



# Mark scheme

May 2019

Biology

Higher level

Paper 2

19 pages

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## 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.

**Section A**

Question		Answers	Notes	Total
1.	a	<p>a. armyworm «infestation» produced more X than Y than Z/decreasing amounts <b>AND</b> herbivorous mite showed the opposite pattern/more Z than Y than X ✓</p> <p>b. armyworm «infestation» produced more X than herbivorous mite ✓</p> <p>c. armyworm «infestation» produced more Y than herbivorous mite / Y is the middle value for both ✓</p> <p>d. armyworm «infestation» produced less Z than the herbivorous mite ✓</p> <p>e. other valid distinction ✓</p>	<p><i>Clear distinction required not simple lists of values.</i></p> <p><i>Accept OWTTE.</i></p> <p><i>For mp b-d accept vice versa.</i></p>	<p><b>3 max</b></p>

*(continued...)*

(Question 1 continued)

1.	b	<p>a. C1 caused the leaf to produce two of the same chemicals/Y and Z as the attack of herbivorous mites in a similar pattern «but in lower quantities» ✓</p> <p>b. C1 produces the least «total» amount of chemicals of all the treatments ✓</p> <p>c. C2 has very similar pattern to those caused by the armyworms «but in lower quantities» ✓</p> <p>d. <b>both</b> herbivores caused a greater production of chemicals/all three chemicals compared to either C1 or C2 ✓</p> <p>e. armyworms cause the greatest total amount of chemical production of any of the other treatments ✓</p> <p>f. other valid comparison of chemical effect versus herbivore effect ✓</p>	<p><i>Clear comparison required between herbivore infestation and chemical treatment not simple lists of values.</i></p> <p>OWTTE</p> <p>OWTTE</p>	<p><b>3 max</b></p>
1.	c	PCR	Accept RT-PCR.	1
1.	d	gene 1 is first transcribed «after C2 treatment» as it shows activation after one hour ✓		1

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	e	<p>a. herbivorous mites induce activation of gene 2 first «at 1 hour» <b>and</b> then also gene 1 and gene 3 «at 24 hours»  <b>OR</b>                      herbivorous mite «infestation» is the only treatment to affect all three genes/leads to greater gene expression overall ✓</p> <p>b. gene 2 activation similar for mite and C1 «at both 1 and 24 hours» ✓</p> <p>c. gene 3 activation similar for mite and C2 «both at 24 hours» ✓</p> <p>d. gene 1 activation slower for mite compared to C2 <b>but</b> more intense (than C2 at 24 hours) ✓</p> <p>e. gene 1 and gene 3 expressed in higher amounts «after 24 hours» in mite infestation compared to C2 ✓</p>	<p><i>Both parts OWTTE required for mpd.</i></p>	<p><b>3 max</b></p>
1.	f	<p>a. the greater «gene expression» response of the lima bean plant to the mite infestation indicates a longer evolutionary relationship ✓</p> <p>b. herbivorous mites cause more genes to be expressed/higher intensity of gene activation ✓</p> <p>c. herbivorous mites cause a more immediate/earlier response in gene activation ✓</p>	<p><i>OWTTE.</i></p>	<p><b>2 max</b></p>

2.	a	i	telophase because the chromosomes/chromatids have reached the poles <b>OR</b> «late» anaphase as some chromosomes/chromatids are still moving/tails visible ✓	OWTTE	1
2.	a	ii	a. mitotic index is an indication of the ratio/percentage of cells undergoing mitosis/cell division ✓  b. cancer cells «generally» divide much more than normal «somatic» cells ✓  c. a <u>high/elevated</u> mitotic index in tumours / possible diagnosis of cancer / measure of how aggressive/fast growing the tumour is ✓		2 max
2.	a	iii	a. promoters / operators / regulation of gene expression/transcription ✓  b. telomeres/give protection to the end of chromosomes «during cell division» ✓  c. genes for tRNA/rRNA production ✓  d. other valid function for non-coding sequence ✓	<i>Do not accept stop codon, accept centromeres (connecting sister chromatids).</i>	2 max

(continued...)

(Question 2 continued)

Question			Answers	Notes	Total
2.	b	i	a. «overall» much more methylation in the colon tumour samples than normal ✓ b. tumour and normal samples the markers 258 and 269 similar degree of methylation/fewer differences ✓ c. degree of methylation on certain markers may correlate with the presence of cancer / correct example of a marker only methylated in tumour cells eg marker 32 ✓		2 max
2.	b	ii	a. «DNA» methylation may inhibit transcription of genes that would prevent cancer/tumor formation ✓ b. «DNA» methylation may increase mitosis/cell division leading to tumor formation ✓	Do not accept discussion of histone methylation.	1 max
3.	a		I. aorta ✓ II: «left» atrium ✓		2
3.	b		a. platelets/cut tissues release clotting factors ✓ b. «clotting factors» activate thrombin «from prothrombin» ✓ c. thrombin converts fibrinogen to fibrin ✓ d. «fibrin» forms a clot/scab/mesh that seals the cut ✓ e. phagocytic white blood cells ingest pathogens ✓	Mp a requires student to identify source of clotting factors.	3 max

(continued...)



(Question 3 continued)

Question		Answers	Notes	Total
3.	c	<p>a. FSH/follicle stimulating hormone stimulates the development of follicles/follicle cell division in the ovary «to produce eggs» ✓</p> <p>b. LH/luteinizing hormone triggers ovulation/development of the corpus luteum ✓</p> <p>c. estrogen stimulates development of the uterine lining/endometrium ✓</p> <p>d. progesterone maintains the uterine lining/endometrium <b>OR</b> inhibits other hormones by negative feedback eg, FSH ✓</p> <p>e. HCG stimulates ovary to produce progesterone «in early pregnancy» ✓</p> <p>f. other verifiable hormone and roles relevant to the menstrual cycle ✓</p>	<p><i>Two different hormones must be identified.</i></p> <p><i>Description of role required as well as name of hormone.</i></p>	<p><b>2 max</b></p>

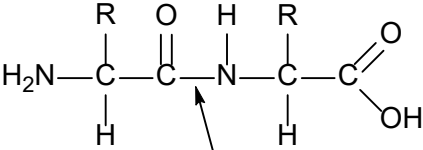
4.	a	<p>X: Filicinophyta ✓                  Y: Coniferophyta/Conifera/Gymnosperms ✓</p>		2
4.	b	<p>a. «previous» classification used to be based on the appearance/structures of the plant/leaves/flowers/seeds/analogy/phenotype ✓                  b. «modern cladistics uses» RNA/DNA nucleotide/base sequencing/amino acid sequencing/homology ✓                  c. DNA mutation occurs at a relatively constant rate allowing estimation of when species diverged ✓                  d. a shared/common derived characteristic places organisms in the same clade ✓                  e. the number of changes in sequences indicates distance from common ancestor  <b>OR</b>                  the fewer the differences «in sequences» means the closer the relationship ✓</p>		3 max
4.	c	<p><i>pollination:</i>                  transfer/dispersal/movement of <u>pollen</u> from anther/stamen to <u>stigma</u>  <b>OR</b>                  transfer/dispersal/movement of <u>pollen</u> between plants/flowers prior to/allowing <u>fertilization</u> ✓  <i>seed dispersal:</i>                  «strategy of» distribution of seeds so that new plants have space/nutrients to develop/avoid competition/colonize new habitats ✓</p>	<p><i>Accept any other valid role.</i>   <i>Accept OWTTE. Answers must be about the role.</i></p>	2

Question		Answers	Notes	Total
5.	a	<p>a. «cell» respiration/loss of CO<sub>2</sub>/biomass consumed to provide/as a source of energy ✓</p> <p>b. loss of energy «as heat» between trophic levels means less energy available for building biomass ✓</p> <p>c. waste products «other than CO<sub>2</sub>»/loss of urea/feces/egesta ✓</p> <p>d. material used/CO<sub>2</sub> released by saprotrophs ✓</p> <p>e. undigested/uneaten material «teeth, bones, etc»/detritus buried/not consumed <b>OR</b> formation of peat/fossils/limestone ✓</p>		2
	b.	<p>a. increased CO<sub>2</sub> flux to the atmosphere due to increased burning of fossil fuels by industry/transportation / cement production ✓</p> <p>b. «land use change leading to» decreased rate of forest burning <b>OR</b> better fire suppression leading to decrease in CO<sub>2</sub> release <b>OR</b> example of land use changes that uses less fossil fuel <b>OR</b> increase in land covered by forests/plants / forests recovering from historical forestry <b>OR</b> any other reasonable explanation of land use change that would lead to decreased rate of carbon flow to atmosphere ✓</p> <p>c. carbon storage in land decreased as less photosynthesis due to fewer forests/more construction <b>OR</b> release of methane due to «drying of» wetlands/sealing of land with concrete/buildings/roads ✓</p> <p>d. carbon storage in ocean increased due to more photosynthesis/algae/greater concentration of CO<sub>2</sub> in the atmosphere <b>OR</b> increased diffusion/rate of dissolving of CO<sub>2</sub> into ocean from the atmosphere <b>OR</b> limestone/carbonate accumulation «more snails» ✓</p>		3 max

6.	a	<p>a. simple diffusion is passive movement of molecules/ions along a concentration gradient ✓</p> <p>b. facilitated diffusion is passive movement of molecules/ions along a concentration gradient through a protein channel «without use of energy» ✓</p> <p>c. osmosis is the passage of water <u>through a membrane</u> from lower solute concentration to higher ✓</p> <p>d. active transport is movement of molecules/ions <u>against the concentration gradient</u> «through membrane pumps» with the use of ATP/energy ✓</p> <p>e. endocytosis is the infolding of membrane/formation of vesicles to bring molecules into cell with use of energy <b>OR</b> exocytosis is the infolding of membrane/formation of vesicles to release molecules from cell with use of energy ✓</p> <p>f. chemiosmosis occurs when protons diffuse through ATP synthase «in membrane» to produce ATP ✓</p>	<p><i>mpa, mpb and mpc require reference to concentration.</i></p> <p><i>OWTTE</i></p> <p><i>Active transport requires mention of the use of energy.</i></p>	<p><b>4 max</b></p>
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(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	b	<p>a. two amino acids, one with NH<sub>2</sub>/NH<sub>3</sub><sup>+</sup> end and one with COOH/COO<sup>-</sup> end ✓</p> <p>b. peptide bond between C=O and N—H correctly drawn ✓</p> <p>c. «chiral» C with H and R group on each amino acid ✓</p> <p>d. peptide bond labelled/clearly indicated between C terminal of one amino acid and N terminal of the second amino acid ✓</p>	 <p>candidate may indicate peptide bond here</p> <p><i>Labels not required for amino group and carboxyl group.</i></p>	3

(continued...)

(Question 6 continued)

<p><b>6.</b></p>	<p><b>c</b></p>	<ul style="list-style-type: none"> <li>a. ADH plays a role in osmoregulation/regulating blood solute concentration ✓</li> <li>b. acts on the collecting ducts of the kidney ✓</li> <li>c. acts in «late» distal convoluted tubule ✓</li> <li>d. <u>hypothalamus</u> detects plasma/blood osmolarity/solute concentration ✓</li> <li>e. if plasma/blood is too concentrated/hypertonic, «posterior» <u>pituitary</u> releases ADH ✓</li> <li>f. ADH stimulates insertion of aquaporins/water channels / increases permeability of collecting duct ✓</li> <li>g. water moves «through aquaporins» by <u>osmosis</u> into the medulla/blood ✓</li> <li>h. urine becomes more concentrated/smaller volume ✓</li> <li>i. negative feedback occurs ✓</li> <li>j. if blood is hypotonic no ADH is released ✓</li> <li>k. water is not reabsorbed from the collecting ducts/permeability of the collecting duct decreases ✓</li> <li>l. urine becomes more dilute/less concentrated / higher volume ✓</li> </ul>	<p><i>OWTTE for all mp.</i></p> <p><i>OWTTE for negative feedback acceptable.</i></p>	<p><b>8 max</b></p>
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Question		Answers	Notes	Total										
7.	a	<table border="1"> <thead> <tr> <th>DNA</th> <th>RNA</th> </tr> </thead> <tbody> <tr> <td>a. double stranded</td> <td>single stranded ✓</td> </tr> <tr> <td>b. deoxyribose</td> <td>ribose ✓</td> </tr> <tr> <td>c. adenine, guanine, thymine, cytosine <b>OR</b> thymine instead of uracil</td> <td>adenine, guanine, cytosine, uracil <b>OR</b> uracil instead of thymine ✓</td> </tr> <tr> <td>d. «all» helical</td> <td>variety of forms <b>OR</b> mRNA, tRNA and rRNA ✓</td> </tr> </tbody> </table>	DNA	RNA	a. double stranded	single stranded ✓	b. deoxyribose	ribose ✓	c. adenine, guanine, thymine, cytosine <b>OR</b> thymine instead of uracil	adenine, guanine, cytosine, uracil <b>OR</b> uracil instead of thymine ✓	d. «all» helical	variety of forms <b>OR</b> mRNA, tRNA and rRNA ✓	<p><i>A table format is not required but clear distinctions must be apparent.</i></p> <p><i>The full names of the bases must be given.</i></p>	3 max
		DNA	RNA											
		a. double stranded	single stranded ✓											
		b. deoxyribose	ribose ✓											
c. adenine, guanine, thymine, cytosine <b>OR</b> thymine instead of uracil	adenine, guanine, cytosine, uracil <b>OR</b> uracil instead of thymine ✓													
d. «all» helical	variety of forms <b>OR</b> mRNA, tRNA and rRNA ✓													
7.	b	a. some traits may involve many genes/be polygenic eg: height, skin colour «correct example required» ✓	<p><i>Accept any verifiable examples of these types of inheritance.</i></p>	4 max										
		b. linked genes/alleles of different genes on same chromosome ✓												
		c. «small numbers of» recombinant phenotypes due to crossing over «between linked genes» ✓												
		d. co-dominance of specific alleles/intermediate forms eg: pink flowers «from red and white ones»/blood groups «correct example required» ✓												
		e. sex-linked effects eg: colour blindness «correct example required» ✓												
		f. environmental influence on inheritance/epigenetics/methylation ✓												
		g. any other example of non-Mendelian inheritance with a specific example ✓												

(continued...)

(Question 7 continued)

Question		Answers	Notes	Total
7.	c	a. caused by a single nucleotide/base substitution mutation/GAG to GTG ✓ b. «mutation of» a gene of β-globin/a subunit of hemoglobin ✓ c. mRNA copies the mutation of DNA and substitutes an amino acid in hemoglobin «subunit» ✓ d. glutamic acid is substituted by valine ✓ e. sickle cell anemia involves distorted hemoglobin protein/HbS ✓ f. «distorted HbS causes» distortion/sickling/shape change of red blood cells ✓ g. «distorted/sickled red blood cells» block capillaries/blood flow ✓ h. HbS/sickled red blood cells cannot carry enough oxygen «for the body»/leads to fatigue ✓ i. low oxygen concentration seriously affects structure of HbS ✓ j. homozygous «HbS/HbS» state causes severe anemia/death at low oxygen concentrations ✓ k. heterozygous state has less anemia/minor effects/less effect of structure of hemoglobin <b>OR</b> heterozygous state only affected at high altitude/extreme exercise/low levels of oxygen ✓ l. «heterozygous state» provides protection against malaria parasite/selective advantage in malaria areas ✓	OWTTE	8 max



Question		Answers	Notes	Total
8.	a	<p>a. energy from the sun/light energy is converted to chemical energy by photosynthesis ✓</p> <p>b. «chemical» energy flows through the food chains by feeding ✓</p> <p>c. energy is released «from carbon compounds» by respiration <b>OR</b> energy from respiration is used by living organisms and converted to heat ✓</p> <p>d. heat is not recyclable / heat is lost from food chains <b>OR</b> heat cannot be converted to other forms of energy ✓</p> <p>e. energy is lost in excretion/uneaten material/egestion/feces ✓</p> <p>f. energy losses between trophic levels limits the length of food chains <b>OR</b> energy transfer is only 10 % between trophic levels ✓</p>		4 max

(continued...)

(Question 8 continued)

8.	b	<p>a. axes correctly labelled «wavelength and <u>rate</u> of photosynthesis» ✓</p> <p>b. 400 and 700 <u>nm</u> as limits ✓</p> <p>c. correct shape of curve involving two peaks at the correct places, broader in the blue-violet range not starting at zero and a narrower peak in the orange-red range with the trough in the green range that does not reach zero ✓</p> <p>d. peaks of activity at 430 nm <b>AND</b> at 660 nm ✓</p> <p>e. peaks indicated as «violet» blue light AND peak indicated as «orange» red light ✓</p>	<p>Accept <u>rate</u> of oxygen production for <u>rate</u> of photosynthesis.</p>	<p><b>3 max</b></p>
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(continued...)

(Question 8 continued)

Question		Answers	Notes	Total
8.	c	a. Calvin cycle is light-independent ✓ b. carbon fixation <b>OR</b> carboxylation of ribulose bisphosphate/RuBP occurs ✓ c. algae placed in thin glass container/"lollipop" apparatus ✓ d. given plenty of light and bicarbonate/ CO <sub>2</sub> ✓ e. at start of experiment algae supplied radioactive carbon/HCO <sub>3</sub> <sup>-</sup> / <sup>14</sup> C ✓ f. samples taken at intervals / heat/alcohol killed samples ✓ g. C-compounds separated by chromatography ✓ h. <sup>14</sup> C/radioactive-compounds identified by autoradiography ✓ i. showed that RuBP was phosphorylated ✓ j. after five seconds/immediately more glycerate-3-phosphate/3-PGA labelled than any other compound ✓ k. shows glycerate-3-phosphate/3-PGA first «carboxylated» compound/the first stable product ✓ l. next compound to be detected containing radioactive carbon was triose phosphate/G3P/glyceraldehyde 3 phosphate ✓ m. showed that a wide range of carbon compounds was quickly made in sequence ✓ n. showed that a cycle of reactions was used to regenerate RuBP ✓		8 max