Diploma Programme
Programme du diplôme
Programa del Diploma

Mark scheme

May 2019

Biology

Higher level

Paper 2

19 pages

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

(continued…)

(Question 1 continued)

1.	**b**		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**»** ✓ b. C1 produces the least **«**total**»** amount of chemicals of all the treatments ✓ c. C2 has very similar pattern to those caused by the armyworms **«**but in lower quantities**»** ✓ d. **both** herbivores caused a greater production of chemicals/all three chemicals compared to either C1 or C2 ✓ e. armyworms cause the greatest total amount of chemical production of any of the other treatments ✓ f. other valid comparison of chemical effect versus herbivore effect ✓	*Clear comparison required between herbivore infestation and chemical treatment not simple lists of values.* *OWTTE* *OWTTE*	**3 max**
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**		a. herbivorous mites induce activation of gene 2 first «at 1 hour» **and** then also gene 1 and gene 3 «at 24 hours» ***OR*** herbivorous mite «infestation» is the only treatment to affect all three genes/leads to greater gene expression overall ✓ b. gene 2 activation similar for mite and C1 «at both 1 and 24 hours» ✓ c. gene 3 activation similar for mite and C2 «both at 24 hours» ✓ d. gene 1 activation slower for mite compared to C2 **but** more intense (than C2 at 24 hours) ✓ e. gene 1 and gene 3 expressed in higher amounts «after 24 hours» in mite infestation compared to C2 ✓	*Both parts OWTTE required for mpd.*	**3 max**
1.	**f**		a. the greater «gene expression» response of the lima bean plant to the mite infestation indicates a longer evolutionary relationship ✓ b. herbivorous mites cause more genes to be expressed/higher intensity of gene activation ✓ c. herbivorous mites cause a more immediate/earlier response in gene activation ✓	*OWTTE.*	**2 max**

2.	**a**	**i**	telophase because the chromosomes/chromatids have reached the poles ***OR*** **«**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 ✓	*Do not accept stop codon, accept centromeres (connecting sister chromatids).*	**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**		a. FSH/follicle stimulating hormone stimulates the development of follicles/follicle cell division in the ovary **«**to produce eggs**»** ✓ b. LH/luteinizing hormone triggers ovulation/development of the corpus luteum ✓ c. estrogen stimulates development of the uterine lining/endometrium ✓ d. progesterone maintains the uterine lining/endometrium ***OR*** inhibits other hormones by negative feedback *eg*, FSH ✓ e. HCG stimulates ovary to produce progesterone **«**in early pregnancy**»** ✓ f. other verifiable hormone and roles relevant to the menstrual cycle ✓	*Two different hormones must be identified.* *Description of role required as well as name of hormone.*	**2 max**

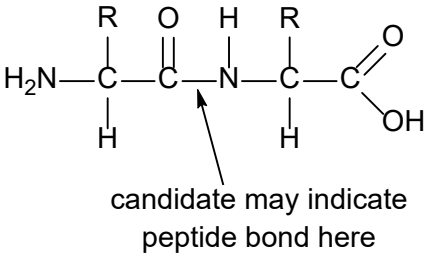
4.	**a**		X: Filicinophyta ✓ Y: Coniferophyta/Conifera/Gymnosperms ✓		**2**
4.	**b**		a. **«**previous**»** classification used to be based on the appearance/structures of the plant/leaves/flowers/seeds/analogy/phenotype ✓ b. **«**modern cladistics uses**»** RNA/DNA nucleotide/base sequencing/amino acid 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 ***OR*** the fewer the differences **«**in sequences**»** means the closer the relationship ✓		**3 max**
4.	**c**		*pollination*: transfer/dispersal/movement of <u>pollen</u> from anther/stamen to <u>stigma</u> ***OR*** transfer/dispersal/movement of <u>pollen</u> between plants/flowers prior to/allowing <u>fertilization</u> ✓ *seed dispersal*: **«**strategy of**»** distribution of seeds so that new plants have space/nutrients to develop/avoid competition/colonize new habitats ✓	*Accept any other valid role.* *Accept OWTTE. Answers must be about the role.*	**2**

Question				Answers	Notes	Total
5.	a			a. «cell» respiration/loss of CO_2/biomass consumed to provide/as a source of energy ✓ b. loss of energy «as heat» between trophic levels means less energy available for building biomass ✓ c. waste products «other than CO_2»/loss of urea/feces/egesta ✓ d. material used/CO_2 released by saprotrophs ✓ e. undigested/uneaten material «teeth, bones, etc»/detritus buried/not consumed ***OR*** formation of peat/fossils/limestone ✓		**2**
	b.			a. increased CO_2 flux to the atmosphere due to increased burning of fossil fuels by industry/transportation / cement production ✓ b. «land use change leading to» decreased rate of forest burning ***OR*** better fire suppression leading to decrease in CO_2 release ***OR*** example of land use changes that uses less fossil fuel ***OR*** increase in land covered by forests/plants / forests recovering from historical forestry ***OR*** any other reasonable explanation of land use change that would lead to decreased rate of carbon flow to atmosphere ✓ c. carbon storage in land decreased as less photosynthesis due to fewer forests/more construction ***OR*** release of methane due to «drying of» wetlands/sealing of land with concrete/buildings/roads ✓ d. carbon storage in ocean increased due to more photosynthesis/algae/greater concentration of CO_2 in the atmosphere ***OR*** increased diffusion/rate of dissolving of CO_2 into ocean from the atmosphere ***OR*** limestone/carbonate accumulation «more snails» ✓		**3 max**

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

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
6.	**b**				
			a. two amino acids, one with NH_2/NH_3^+ end and one with COOH/COO^- end ✓	*Labels not required for amino group and carboxyl group.*	**3**
			b. peptide bond between C=0 and N—H correctly drawn ✓		
			c. «chiral» C with H and R group on each amino acid ✓		
			d. peptide bond labelled/clearly indicated between C terminal of one amino acid and N terminal of the second amino acid ✓		

(continued…)

(Question 6 continued)

6.	**c**		a. ADH plays a role in osmoregulation/regulating blood solute concentration ✓ b. acts on the collecting ducts of the kidney ✓ c. acts in «late» distal convoluted tubule ✓ d. <u>hypothalamus</u> detects plasma/blood osmolarity/solute concentration ✓ e. if plasma/blood is too concentrated/hypertonic, «posterior» <u>pituitary</u> releases ADH ✓ f. ADH stimulates insertion of aquaporins/water channels / increases permeability of collecting duct ✓ g. water moves «through aquaporins» by <u>osmosis</u> into the medulla/blood ✓ h. urine becomes more concentrated/smaller volume ✓ i. negative feedback occurs ✓ j. if blood is hypotonic no ADH is released ✓ k. water is not reabsorbed from the collecting ducts/permeability of the collecting duct decreases ✓ l. urine becomes more dilute/less concentrated / higher volume ✓	*OWTTE for all mp.* *OWTTE for negative feedback acceptable.*	**8 max**

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>7.</td><td>a</td><td></td><td>
<table>
<tr><th>DNA</th><th>RNA</th></tr>
<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
OR
thymine instead of uracil</td><td>adenine, guanine, cytosine, uracil
OR
uracil instead of thymine ✓</td></tr>
<tr><td>d. «all» helical</td><td>variety of forms
OR
mRNA, tRNA and rRNA ✓</td></tr>
</table>
</td><td>A table format is not required but clear distinctions must be apparent.

The full names of the bases must be given.</td><td>3 max</td></tr>
<tr><td>7.</td><td>b</td><td></td><td>a. some traits may involve many genes/be polygenic eg: height, skin colour «correct example required» ✓
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-Mendelien inheritance with a specific example ✓</td><td>Accept any verifiable examples of these types of inheritance.</td><td>4 max</td></tr>
</table>

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

(continued…)

(Question 8 continued)

8.	**b**		a. axes correctly labelled «wavelength and rate of photosynthesis» ✓ b. 400 and 700 nm as limits ✓ 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 ✓ d. peaks of activity at 430 nm ***AND*** at 660 nm ✓ e. peaks indicated as «violet» blue light AND peak indicated as «orange» red light ✓	*Accept rate of oxygen production for rate of photosynthesis.*	**3 max**

(continued…)

(Question 8 continued)

Question			Answers	Notes	Total
8.	**c**		a. Calvin cycle is light-independent ✓ b. carbon fixation ***OR*** carboxylation of ribulose bisphosphate/RuBP occurs ✓ c. algae placed in thin glass container/"lollipop" apparatus ✓ d. given plenty of light and bicarbonate/ CO_2 ✓ e. at start of experiment algae supplied radioactive carbon/HCO_3^-/^{14}C ✓ f. samples taken at intervals / heat/alcohol killed samples ✓ g. C-compounds separated by chromatography ✓ h. ^{14}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**