Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2018

Biology

Higher level

Paper 2

14 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	i	«130 – 85» = 45 «mm^2» ✓	*Allow answers in the range of 40 to 50 «mm^2»*	1
1.	a	ii	a. S1/S2 is longer in short day plants ***OR*** the stages in long day plants are more variable in length ✓ b. leaves of plants grown in long day reach S2 / S3 /S4 stages sooner ***OR*** S1/S2/S3 completed earlier in plants grown in long days ✓ c. leaves of plants grown in long day reach S1 later than plants grown in short days ✓	*Accept vice versa.*	2 max
1.	b		a. rosette of plant grown in long day has fewer leaves ✓ b. rosette leaf number of plant grown in long day plateaus/stays constant while the number continues to increase for plants grown in short days ✓	*Accept vice versa.* *OWTTE.*	2 max
1.	c		a. lower starch levels at end of night <u>in all stages</u> ✓ b. lower starch levels at end of night in both plants grown in short day and long days;; c. no evidence that starch is being used for respiration ***OR*** starch may have been exported/stored in other tissues/example tissue «rather than used in respiration» ✓		2 max

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**d**	**i**	higher in plants grown in short days in S1 and higher in plants grown in long days for all other stages/S2, S3 and S4 ✓	*Candidates must mention all stages for the mark.*	**1**
1.	**d**	**ii**	a. leaves in plants grown in long day receive longer period of light / more leaf surface area so more photosynthesis occurs resulting in more starch ✓ b. plants in short days using starch to produce more leaves/for growth/S2 a period of rapid increase in number of leaves ✓	*Accept vice versa.* *Accept vice versa.*	**2**
1.	**e**		a. **«**mRNA**»** transcripts differ in plants grown in long days and short days ✓ b. indicates different genes are being expressed ✓ c. plants adapt to different daylight regimes by altering gene expression ✓ d. short day length causes struggle to get enough light to photosynthesize and more **«**mRNA**»** transcripts related to photosynthesis ***OR*** plants produce large leaves rapidly when grown in long days which may result in more transcripts for biotic stress ✓	*Accept an example of such a transcript from the bar chart* *Accept other valid reason.*	**3 max**
1.	**f**		a. long day plant ✓ b. flowering hormone metabolism gene over represented in long day exposure c. fewer leaves produced **«**rapidly**»** by plant in long day as energy shifted to flower formation ✓ d. plants grown in short days produce more leaves over longer period before beginning to flower/need to use light more efficiently to photosynthesize ✓	*Accept other valid reasons from the data* *Allow ECF if student indicates short day plant.*	**2 max**

Question			Answers	Notes	Total
2.	a		a. I. cytosine ✓ (NOT simply Nitrogenous base) b. II. sugar-phosphate/covalent/phosphodiester bond ✓ c. III. phosphate ✓ (NOT phosphorus) d. IV. deoxyribose ✓ (NOT pentose sugar)	*Award **[1]** for any **two** correct responses.*	**2 max**
2.	b	i	a. help to supercoil/pack DNA in chromosomes ✓ b. help to regulate transcription / gene expression ✓		**1 max**
2.	b	ii	a. experiment is meant to determine whether DNA or protein is the genetic material ✓ b. viruses/bacteriophages grown in radioactive S/S^{35} which enters the protein coat ✓ c. viruses/bacteriophages grown in radioactive P/P^{32} which enters the DNA ✓ d. **«**radioactive**»** viral DNA entered the bacterial cell during infection ***OR*** **«**radioactive**»** viral protein did not enter the bacterial cell during infection ✓		**3 max**
2.	b	iii	regulator of gene expression/introns/telomeres/genes for tRNA / rRNA / promoter / enhancer / silencer / site for primer to bind / codes for mRNA primer ✓		**1**
2.	c	i	binding/entry of tRNA carrying amino acids/aminoacyl tRNA / charged tRNA / site of transfer of growing polypeptide chains/peptide bond formation ✓	*Marks can be awarded to an annotated diagram.*	**1**
2.	c	ii	a. ATP **«**hydrolysis**»** provides energy for amino acid attachment ✓ b. they attach a specific amino acid to the (3') end / free CCA of a tRNA ✓ c. they do this repeatedly / they attach amino acid to all of the tRNA molecules that have anticodon corresponding to that amino acid ✓		**2 max**

Question			Answers	Notes	Total
3.	**a**	**i**	a. anaphase <u>II</u> ✓ b. as four daughter cells are being formed ***OR*** the centromeres split / sister chromatids separate ***OR*** sister chromatids/ chromosomes are pulled **«**by the spindle microtubules**»** to opposite poles ✓		**2**
3.	**a**	**ii**	a. two **«**or more**»** traits/genes are inherited independently of one another ✓ b. observed for traits/genes that are not linked/far apart on the chromosome ✓ c. **«**due to homologous**»** chromosomes aligning independently/randomly on equator during metaphase I/meiosis I ✓ d. during anaphase I homologues pulled to separate poles ✓	*Accept vice versa.* *Can be shown in annotated diagram.*	**2 max**
3.	**b**		a. correct parental genotypes shown / Ff ii, $FfI^A I^B$ ✓ b. Punnett square with correct gametes shown ✓ c. correct probability: $\frac{1}{8}$ ***OR*** 12.5% ✓	*Must use blood type symbols I^B I^A and i.* *No specific letters required to represent cystic fibrosis allele though dominant and recessive must be apparent.*	**3**

Question			Answers	Notes	Total
4.	a		a. secondary structure includes alpha helices/beta pleated sheets ✓ b. secondary structure «of this protein» consists «mainly» of alpha helices ✓ c. spiral coils «of polypeptide chain» held together by hydrogen bonds ✓ d. between oxygen «C=O» and hydrogen atoms «N–H» of amino acids «on backbone» ✓ e. «some» beta pleated sheets present in this protein ✓		**3 max**
4.	b	i	salivary glands ***AND*** pancreas ✓	*Both needed.*	**1**
4.	b	ii	breaks down starch «by hydrolysis» into maltose/disaccharides ✓		**1**
4.	c		a. enzymes work by forming enzyme-substrate complexes ✓ b. binding of substrate«s» to active site «of enzyme» ✓ c. «enzyme» changes shape slightly ***OR*** puts strains on chemical bonds «of substrate» ✓ d. decreases activation energy / increases rate of reaction ✓ e. enzymes bind to specific substrates ✓	*Can show these points in an annotated diagram.*	**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
5.	**a**		a. early evidence showed membranes are partially permeable ***AND*** organic solvents penetrate faster than water ✓ b. suggests they have non-polar regions ✓ c. chemical analysis showed membranes consist mainly of proteins and lipids ✓ d. layer of phospholipids spread over water, orientate themselves into monolayer with nonpolar/hydrophobic tails out of water and polar/hydrophilic heads in water surface ✓ e. when shaken with water form micelles/particles with tails inwards away from water ✓ f. Davson–Danielli model proposed phospholipid bilayer coated with protein molecules on both surfaces ✓ g. evidence from electron microscopy **«**supported Davson–Danielli model**»** ✓ h. three-layered structure/ sandwich/railway tracks/two dark bands with a light band between ✓ i. model could not account for hydrophobic proteins / artifacts due to low resolution ✓ j fluorescent labelling / freeze fracturing later used to investigate membrane structure ✓ k. led to Singer-Nicholson / fluid mosaic model of protein molecules floating in fluid lipid bilayer ✓ l. shows particles/proteins project partially and sometimes right through lipid bilayer ✓ m. indicates peripheral and integral proteins present ✓	*Accept any of the points clearly explained in an annotated diagram.*	**8 max**

(continued…)

(Question 5 continued)

Question			Answers	Notes	Total
5.	**b**		a. (simple diffusion) of nutrients along/down a concentration gradient ✓ b. example of simple diffusion *eg* fatty acids ✓ c. facilitated diffusion of nutrients involves movement through channel proteins ✓ d. example of nutrient diffusion *eg* fructose ✓ e. active transport of nutrients against a concentration gradient / involving protein pumps ✓ f. example of active transport, *eg* (iron) ions/glucose/amino acids ✓ g. endocytosis / by means of vesicles ✓ h. example of nutrient for endocytosis, *eg* cholesterol in lipoprotein particles ✓		**4 max**
5.	**c**		a. active transport/loading of sucrose/amino acids/organic metabolites ✓ b. sucrose moves by apoplastic / symplastic routes ✓ c. **«**loading**»** at source into companion cells **«**of sieve tubes**»** ✓ d. movement **«**of sucrose**»** through plasmodesmata ✓ e. high concentration of solutes in phloem leads to water movement by osmosis ✓		**3 max**

*(Plus up to **[1]** for quality)*

Question			Answers	Notes	Total
6.	a		a. «cell» respiration is the «controlled» release of energy from organic compounds to produce ATP ✓ b. «cell respiration» involves the oxidation and reduction of electron carriers ✓ c. in link reaction pyruvate is converted into acetyl coenzyme A, CO_2 is released and NAD is reduced ✓ d. in the Krebs cycle, a 4 C molecule combines with acetyl CoA ✓ e. decarboxylation releases 2 CO_2 molecules for each pyruvate / conversion of 6C to 5C/5C to 4C releases CO2 ✓ f. «3» reduced NAD and «1» reduced FAD are produced ✓ g. ATP generated in the Krebs cycle ✓ h. reduced molecules/FAD/NAD are carried to the cristae/inner membrane of the mitochondria ✓ i. transfer of electrons between carriers in the electron transport chain in the membrane of the cristae is coupled to proton pumping ✓ j. protons accumulate in intermembrane space/ between cristae/inner membrane and outer membrane ***OR*** proton / electrochemical gradient between intermembrane space and matrix is established ✓ k. protons diffuse through ATP synthase to generate ATP ✓ l. chemiosmosis is the use of a proton/electrochemical gradient to generate ATP ✓ m. oxygen is the final electron acceptor ✓	*Accept any of the points in a correctly annotated diagram.*	**8 max**

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
6.	**b**		a. ventilation is exchange of gases between lungs and air ✓ b. during inhalation diaphragm contracts ***AND*** lowers ✓ c. external intercostal muscles contract, raising ribs upwards and outwards ✓ d. increase in volume ***AND*** decrease in pressure within thoracic cavity ✓ e. air drawn into alveoli bringing fresh supply of oxygen ✓ f. oxygen concentration in alveolar sacs is higher than in blood capillaries ✓ g. **«**oxygen concentration gradient**»** causes oxygen to diffuse out of alveoli into red blood cells in capillaries ✓	*Both needed.*	**4 max**
6.	**c**		a. pyramid of energy has stepped shape with largest bottom step being producers, then first consumer, second consumer, *etc* ✓ b. light energy **«**from sun**»** converted to chemical energy in carbon compounds by photosynthesis ✓ c. energy released by respiration is used in living organisms ***AND*** converted to heat ✓ d. heat **«**energy**»** is lost from ecosystems ✓ e. approximately 10 % of energy in trophic level converted into new material for next level ✓ f. energy also lost as undigested material/uneaten material/feces/excretion ✓		**3 max**

*(Plus up to **[1]** for quality)*

Question			Answers	Notes	Total
7.	a		a. specific immune response/antibody production as a consequence of the presence of bacterial antigens ✓ b. macrophage / phagocyte ingests bacterial pathogen displaying bacterial antigens on surface ✓ c. attached to major histocompatibility/MHC molecules ✓ d. helper T cell activated by presentation of antigen on surface of macrophage ✓ e. activated helper T cell binds to B cell specific to the antigen ✓ f. stimulated B cell undergoes repeated mitotic/cell divisions ✓ g. «cells enlarge and differentiate» to form clone of plasma cells ✓ h. plasma cells produce specific antibodies ✓ i. antibodies bind to bacteria making them easier to digest by white cells ***OR*** opsonization ***OR*** agglutination ✓ j. (some antibodies combined with antigen) activate a complement cascade to kill bacteria directly ✓ k. some antibodies act as antitoxins / neutralize toxins / change chemical structure of toxins ✓ l. once begun, antibody production lasts for several days until all antigens destroyed ✓ m. memory cells remain in blood giving extended immunity ✓	*OWTTE.*	**8 max**

(continued…)

(Question 7 continued)

Question			Answers	Notes	Total
7.	**b**		a. problem results from excessive use of antibiotics by doctors/veterinarians/in livestock ***OR*** low antibiotic doses taken by patients (not finishing treatment) ✓ b. natural variation exists in any population of bacteria making some resistant to a specific antibiotic ✓ c. variation arises from mutation ***OR*** antibiotic resistance can be transferred between bacteria by plasmids ✓ d. antibiotic kills most bacteria except those that are resistant ✓ e. resistant bacteria survive, reproduce and pass on resistance to offspring ✓ f. soon population is made of mainly antibiotic resistant bacteria ✓ g. this is an example of natural selection **«**increasing frequency of characteristics that make individuals better adapted to environment**»** ✓		**4 max**
7.	**c**		a. decomposition of dead organic material **«**by saprotrophic bacteria**»** ✓ b. **«**decomposition**»** leads to CO_2 formation/regeneration due to respiration ✓ c. **«**saprotrophic bacteria only**»** partially decompose dead organic matter in acidic/anaerobic conditions in waterlogged soil ✓ d. results in peat formation in bogs/swamps ✓ e. photosynthetic bacteria/cyanobacteria fix CO_2 in photosynthesis ✓		**3 max**

*(Plus up to **[1]** for quality)*