Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2019

Biology

Higher level

Paper 2

22 pages

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		week 34 ***AND*** 2014 ✓	*both needed*	1
1.	b		a. start of epidemic/first cases in rural areas ***OR*** epidemic spread to suburbs later ✓ b. higher maximum number of cases/greater increase in rural areas ***OR*** converse for suburbs ✓ c. increase came earlier in rural areas «than suburbs» ***OR*** number of cases peaked earlier in rural areas ***OR*** more cases in rural areas «than suburbs» in 2014 ✓ d. decrease came earlier in rural areas «than suburbs» ***OR*** decreasing in rural areas but not in suburbs in 2015/by end of study period ***OR*** more cases in suburbs than rural areas in 2015 ✓ e. «large» fluctuations in both ✓		3 max

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**c**		a. «overall decline due to» fewer cases in rural areas ✓ *Answers relating to people who died from the disease or develop immunity to it:* b. fewer cases due to deaths of people who had the disease/people recovering ***OR*** more people vaccinated/became immune/made antibodies/were not vulnerable to infection ✓ *Answers relating to health care workers or availability of resources:* c. more doctors/nurses/medical equipment/treatment centers/hospitals/spending/aid/NGOs ✓ *Answers relating to medical techniques used to tackle the epidemic:* d. better treatments/infection control/hygiene/quarantine/new vaccine/new antiviral drugs ✓ *Answers relating to the public and patients:* e. education/better awareness/avoidance of infection/taking precautions/vaccination accepted ✓ *Answers relating to reservoirs of infection:* f. fewer infected people «who could spread infection»/fewer bats/less contact with bats ✓		**2 max**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**d**		*differences*: a. Conakry has more cases than any of the suburbs ***OR*** more cases in total in the suburbs than in Conakry ✓ b. more male cases in Conakry whereas more female cases in suburbs ✓ c. higher **«**% of**»** fatal cases at Ebola treatment centers in suburbs than in Conakry ✓ *similarity:* d. in both Conakry and suburbs **«**% of**»** fatal cases in treatment centers is higher than outside ✓		**2 max**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**e**		a. most serious cases are in/are taken to treatment centers ***OR*** treatment centers are set up where there are most cases/most serious cases ✓ b. long time/distance to travel between contracting disease and arrival at treatment center ***OR*** travel to treatment center weakens/upsets/harms the patient ✓ c. Ebola is a virulent disease/Ebola virus mutated «to become virulent» ***OR*** little known about Ebola/new disease so treatments not yet developed ✓ d. no/not enough vaccine/antiviral drug available «in 2014/15» ***OR*** antibiotics do not work against viral diseases ✓ e. secondary infections/Ebola patients infected with other diseases/other Ebola strains ***OR*** ineffective hygiene/cleaning/sterilization/use of contaminated equipment/disposal of corpses ✓ f. small number of staff relative to patients/treatment centers overcrowded/swamped with patients ***OR*** insufficient equipment/supplies for large number of patients/with the rapid rise in patients ✓ g. better reporting at Ebola centers/deaths due to Ebola not reported in rural areas ✓		**3 max**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**f**		a. cells not killed/few cells killed **«**even at high concentrations**»** ✓ b. **«**T-705**»** effective/viruses reduced/viruses killed at 100 µM ***OR*** **«**T-705**»** very effective/viruses much reduced/nearly all viruses killed at 1000 µM ✓ c. virus concentration decreases as T-705 concentration increases ✓ d. drug has **«**high**»** potential for treatment **«**at high enough concentration**»** ✓		**2 max**
1.	**g**		a. <u>vaccine</u> contains Ebola <u>antigens</u> ✓ b. vaccine **«**could**»** contain weakened/attenuated/dead/killed form of **«**Ebola**»** virus/virus genetically modified to express an Ebola/viral protein ✓ c. phagocyte/macrophage engulfs the antigen/presents the antigen to T cell ✓ d. antigen recognized by **«**specific**»** T cells/binds to T cells ✓ e. **«**activated**»** T cells activate **«**specific) B cells ✓ f. **«**activated**»** B cells make the <u>antibodies</u> **«**against Ebola**»** ✓ g. B cells divide forming **«**clone of**»** plasma cells/producing more B cells specific to Ebola ✓		**3 max**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**h**		a. poor transport infrastructure/poor communication/bad roads/difficult access/no maps/support slow arriving/scattered population ✓ b. poor education/understanding of disease amongst health workers/local population ***OR*** continued contact with infected people / other example of unsafe actions ✓ c. more sources of infection such as bats/difficult to find sources of infection ✓ d. lack of/limited access to medical care/doctors/health care workers ✓ e. lack of/no access to/unaffordability of treatment centers/medical supplies/equipment/antivirals/drugs/vaccine/treatments ✓ f. refusal/reluctance in local population to be vaccinated ***OR*** difficult to find/reach everyone to vaccinate them/repeat the vaccination ✓ g. migration of people spreads the infection ✓ h. poor sanitation/lack of clean water ✓		**2 max**

Question			Answers	Notes	Total
2	a		a. prokaryotes have circular DNA/chromosome but eukaryote chromosomes linear/*OWTTE* ✓ ***OR*** eukaryotes have telomeres/centromeres whereas prokaryotes do not ✓ b. some prokaryotes have plasmids whereas eukaryotes do not ✓ c. eukaryotes have multiple chromosomes whereas prokaryotes **«**typically**»** have only one ✓ d. histones/nucleosomes/proteins associated with DNA in eukaryotes but not in prokaryotes/naked DNA in prokaryotes ***OR*** eukaryote DNA can coil/supercoil/condense **«**due to histones**»** but not prokaryote DNA ✓		**2 max**
2.	b		a. genetic disease/caused by a gene ***OR*** inherited **«**from parents**»** ***OR*** caused by mutation **«**of a gene**»** ✓ b. base <u>substitution</u> ***OR*** GAG → GTG ✓ c. hemoglobin gene mutated / different allele/form/version of hemoglobin gene ***OR*** $Hb^A \rightarrow Hb^S$ ✓ d. leads to change in amino acid sequence **«**in hemoglobin**»** ***OR*** glutamic acid → valine ✓ e. only homozygotes have full disease/sickled cells / heterozygote has milder form ***OR*** hemoglobin crystallizes at low oxygen concentration ✓ f. **«**selected for/spreads in population**»** as it gives resistance to malaria ✓		**2 max**

(continued…)

(Question 2 continued)

Question			Answers	Notes	Total
2.	**c**	**i**	male because **«**X and**»** Y chromosome present ***OR*** male because sex chromosomes/last two chromosomes/pair 21 are unpaired/different **«**from each other**»**/not homologous ✓	*The answer must include "male" and the reason.*	**1 max**
2.	**c**	**ii**	21		**1**
2.	**d**	**i**	*Heterozygous offspring* **«***grey body, normal wings***»** b+ | | b vg+ | | vg ***OR*** *$b^+b\ vg^+vg$* ***OR*** *$b^+vg^+\ b\ vg$* ✓ *Homozygous recessive parent* **«***black body, vestigial wings***»** b | | b vg | | vg ***OR*** *bb vgvg* ***OR*** *bvg bvg* ✓		**2**

(continued…)

(Question 2 continued)

Question			Answers	Notes	Total
2.	**d**	**ii**	a. not a 1:1:1:1 ratio **«**because of linkage**»** ***OR*** not independent assortment ***OR*** grey normal and black vestigial types/parental combinations/double dominant and double recessive were commoner than 25 %/commoner than expected ✓ b. **«**linked genes**»** so were on the same chromosome ✓ c. grey body vestigial wing and black body normal wing are recombinants ***OR*** 2 % plus 3 % of the offspring are recombinants ✓ d. recombinants due to crossing over/exchange of genes between **«**non-sister**»** chromatids ***OR*** 2 % and 3 % of offspring were due to crossing over ***OR*** genes inherited together unless separated by crossing over ✓ e. crossing over between the two loci/between the two genes on the chromosomes ✓ f. few recombinants/not much crossing over because genes/gene loci close together ✓	*Accept any of these points from an annotated diagram.*	**2 max**

Question			Answers	Notes	Total
3.	a		*differences* a. prokaryote has cell wall but mitochondrion does not ✓ b. mitochondrion has double membrane whereas prokaryote has single membrane ***OR*** **«**Gram negative**»** bacteria have cell wall between two membranes whereas mitochondria has intermembrane space between two membranes ✓ c. mitochondrion has cristae/invaginations of inner membrane but prokaryote does not ***OR*** prokaryote **«**may have**»** flagella/pili/**«**slime**»** capsule which mitochondria do not have ✓ *similarities* d. 70S ribosomes in both ✓ e. DNA in both / loop of DNA in both / naked DNA in both ✓ f. shape similar/both rod shaped/*OWTTE* ***OR*** size of both is similar/both about 3 μm long ✓ g. both are membrane-bound/*OWTTE* ✓		**4 max**

(continued…)

(Question 3 continued)

Question			Answers	Notes	Total
3.	**b**		a. endocytosis/engulfing of prokaryote by a larger/another/anaerobic prokaryote/cell ✓ b. double membrane of the mitochondrion is the result of endocytosis ***OR*** inner membrane of mitochondrion from engulfed cell and outer from food vacuole ✓ c. **«**engulfed prokaryotic cell**»** was aerobic/respired aerobically/consumed oxygen ***OR*** **«**engulfed prokaryotic cell**»** provided energy/ATP ✓ d. **«**engulfed prokaryotic cell**»** not destroyed/not digested ***OR*** **«**endo**»**symbiotic/mutualistic relationship developed ✓ e. **«**engulfed prokaryotic cell**»** had its own DNA/own **«**70S**»** ribosomes ✓	*Do not award mpc for "mitochondrion makes ATP".*	**2 max**

4.	**a**		a. plasma membrane in phloem/sieve tubes but not in xylem/vessels ***OR*** xylem/vessels dead/acellular and phloem/sieve tubes alive ✓ b. xylem vessels have thicker walls **«**than phloem**»** ✓ c. xylem **«**vessel**»** walls are lignified **«**but phloem walls are not**»** ✓ d. phloem vessels have sieve plates **«**whereas xylem vessels have no cross walls**»** ✓ e. xylem/vessels are wider/larger than phloem/sieve tubes ✓ f. companion cells in phloem **«**but not in xylem**»** ✓		**2 max**

(continued…)

(Question 4 continued)

Question			Answers	Notes	Total
4.	**b**		a. water is polar/a dipole/oxygen slightly negative and hydrogen slightly positive ✓ b. polarity results in hydrogen bonds/attraction between water molecules ✓ c. hydrogen bonding/polarity causes cohesion of water **«**molecules**»** ✓ d. cohesion/hydrogen bonding allows water to withstand tension/withstand low pressure/be pulled **«**upwards**»**/moved against gravity ✓ e. cohesion/hydrogen bonding prevents column of water **«**in xylem**»** from breaking/column of water is maintained ✓ f. adhesion of water to xylem/vessel walls **«**due to hydrogen bonds**»** ✓		**2 max**
4.	**c**		a. chains of glucose/1-4 glycosidic linkages/covalent bonding between glucose ✓ b. beta glucose so alternating orientation of glucose units ***OR*** beta glucose forms straight chains ✓ c. forms microfibrils/long and thin/thin fibres/parallel bundles of cellulose molecules ***OR*** hydrogen bonding/cross linkage between cellulose molecules holds them together ✓ d. high tensile strength/rigid/doesn't stretch so provides support/allows turgidity ✓		**2 max**

Section B

Question			Answers	Notes	Total
5.	**a**		**Outline the functions of rough endoplasmic reticulum and Golgi apparatus.**		
			a. ribosomes on RER synthesize/produce polypeptides/proteins ✓ b. proteins from RER for secretion/export/use outside cell/for lysosomes ✓ c. Golgi alters/modifies proteins/example of modification ✓ d. vesicles budded off Golgi transport proteins «to plasma membrane» ***OR*** exocytosis/secretion of proteins in vesicles from the Golgi ✓	*Accept "for use inside and outside the cell" for mpb.*	**3 max**
5.	**b**		**Outline the control of metabolism by end-product inhibition.**		
			a. metabolism is chains/web of enzyme-catalyzed reactions ***OR*** metabolic pathway is a chain of enzyme-catalyzed reactions ✓ b. end product/inhibitor is final product of chain/pathway ✓ c. inhibits/binds to/blocks the first enzyme in chain/pathway ✓ d. non-competitive inhibition ✓ e. end-product/inhibitor binds to an allosteric site/site away from the active site ✓ f. changes the shape of the active site/affinity of the active site «for the substrate» ✓ g. prevents intermediates from building up ***OR*** prevents formation of excess «end» product/stops production when there is enough ***OR*** whole metabolic pathway can be switched off ✓ h. negative feedback ✓ i. binding of the end product/inhibitor is reversible ***OR*** pathway restarts if end product/inhibitor detaches/if end product concentration is low ✓ j. isoleucine inhibits/slows «activity of first enzyme in» threonine to isoleucine pathway ✓	*Allow mark points shown in clearly annotated diagrams.* *To gain mpd, mpe and mpf the answer must be in the context of end-product inhibition, not enzyme inhibition generally.*	**5 max**

Question			Answers	Notes	Total
5.	**c**		**Explain how hydrophobic and hydrophilic properties contribute to the arrangement of molecules in a membrane.**		
			a. hydrophilic is attracted to/soluble in water and hydrophobic not attracted/insoluble ✓ b. hydrophilic phosphate/head and hydrophobic hydrocarbon/tail in <u>phospholipids</u> ✓ c. <u>phospholipid bilayer</u> in water/in membranes ✓ d. hydrophilic heads **«**of phospholipids**»** face outwards/are on surface ✓ e. hydrophobic tails **«**of phospholipids**»** face inwards/are inside/are in core ✓ f. cholesterol is **«**mainly**»** hydrophobic/amphipathic so is located among phospholipids/in hydrophobic region of membrane ✓ g. some amino acids are hydrophilic and some are hydrophobic ✓ h. hydrophobic **«**amino acids/regions of**»** proteins in phospholipid bilayer **«**core**»** ✓ i. hydrophilic **«**amino acids/regions of**»** proteins are on the membrane surface ✓ j. <u>integral proteins</u> are embedded in membranes due to hydrophobic properties/region ***OR*** <u>transmembrane</u> proteins have a hydrophobic middle region and hydrophilic ends ✓ k. <u>peripheral proteins</u> on are on the membrane surface/among phosphate heads due to being **«**entirely**»** hydrophilic ***OR*** **«**carbohydrate**»** part of <u>glycoproteins</u> is hydrophilic so is outside the membrane ✓ l. pore of <u>channel proteins</u> is hydrophilic ✓	*Allow mark points shown in clearly annotated diagram.* *In any part of the answer, accept polar instead of hydrophilic and non-polar or apolar instead of hydrophobic.*	**7 max**

*(Plus up to **[1]** for quality: 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**		**Outline the process of inspiration in humans.**		
			a. diaphragm and external intercostal muscles contract ✓ b. diaphragm moves down/becomes flatter ***OR*** external intercostals raise the ribcage/move the ribcage up/out ✓ c. muscles/diaphragm/intercostals increase volume of thorax/expand the thorax ***OR*** muscles/diaphragm/intercostals decrease pressure in the thorax ✓ d. as volume «of thorax/lungs» increases the pressure decreases ✓ e. air enters «lungs» due to decreased pressure/higher pressure outside body ✓ f. air flows to lungs through trachea and bronchi/bronchioles ✓	*Accept thoracic cavity or chest cavity in place of thorax in any part of the answer.* *Do not allow "oxygen" instead of air in mpe or mpf.*	**4 max**
6.	**b**		**Describe the functions of valves in the mammalian heart.**		
			a. prevents backflow/ensures one-way flow/controls direction of flow ✓ b. open valves allow blood to flow through ***OR*** opening and closing of valves controls timing of blood flow «during cardiac cycle» ✓ c. closed «semilunar» valves allow ventricles/chambers to fill with blood ***OR*** closed «semilunar» valves allow pressure in ventricles to rise «rapidly» ✓ d. valves open when pressure is higher upstream/*OWTTE*/converse for closed valves ✓ e. AV/bicuspid/tricuspid/mitral valves prevent backflow from ventricle to atrium ***OR*** AV/bicuspid/tricuspid/mitral valves open when pressure in atrium is higher «than in the ventricle»/when atrium is pumping/contracting ✓ f. semilunar/aortic/pulmonary valves prevent backflow from artery to ventricle ***OR*** semilunar/aortic/pulmonary valves open when pressure in ventricle is higher «than in the artery»/when ventricle is pumping/contracting ✓	*Allow mpa, mpb, mpc or mpd if the point is made through the example of one specific valve.*	**4 max**

(Question 6 continued)

Question			Answers	Notes	Total
6.	**c**		**Explain how blood solute concentrations are kept within narrow limits in the human body.**		
			a. solute concentration of blood monitored by the brain/hypothalamus ✓ b. pituitary gland secretes ADH ✓ c. ADH secreted when solute concentration/osmolarity is too high/a person is dehydrated/*OWTTE* ✓ d. collecting duct more permeable to water ✓ e. **«**more**»** aquaporins/opens aquaporins **«**in the plasma membrane of collecting duct cells**»** ✓ f. **«**more**»** water reabsorbed **«**into the medulla**»** ✓ g. medulla is hypertonic/hyperosmotic **«**so water can be reabsorbed from filtrate**»** ✓ h. small volume of urine/concentrated urine produced **«**with ADH**»** ✓ i. no/little/less ADH secreted if **«**blood**»** solute concentration is too low ✓ j. collecting duct less permeable to water/less water reabsorbed/large volume of urine produced/ dilute urine produced **«**with low/no ADH**»** ✓ k. insulin causes blood glucose **«**concentration**»** to be reduced ✓ l. glucose stored as glycogen in the liver ✓ m. glucagon causes blood glucose **«**concentration**»** to be increased ✓ n. negative feedback ✓	*Accept hypertonic for solute concentration too high and hypotonic for too low.*	**7 max**

*(Plus up to **[1]** for quality: 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
7.	a		**Outline the roles of helicase and ligase in DNA replication.**		
			helicase: a. unwinds/uncoils the DNA **«**double helix**»** ✓ b. breaks hydrogen bonds **«**between bases**»** ✓ c. separates the **«**two**»** strands/unzips the DNA/creates replication fork ✓ *ligase*: d. seals nicks/forms a continuous **«**sugar-phosphate**»** backbone/strand ✓ e. makes sugar-phosphate bonds/covalent bonds between adjacent nucleotides ✓ f. after **«**RNA**»** primers are removed/where an **«**RNA**»** primer was replaced by DNA ✓ g. **«**helps to**»** join Okazaki fragments ✓		**4 max**

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
7.	**b**		**Explain how natural selection can lead to speciation.**		
			a. variation is required for natural selection/evolution/variation in <u>species</u>/<u>populations</u> ✓ b. mutation/meiosis/sexual reproduction is a source of variation ✓ c. competition/more offspring than the environment can support ✓ d. <u>adaptations</u> make individuals suited to their environment/way of life ✓ e. survival of better adapted «individuals)/survival of fittest/converse ✓ f. inheritance of traits/passing on genes of better adapted «individuals» ***OR*** reproduction/more reproduction of better adapted/fittest «individuals» ✓ g. speciation is formation of a new species/splitting of a species/one population becoming a separate species ✓ h. reproductive isolation of separated populations ✓ i. geographic isolation «of populations can lead to speciation» ✓ j. temporal/behavioral isolation «of populations can lead to speciation» ✓ k. disruptive selection/differences in selection «between populations can lead to speciation» ✓ l. gradual divergence of populations due to natural selection/due to differences in environment ✓ m. changes in the <u>gene pools</u> «of separated populations»/separation of <u>gene pools</u> ✓ n. interbreeding becomes impossible/no fertile offspring «so speciation has happened» ✓		**7 max**

(continued…)

(Question 7 continued)

Question			Answers	Notes	Total
7.	**c**		**Outline the features of ecosystems that make them sustainable.**		
			a. recycling of nutrients/elements/components/materials ✓ b. carbon/nitrogen/another example of recycled nutrient/element ✓ c. decomposers/saprotrophs break down organic matter/release **«**inorganic**»** nutrients ✓ d. energy supplied by the sun ***OR*** energy cannot be recycled **«**so ongoing supply is needed**»** ***OR*** energy is lost from ecosystems as heat ✓ e. <u>energy</u> flow along food chains/through food web/through trophic levels ✓ f. photosynthesis/autotrophs make foods/trap energy ***OR*** autotrophs supply the food that supports primary consumers ✓ g. <u>oxygen</u> **«**for aerobic respiration**»** released by autotrophs/photosynthesis/plants ✓ h. <u>carbon dioxide</u> **«**for photosynthesis**»** released by respiration ✓ i. populations limited by food supply/predator-prey/interactions/competition ***OR*** populations regulated by negative feedback ***OR*** fewer/less of each successive trophic level **«**along the food chain**»**/*OWTTE* ✓ j. supplies of water from rainfall/precipitation/rivers/water cycle ✓		**4 max**

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