolysis		larger gain / more than 30 per glucose / chemiosmosis / by oxidative phosphorylation ✓												
use of oxygen	none / ✗ / no	required/used (as terminal electron acceptor) / ✓ / yes ✓															
release of CO <sub>2</sub>	none / ✗ / no	waste product /produced (by link reaction and Krebs cycle) / ✓ / yes ✓															
5.	d	curve starting and ending at the same energy level but rising to a lower peak ✓		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
6.	a	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p><b>Draw a labelled diagram to show the fluid mosaic model of the plasma membrane.</b></p> </div> <p>a. two correctly orientated layers of <u>phospholipids/phospholipid bilayer</u> shown with heads facing in opposite directions ✓</p> <p>b. phospholipids shown with two parts labelled <u>hydrophilic/phosphate</u> head <b>AND</b> <u>hydrophobic/hydrocarbon</u> tail ✓</p> <p>c. <u>protein</u> (any) shown as a globular structure embedded in one/both layers of phospholipid ✓</p> <p>d. <u>peripheral protein</u> shown as globular structures at the surface of the membrane <b>AND</b> <u>integral protein</u> shown as embedded globular structures ✓</p> <p>e. <u>glycoprotein</u> shown as embedded globular structure with antenna-like carbohydrate protruding  <b>OR</b>  <u>carbohydrate</u> shown as branched/antenna-like structure attached either to a protein or to a phospholipid ✓  <b>OR</b>  <u>channel</u> protein(s) shown with a pore passing through it  <b>OR</b>  <u>pump</u> protein shown as a transmembrane globular structure ✓</p> <p>f. <u>cholesterol</u> shown in between adjacent phospholipids ✓</p>	<p><i>Do not award the mark unless the structure is labelled with the underlined name.</i></p>	<p><b>4 max</b></p>

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	b	<p><b>Outline how neurons generate a resting potential.</b></p> <p>a. sodium-potassium pump ✓</p> <p>b. sodium /Na<sup>+</sup> out and potassium /K<sup>+</sup> in ✓</p> <p><b>OR</b></p> <p>sodium/Na<sup>+</sup> concentration higher outside and potassium/K<sup>+</sup> higher inside ✓</p> <p>c. three Na<sup>+</sup> pumped for every two K<sup>+</sup> (hence negative inside) ✓</p> <p><b>OR</b></p> <p>inside of axon holds negative ions/Cl<sup>-</sup> ions/negatively charged proteins/organic anions (hence negative inside) ✓</p> <p>d. by active transport / using ATP ✓</p> <p>e. <u>inside</u> (of axon/neuron) is negative in comparison to outside ✓</p> <p><b>OR</b></p> <p>electrochemical concentration/charge difference (across the membrane) is the resting potential ✓</p> <p>f. resting potential is -70mV ✓</p>		4 max

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	c	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p><b>Explain the importance of hydrogen bonding for living organisms.</b></p> </div> <p>a. cohesion in water/water molecules stick together (due to hydrogen bonds) ✓                      b. cohesion helps transport under tension of water/sap in xylem / transpiration stream ✓                      c. adhesion between water and cell walls/cellulose/polar molecules ✓                      d. adhesion/capillary action helps water to rise in plants/stems/xylem / helps keep leaf walls moist ✓                      e. solvent properties (due to hydrogen bonds) with polar/hydrophilic molecules ✓                      f. solvent properties exemplified by glucose/other example of a polar solute ✓                      g. high latent heat of evaporation / (much) energy required for evaporation so water useful as coolant/for sweating ✓                      h. high (specific) heat capacity so water temperature changes less ✓                      i. base pairing between bases/nucleotides/strands in DNA by hydrogen bonding ✓                      j. base pairing between bases in RNA and DNA for transcription/between codon and anticodon for translation ✓                      k. proteins have hydrogen bonding in secondary structure/<math>\alpha</math> helix/<math>\beta</math> pleated sheet ✓                      l. proteins have hydrogen bonding between R groups/in tertiary structure/to maintain conformation ✓                      m. habitats because water is liquid due to high boiling point/due to water freezing on the surface ✓                      n. habitats on water surface due to surface tension ✓</p>		<b>7 max</b>

Question		Answers	Notes	Total
7.	a	<p><b>Outline how greenhouse gases interact with radiation and contribute to global warming.</b></p> <p>a. carbon dioxide is a greenhouse gas ✓                      b. methane/nitrogen oxide/water vapour is a greenhouse gas ✓                      c. sunlight/light/(solar) radiation passes through the atmosphere (to reach the Earth's surface) ✓                      d. CO<sub>2</sub> in atmosphere/greenhouse gases absorb/trap/reflect back some radiation/heat (emitted by the Earth's surface) ✓                      e. CO<sub>2</sub> in atmosphere/greenhouse gases allow <u>short wave</u> radiation to pass (through atmosphere) but absorb <u>long wave/infra-red</u> ✓                      f. solar radiation/sunlight is (mostly) short wave ✓                      g. radiation/heat emitted by the Earth is long wave/infra-red ✓</p>	Allow answers presented in a clearly annotated diagram.	4 max
7.	b	<p><b>Outline how plants make use of the different wavelengths of light.</b></p> <p>a. light used in photosynthesis/light-dependent reactions/ photolysis/photosystems/photophosphorylation/excitation of electrons/switch to flowering ✓                      b. <u>chlorophyll</u> absorbs red <b>AND</b> blue light (more) ✓                      c. chlorophyll/leaf/plant reflects/does not absorb/does not use green light ✓                      d. <u>absorption spectrum</u> of chlorophyll has peaks in the red and blue/sketch graph to show this ✓                      e. <u>action spectrum</u> shows which wavelengths plants use in photosynthesis/sketch graph of action spectrum showing peaks in the blue and red ✓                      f. accessory/other (named) photosynthetic pigments absorb different wavelengths/colours ✓                      g. violet is the shortest wavelength and red the longest ✓                      h. red light and far red/infra-red absorbed to measure length of light/dark periods ✓</p>		4 max

(continued...)

(Question 7 continued)

Question		Answers	Notes	Total
7.	c	<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> <p><b>Explain how organic compounds are transported within plants.</b></p> </div> <p>a. transported in/translocated in/loaded into <u>phloem</u> ✓                      b. in sieve tubes ✓                      c. by mass flow ✓                      d. from sources to sinks ✓                      e. from leaves/other example of source to roots/other example of sink ✓                      f. loading (of sugars/organic compounds) by <u>active transport</u> ✓                      g. cause high concentration of solutes (in phloem/sieve tubes) ✓                      h. water uptake (in phloem/sieve tubes) by osmosis/water diffuses into phloem ✓                      i. rise in (hydrostatic) pressure at source (in phloem) ✓                      j. creates a (hydrostatic) pressure gradient/higher pressure in source than sink ✓                      k. flow can be in either direction/bidirectional ✓</p>		<b>7 max</b>

Question		Answers	Notes	Total
8.	a	<p><b>Describe the process of spermatogenesis leading to the production of four sperm cells in a human male.</b></p> <p>a. in the seminiferous tubule ✓                      b. diploid cells/spermatogonia grow/enlarge ✓                      c. two divisions of meiosis ✓                      d. primary spermatocyte carries out the first division and secondary spermatocytes carry out the second division ✓                      e. meiosis produces haploid cells/spermatids ✓                      f. haploid cells/spermatids <u>differentiate</u> into spermatozoa/sperm cells  <b>OR</b>                      develop tail/flagellum/helical mitochondrion/acrosome/sac of enzymes ✓                      g. Sertoli cells help sperm to mature/differentiate</p>	<p><i>Allow answers presented in a clearly annotated diagram.</i></p>	<p><b>4 max</b></p>
8.	b	<p><b>Outline the roles of estrogen and progesterone in females during human reproduction.</b></p> <p>a. estrogen/progesterone for repair/thickening/development/vascularisation of uterus lining/endometrium ✓                      b. estrogen (at high levels) stimulates LH secretion (which stimulates ovulation)                      c. progesterone maintains the uterus lining/endometrium during pregnancy/prevents miscarriage ✓                      d. progesterone/estrogen inhibits FSH/LH secretion ✓                      e. progesterone for development of breast tissue during pregnancy ✓                      f. fall in progesterone/rise in estrogen leads to labour/contractions/childbirth ✓                      g. estrogen/progesterone cause pre-natal development of female reproductive organs  <b>OR</b>                      h. estrogen/progesterone cause secondary sexual characteristics ✓</p>		<p><b>4 max</b></p>

(continued...)

(Question 8 continued)

Question		Answers	Notes	Total
8.	c	<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> <p><b>Explain the process of muscle contraction.</b></p> </div> <p>a. muscle fibre contains many myofibrils ✓                      b. made up of sarcomeres/labelled diagram showing one or more sarcomeres ✓                      c. nerve impulse/signal from (motor) neuron causes release of calcium (ions)/Ca<sup>2+</sup> ✓                      d. calcium (ions)/Ca<sup>2+</sup> released from sarcoplasmic reticulum ✓                      e. calcium (ions)/Ca<sup>2+</sup> link to troponin ✓                      f. tropomyosin moves to expose actin binding sites ✓                      g. ATP hydrolysis/ATP to ADP and phosphate/release of phosphate from ATP ✓                      h. ATP binds to myosin heads and causes them to cock/change angle/release/gain energy ✓                      i. myosin heads bind/form cross-bridges to actin ✓                      j. myosin heads push on actin and then detach from actin ✓                      k. actin moved towards centre of sarcomere/sliding of filaments ✓                      l. sarcomere becomes shorter (resulting in muscle contraction) ✓</p>	<p><i>Accept any mark point if clearly made on an annotated diagram.</i></p>	<p><b>7 max</b></p>