

Markscheme

November 2018

Biology

Higher level

Paper 2

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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 to be 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.
- ∞ Candidates that score very highly on the content marks need not necessarily automatically gain **[1]** for quality (and *vice versa*).

Section A

Question			Answers	Notes	Total
1.	a		positive <u>correlation</u> OR lung tumour incidence increases as dose increases/ <i>OWTTE</i> ✓		1
1.	b		a. NNK/mutagens alter «base» sequence of DNA/alter genes/create new alleles ✓ b. increases rate/frequency/incidence of mutations ✓ c. in oncogenes/in genes that control cell division/mitosis ✓ d. tumors/cancers «develop/grow» if cell division/mitosis is uncontrolled ✓		2 max
1.	b		42 nmol ml ⁻¹ ✓		1
1.	d	i	higher in urine due to concentration of waste products «during the process of urine production» OR higher in urine because water is reabsorbed «from glomerular filtrate/in the collecting duct»/ because «waste products» are not reabsorbed ✓		1
d.	d	ii	higher «concentrations» so easier to measure/identify/find OR wider spread/greater range «of values/concentrations» OR units are larger/nmol rather than pmol ✓		1

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	e	<p><i>Answers supporting the conclusion</i></p> <p>a. first graph/data/research shows that NNK induces lung tumors/causes cancer ✓</p> <p>b. second graph shows that smokers have absorbed NNK «from smoke»/shows that there is NNK in the blood of smokers ✓</p> <p><i>Answers giving reservations about the conclusion</i></p> <p>c. results are for rats not humans ✓</p> <p>d. injection of NNK and not inhalation of tobacco smoke ✓</p> <p>e. dosage of NNK much larger than amounts likely in smokers ✓</p> <p>f. other chemicals in smoke could cause lung cancer «in addition to those caused by NNK»/no proof that NNK is the only cause ✓</p>		3 max
1.	f	<p>a. all/100% «of mice/in treatment group 3/in treatment groups 3 to 6» had tumours ✓</p> <p>b. tumours per «significantly» increased «by NNK» ✓</p> <p>c. no/little difference when nicotine was added «to mice with NNK» ✓</p>		2 max

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	g	<p><i>hypothesis supported</i> (relevant treatment groups indicated with T numbers)</p> <p>a. «by itself» nicotine did not increase percentage «of mice» with tumours «T1 versus T2» OR percentage with tumours went down from 31 to 26 with nicotine «T1 versus T2» OR second treatment group does not have a higher percentage than first group ✓</p> <p>b. «by itself» nicotine did not increase the number of tumours per mouse «T1 + T2» OR second treatment group does not have more tumours per mouse than first group ✓</p> <p>c. in mice given NNK nicotine did not increase tumours «significantly» «T3 versus T4/5/6» OR 100% of rats already had tumours with NNK only «T3» OR no significant difference/more tumours per mouse in 5th treatment group than 4th/6th even though nicotine was given for a shorter time/for only 2 weeks «T5 versus T4/6» ✓</p> <p>d. if nicotine was mutagenic there would have been more tumours ✓</p> <p><i>hypothesis not supported</i></p> <p>e. mice and humans may react to/metabolize nicotine differently/OWTTE ✓</p> <p>f. nicotine from tobacco smoke may have different effects «from ingested nicotine» ✓</p>		3 max

(continued...)

(Question 1 continued)

Question			Answers	Notes	Total
1.	h		a. effects of long term/longer than 46 weeks NRT not known ✓ b. NRT/nicotine «in NRT» may have negative effects «other than cancer» on health/named other health effect/may affect unborn children ✓ c. tests needed on humans ✓ d. nicotine is addictive/causes dependency/NRT does not cure the addiction ✓ e. this research gives no grounds for concern ✓ f. data in second graph/previous study shows that nicotine is not a mutagen/does not cause cancer ✓		2 max

2.	a	i	<p>The diagram shows a linear peptide chain with the following structure: $\text{H}_2\text{N}-\text{CH}(\text{H})-\text{C}(=\text{O})-\text{NH}-\text{CH}(\text{CH}_3)-\text{C}(=\text{O})-\text{NH}-\text{CH}(\text{CH}_3)-\text{C}(=\text{O})-\text{NH}-\text{CH}(\text{CH}_2\text{OH})-\text{C}(=\text{O})-\text{NH}-\text{CH}(\text{H})-\text{C}(=\text{O})-\text{OH}$. Four arrows point to the peptide bonds connecting the first, second, third, and fourth amino acid residues.</p>	Award [1] for any one of the four peptide bonds identified in this markscheme.	1
2.	a	ii	number/sequence/order of amino acids «in a protein/polypeptide chain» ✓		1

(continued...)

(Question 2 continued)

Question		Answers	Notes	Total
2.	b	a. polysaccharides to disaccharides/monosaccharides OR starch/glycogen to <u>maltose</u> ✓ b. sucrose to glucose AND fructose ✓ c. maltose to glucose ✓ d. lactose to glucose AND galactose ✓ e. proteins/peptides/polypeptides to shorter peptides/amino acids OR dipeptides to amino acids ✓ f. triglycerides/lipids/fats/oils to glycerol AND fatty acids ✓		2 max

Question		Answers	Notes	Total
3.	a	<p><i>similarity:</i> both made of DNA/nucleotides OR both have bases/adenine/cytosine/guanine/thymine OR neither has uracil ✓</p> <p><i>difference:</i> genes are longer/have longer DNA/base sequences «without repeats» OR genes have introns/exons but tandem repeats do not OR genes have base sequences that code for polypeptides/proteins and tandem repeats do not ✓</p>		2
3.	b	<p>a. tandem repeats allow individuals to be distinguished/compared/identified OR tandem repeats are used to identify the source of a DNA sample ✓</p> <p>b. unique/different number of repeats/combination of tandem repeats in each individual OR unique/different pattern of bands in each individual ✓</p> <p>c. PCR used for copying/amplifying «tandem repeats» ✓</p> <p>d. gel electrophoresis used for separation «of tandem repeats»/create pattern of bands ✓</p>		2

Question		Answers	Notes	Total
4.	a	coniferophyta/conifer/coniferous/gymnosperms/pinophyta ✓		1
4.	b	a. waterlogged soils/poor drainage OR acidic soil OR anaerobic conditions/soil ✓ b. organic matter not «fully» decomposed «leading to peat formation» OR decomposers/saprotrophs less active/fewer in cold «temperatures» ✓		2
4.	c	a. higher temperatures so more transpiration/droughts/dehydration/water shortage ✓ b. more forest fires ✓ c. more/new pests/diseases because of the changed conditions ✓ d. competition from trees/plants «that colonize/spread to boreal forests» ✓ e. trees/«named» organisms «of boreal forests» not adapted to warmer conditions OR trees/«named» organisms migrate/change their distribution due to warmer conditions ✓ f. trees die so loss of habitat for animals ✓ g. faster decomposition/nutrient cycling «so conditions in the ecosystem change» ✓ h. standing water/floods due to more snow/permafrost melting ✓		2 max

(continued...)

(Question 4 continued)

Question			Answers	Notes	Total
4.	d	i	animals/insects/mutualistic «relationships» not needed «for pollination» OR pollen not eaten by animals/insects ✓		1
4.	d	ii	a. seeds are protected «inside the fruit» ✓ b. seed dispersal by fruits ✓ c. example of a strategy for seed dispersal by a fruit ✓ d. dispersal reduces competition/spreads seeds away from parent plant/to colonize new areas ✓	<i>For mpc suitable strategies are dispersal by wind, by animals ingesting/carrying away succulent fruits, by animals being attracted to colourful/sweet/tasty fruits, by animals burying nuts, by burrs or other hooked fruits sticking to animals and by self-explosion.</i>	2 max
4.	e	i	a. x-axis labelled as light intensity/amount of light AND y-axis labelled as rate of photosynthesis/rate of oxygen release/rate of carbon dioxide uptake ✓ b. curve starting at/slightly to the right of the x-axis origin and rising rapidly and then more slowly and plateauing but never dropping ✓		2
4.	e	ii	a. carbon fixation/fixes carbon dioxide/carboxylation OR rubisco is used in the Calvin cycle/light independent stage ✓ b. <u>carbon dioxide</u> linked to <u>RuBP/ribulose bisphosphate</u> «by rubisco» ✓ c. <u>glycerate 3-phosphate/glycerate phosphate</u> produced «by rubisco» ✓		2 max

Question		Answers	Notes	Total
5.	a	X: cortex ✓ Y: ureter ✓		2
5.	b	a. concentration constant inside osmoregulators versus variable inside osmoconformers ✓ b. internal solute concentration can differ from the external environment in osmoregulators versus same/equal in osmoconformers OR osmoregulators are independent of the external environment in solute concentration versus osmoconformers are tied to it ✓ c. birds/mammals/humans/freshwater fish are osmoregulators versus starfish/mussels/crabs/jellyfish/sea squirts/squid/sharks are osmoconformers ✓		2 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
6.	a	<p>a. moved against a concentration gradient/lower to higher concentration ✓</p> <p>b. energy/ATP required/used ✓</p> <p>c. pump/carrier «protein» «carries out active transport» ✓</p> <p>d. absorption «by active transport» into a cell is possible even if exterior concentrations are «very» low</p> <p>OR</p> <p>allows all/nearly all of/more of the substance/calcium to be absorbed «whereas diffusion can only even out concentrations»</p> <p>OR</p> <p>unidirectional/allows the direction of movement to be controlled</p> <p>OR</p> <p>allows a concentration gradient to be built up/potential energy to be stored/membrane potential to be generated/maintained</p> <p>OR</p> <p>allows a specific concentration to be maintained «in a cell» ✓</p>		3 max

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	b	a. terminal/final electron acceptor ✓ b. at the end of electron transport chain ✓ c. oxygen also accepts protons/hydrogen ions ✓ d. water produced/ $\frac{1}{2}\text{O}_2 + 2 \text{ electrons} + 2\text{H}^+ \rightarrow \text{H}_2\text{O}$ ✓ e. helps to maintain proton gradient «across inner mitochondrial membrane by removal of protons from the stroma» ✓ f. oxygen is highly electronegative/electrons strongly attracted to oxygen ✓ g. avoids anaerobic respiration/buildup of lactic acid ✓ h. allows more electrons to be delivered to the electron transport chain OR allows NAD/FAD to be regenerated/reduced NAD/FAD converted back to NAD/FAD ✓ i. oxygen allows maximum yield of energy «from glucose» allows complete oxidation of glucose/allows fats to be used in respiration ✓		5 max

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	c	a. ventilation/inhaling brings fresh air/air with high oxygen concentration to the lungs OR ventilation/exhaling gets rid of stale air/air with high concentration of carbon dioxide ✓ b. ventilation due to muscle contractions causing pressure/volume changes in the thorax ✓ c. contraction of external intercostal muscles AND diaphragm occurs during inspiration OR contraction of internal intercostal muscles/abdomen wall muscles during «forced» expiration ✓ d. alveoli surrounded by «many» <u>capillaries</u> ✓ e. blood flow/pumping of heart «brings blood to/takes blood away from alveoli/lungs» ✓ f. <u>concentration gradients</u> «of oxygen/ CO ₂ » maintained «by ventilation/blood flow» ✓ g. O ₂ AND CO ₂ diffuse ✓ h. CO ₂ from capillaries/blood/vessel to alveolus/air AND O ₂ from alveoli into capillaries/blood/vessel ✓ i. large numbers of alveoli increase surface area ✓ j. short distance so rapid diffusion/gas exchange ✓ k. type I pneumocytes/alveolus wall/capillary walls are one cell thick/very thin ✓ l. alveoli «lining» moist for dissolving of gases/rapid diffusion OR type II pneumocytes keep the «lining of» the alveolus moist ✓ m. type II pneumocytes secrete surfactant to reduce surface tension/prevents alveoli from collapsing ✓		7 max

(Plus up to [1] for quality)

Question		Answers	Notes	Total
7.	a	a. sex linked/gene is on the X chromosome ✓ b. allele «for red-green colour blindness» is recessive/colour blindness is recessive trait/disorder ✓ c. heterozygous females are unaffected/carriers ✓ d. X^B denotes normal allele and X^b denotes colour blindness allele ✓ e. more frequent in males because they only have one X chromosome ✓ f. 50% chance of colour blindness in sons whose mother is heterozygous/ $X^B X^b$ ✓	Accept any other letter for the alleles. Award mpb, mpc, mpd and mpf if these points are clearly made on a Punnett grid.	3 max
7.	b	a. height/skin colour/other valid example ✓ b. with continuous variation any level of the variable/phenotype is possible/OWTTE ✓ c. polygenic inheritance/combined effect of more than one gene on the trait ✓ d. additive effects on the trait of alleles of multiple genes/OWTTE ✓ e. histogram showing effects of alleles of multiple genes ✓ f. environment «may» also affect the trait/sunlight affects skin colour/other example ✓ g. normal distribution curve drawn or described to show typical pattern with continuous variation ✓		5 max

(continued...)

(Question 7 continued)

Question		Answers	Notes	Total
7.	c	a. evolution is a change in the heritable characteristics «of a species» ✓ b. natural selection «causes evolution» ✓ c. overpopulation/over-reproduction/more offspring «than the environment can support» ✓ d. competition «for resources/mates» ✓ e. variation in population/species ✓ f. mutation/meiosis/sexual reproduction contributes to variation ✓ g. adaptation increases chance of survival ✓ h. reproduction/offspring produced «by the better adapted/by those that survive» ✓ i. characteristics passed to offspring by reproduction/variation is heritable ✓ j. allele frequencies/number of organisms carrying a gene changes/gene pool changes ✓ k. environmental change stimulates/triggers/speeds up natural selection/evolution ✓ l. increase in rainfall/introduction of antibiotic/pollution on tree trunks/other valid example of environmental change/new selection pressure ✓ m. artificial selection/selective breeding can speed up evolution ✓	Mark points can be awarded if explained using an example.	7 max

(Plus up to [1] for quality)

Question		Answers	Notes	Total
8.	a	a. sustainable communities/ecosystems allow continued survival of organisms/ <i>OWTTE</i> ✓ b. natural ecosystems can be sustainable over long periods of time/ <i>OWTTE</i> ✓ c. natural ecosystems/rainforest more sustainable than agricultural areas/plantations ✓ d. diverse community/high biodiversity/higher biodiversity in natural ecosystems/rainforest OR less/low biodiversity in agricultural areas/agricultural soils ✓ e. agricultural areas/monocultures more affected by pests/diseases ✓ f. nutrient recycling «efficient» in natural ecosystems/rainforest ✓ g. nutrients removed with crops/nutrients removed when crops are harvested OR less formation of humus/less organic matter in agricultural soils ✓ h. more water recycling/more rainfall/more transpiration in natural ecosystems/rainforest ✓ i. larger biomass/more carbon stored «in biomass» in natural ecosystems/rainforest ✓ j. shallower soils/less soil erosion/degraded soils/infertile soils in agricultural areas ✓		3 max
8.	b	a. shoot apex is an «apical» meristem/has undifferentiated cells ✓ b. mitosis «in shoot apex» ✓ c. cell division/cytokinesis/cells produced «in shoot apex» ✓ d. cell elongation «in shoot apex» ✓ e. stem/shoot growth «due to the cell division and elongation in the shoot apex» ✓ f. produces auxin ✓ g. auxin stimulates growth/cell elongation ✓ h. growth towards light ✓ i. differentiation of cells «produced by the shoot apex» ✓ j. leaf initiation/leaf development begins/leaf «primordia» formation «at shoot apex» ✓ k. flowers produced «by shoot apex» ✓		5 max

(continued...)

(Question 8 continued)

Question		Answers	Notes	Total
8.	c	<p>a. polyploidy is having more than two sets of «homologous» chromosomes ✓</p> <p>b. triploid has three sets/is $3n$ ✓</p> <p>c. tetraploid has four sets/is $4n$ ✓</p> <p>d. <i>Allium/vizcacha rats/other named example»</i> ✓</p> <p>e. details of chromosome numbers in diploid and polyploid species in the example ✓</p> <p>f. non-disjunction/failure of chromosome pairs to separate during meiosis ✓</p> <p>g. diploid gamete «can lead to polyploidy» ✓</p> <p>h. fusion of diploid and haploid gamete produces triploid cells ✓</p> <p>i. DNA replication but no subsequent mitosis doubles the chromosome number/produces tetraploid «from diploid» OR fusion of two diploid gametes produces tetraploid/$4n$ ✓</p> <p>j. polyploid/tetraploid «crossed» with diploid/non-polyploid produces infertile offspring ✓</p> <p>k. meiosis fails in triploids because «homologous» chromosomes cannot pair up ✓</p> <p>l. polyploid individuals are reproductively isolated OR polyploidy causes instant/immediate speciation OR tetraploids can form a new species because they can cross with each other OR polyploids cannot cross/produce fertile offspring with diploids ✓</p> <p>m. speciation by polyploidy is common in plants/commoner in plants than animals ✓</p> <p>n. polyploid individuals tend to be larger ✓</p>		7 max

(Plus up to [1] for quality)