

Markscheme

May 2019

Biology

Higher level

Paper 2

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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 ✓	<i>both needed</i>	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	<p>a. «overall decline due to» fewer cases in rural areas ✓</p> <p><i>Answers relating to people who died from the disease or develop immunity to it:</i></p> <p>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 ✓</p> <p><i>Answers relating to health care workers or availability of resources:</i></p> <p>c. more doctors/nurses/medical equipment/treatment centers/hospitals/spending/aid/NGOs ✓</p> <p><i>Answers relating to medical techniques used to tackle the epidemic:</i></p> <p>d. better treatments/infection control/hygiene/quarantine/new vaccine/new antiviral drugs ✓</p> <p><i>Answers relating to the public and patients:</i></p> <p>e. education/better awareness/avoidance of infection/taking precautions/vaccination accepted ✓</p> <p><i>Answers relating to reservoirs of infection:</i></p> <p>f. fewer infected people «who could spread infection»/fewer bats/less contact with bats ✓</p>		2 max

(continued...)

(Question 1 continued)

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

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	e	<p>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 ✓</p> <p>b. long time/distance to travel between contracting disease and arrival at treatment center OR travel to treatment center weakens/upsets/harms the patient ✓</p> <p>c. Ebola is a virulent disease/Ebola virus mutated «to become virulent» OR little known about Ebola/new disease so treatments not yet developed ✓</p> <p>d. no/not enough vaccine/antiviral drug available «in 2014/15» OR antibiotics do not work against viral diseases ✓</p> <p>e. secondary infections/Ebola patients infected with other diseases/other Ebola strains OR ineffective hygiene/cleaning/sterilization/use of contaminated equipment/disposal of corpses ✓</p> <p>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 ✓</p> <p>g. better reporting at Ebola centers/deaths due to Ebola not reported in rural areas ✓</p>		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	<p>a. prokaryotes have circular DNA/chromosome but eukaryote chromosomes linear/OWTTE ✓ OR eukaryotes have telomeres/centromeres whereas prokaryotes do not ✓</p> <p>b. some prokaryotes have plasmids whereas eukaryotes do not ✓</p> <p>c. eukaryotes have multiple chromosomes whereas prokaryotes «typically» have only one ✓</p> <p>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 ✓</p>		2 max
2.	b	<p>a. genetic disease/caused by a gene OR inherited «from parents» OR caused by mutation «of a gene» ✓</p> <p>b. base <u>substitution</u> OR GAG → GTG ✓</p> <p>c. hemoglobin gene mutated / different allele/form/version of hemoglobin gene OR Hb^A → Hb^S ✓</p> <p>d. leads to change in amino acid sequence «in hemoglobin» OR glutamic acid → valine ✓</p> <p>e. only homozygotes have full disease/sickled cells / heterozygote has milder form OR hemoglobin crystallizes at low oxygen concentration ✓</p> <p>f. «selected for/spreads in population» as it gives resistance to malaria ✓</p>		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 ✓	<i>The answer must include “male” and the reason.</i>	1 max		
2.	c	ii	21		1		
2.	d	i	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top; border-right: 1px solid black;"> <p style="text-align: center;"><i>Heterozygous offspring</i> «grey body, normal wings»</p> $\begin{array}{c} b^+ \quad b \\ \text{vg}^+ \quad \text{vg} \end{array}$ <p>OR $b^+b \text{ vg}^+\text{vg}$</p> <p>OR $b^+\text{vg}^+ b \text{ vg} \checkmark$</p> </td> <td style="width: 50%; vertical-align: top;"> <p style="text-align: center;"><i>Homozygous recessive parent</i> «black body, vestigial wings»</p> $\begin{array}{c} b \quad b \\ \text{vg} \quad \text{vg} \end{array}$ <p>OR $bb \text{ vgvg}$</p> <p>OR $b\text{vg} b\text{vg} \checkmark$</p> </td> </tr> </table>	<p style="text-align: center;"><i>Heterozygous offspring</i> «grey body, normal wings»</p> $\begin{array}{c} b^+ \quad b \\ \text{vg}^+ \quad \text{vg} \end{array}$ <p>OR $b^+b \text{ vg}^+\text{vg}$</p> <p>OR $b^+\text{vg}^+ b \text{ vg} \checkmark$</p>	<p style="text-align: center;"><i>Homozygous recessive parent</i> «black body, vestigial wings»</p> $\begin{array}{c} b \quad b \\ \text{vg} \quad \text{vg} \end{array}$ <p>OR $bb \text{ vgvg}$</p> <p>OR $b\text{vg} b\text{vg} \checkmark$</p>		2
<p style="text-align: center;"><i>Heterozygous offspring</i> «grey body, normal wings»</p> $\begin{array}{c} b^+ \quad b \\ \text{vg}^+ \quad \text{vg} \end{array}$ <p>OR $b^+b \text{ vg}^+\text{vg}$</p> <p>OR $b^+\text{vg}^+ b \text{ vg} \checkmark$</p>	<p style="text-align: center;"><i>Homozygous recessive parent</i> «black body, vestigial wings»</p> $\begin{array}{c} b \quad b \\ \text{vg} \quad \text{vg} \end{array}$ <p>OR $bb \text{ vgvg}$</p> <p>OR $b\text{vg} b\text{vg} \checkmark$</p>						

(continued...)

(Question 2 continued)

Question			Answers	Notes	Total
2.	d	ii	<p>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 ✓</p> <p>b. «linked genes» so were on the same chromosome ✓</p> <p>c. grey body vestigial wing and black body normal wing are recombinants OR 2% plus 3% of the offspring are recombinants ✓</p> <p>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 ✓</p> <p>e. crossing over between the two loci/between the two genes on the chromosomes ✓</p> <p>f. few recombinants/not much crossing over because genes/gene loci close together ✓</p>	<p><i>Accept any of these points from an annotated diagram.</i></p>	<p>2 max</p>

Question		Answers	Notes	Total
3.	a	<p><i>differences</i></p> <p>a. prokaryote has cell wall but mitochondrion does not ✓</p> <p>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 ✓</p> <p>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 ✓</p> <p><i>similarities</i></p> <p>d. <u>70S</u> ribosomes in both ✓</p> <p>e. <u>DNA</u> in both / loop of <u>DNA</u> in both / naked <u>DNA</u> in both ✓</p> <p>f. shape similar/both rod shaped/<i>OWTTE</i> OR size of both is similar/both about 3 µm long ✓</p> <p>g. both are membrane-bound/<i>OWTTE</i> ✓</p>		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
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(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. <u>ribosomes</u> 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. <u>vesicles</u> budded off Golgi transport proteins «to plasma membrane» OR exocytosis/secretion of proteins in <u>vesicles</u> 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 <u>enzyme</u> -catalyzed reactions OR metabolic pathway is a chain of <u>enzyme</u> -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 <u>active site</u> /affinity of the <u>active site</u> «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	<p>Explain how hydrophobic and hydrophilic properties contribute to the arrangement of molecules in a membrane.</p> <p>a. hydrophilic is attracted to/soluble in water and hydrophobic not attracted/insoluble ✓</p> <p>b. hydrophilic phosphate/head and hydrophobic hydrocarbon/tail in <u>phospholipids</u> ✓</p> <p>c. <u>phospholipid bilayer</u> in water/in membranes ✓</p> <p>d. hydrophilic heads «of phospholipids» face outwards/are on surface ✓</p> <p>e. hydrophobic tails «of phospholipids» face inwards/are inside/are in core ✓</p> <p>f. cholesterol is «mainly» hydrophobic/amphipathic so is located among phospholipids/in hydrophobic region of membrane ✓</p> <p>g. some amino acids are hydrophilic and some are hydrophobic ✓</p> <p>h. hydrophobic «amino acids/regions of» proteins in phospholipid bilayer «core» ✓</p> <p>i. hydrophilic «amino acids/regions of» proteins are on the membrane surface ✓</p> <p>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 ✓</p> <p>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 ✓</p> <p>l. pore of <u>channel proteins</u> is hydrophilic ✓</p>	<p><i>Allow mark points shown in clearly annotated diagram.</i></p> <p><i>In any part of the answer, accept polar instead of hydrophilic and non-polar or apolar instead of hydrophobic.</i></p>	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. <u>diaphragm</u> and <u>external intercostal</u> muscles <u>contract</u> ✓ b. <u>diaphragm</u> moves down/becomes flatter OR <u>external intercostals</u> 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. <u>air</u> 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. <u>open</u> valves allow blood to flow through OR opening and closing of valves controls timing of blood flow «during cardiac cycle» ✓ c. <u>closed</u> «semilunar» valves allow ventricles/chambers to fill with blood OR <u>closed</u> «semilunar» valves allow pressure in ventricles to rise «rapidly» ✓ d. valves open when <u>pressure</u> is higher upstream/ <u>OWTTE</u> /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» <u>aquaporins</u> /opens <u>aquaporins</u> «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 <u>liver</u> ✓ 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.		
		<p><i>helicase:</i></p> <p>a. unwinds/uncoils the DNA «double helix» ✓</p> <p>b. breaks hydrogen bonds «between bases» ✓</p> <p>c. separates the «two» strands/unzips the DNA/creates replication fork ✓</p> <p><i>ligase:</i></p> <p>d. seals nicks/forms a continuous «sugar-phosphate» backbone/strand ✓</p> <p>e. makes sugar-phosphate bonds/covalent bonds between adjacent nucleotides ✓</p> <p>f. after «RNA» primers are removed/where an «RNA» primer was replaced by DNA ✓</p> <p>g. «helps to» join Okazaki fragments ✓</p>		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/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.)