Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2018

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

(continued...)

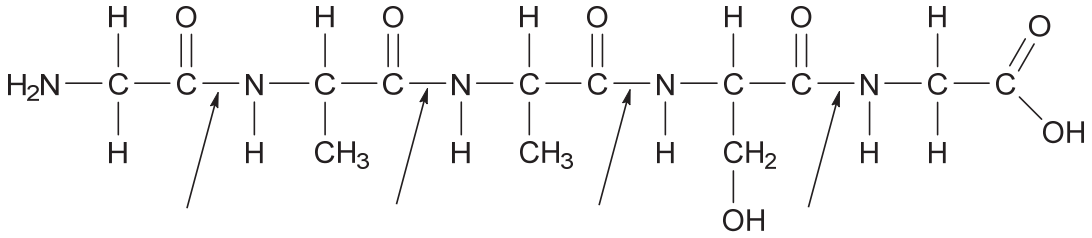
(Question 1 continued)

Question			Answers	Notes	Total
1.	g		***hypothesis supported*** *(relevant treatment groups indicated with T numbers)* 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 ✓ 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 ✓ 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**»** ✓ d. if nicotine was mutagenic there would have been more tumours ✓ ***hypothesis not supported*** e. mice and humans may react to/metabolize nicotine differently/*OWTTE* ✓ f. nicotine from tobacco smoke may have different effects **«**from ingested nicotine**»** ✓		**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**		*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		*similarity*: both made of DNA/nucleotides ***OR*** both have bases/adenine/cytosine/guanine/thymine ***OR*** neither has uracil ✓ *difference*: 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 ✓		2
3.	b		a. tandem repeats allow individuals to be distinguished/compared/identified ***OR*** tandem repeats are used to identify the source of a DNA sample ✓ b. unique/different number of repeats/combination of tandem repeats in each individual ***OR*** unique/different pattern of bands in each individual ✓ c. PCR used for copying/amplifying «tandem repeats» ✓ d. gel electrophoresis used for separation «of tandem repeats»/create pattern of bands ✓		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 ✓	*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.*	**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. carbon dioxide linked to RuBP/ribulose bisphosphate «by rubisco» ✓ c. glycerate 3-phosphate/glycerate phosphate 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**		a. moved against a concentration gradient/lower to higher concentration ✓ b. energy/ATP required/used ✓ c. pump/carrier **«**protein**»** **«**carries out active transport**»** ✓ d. absorption **«**by active transport**»** into a cell is possible even if exterior concentrations are **«**very**»** low ***OR*** allows all/nearly all of/more of the substance/calcium to be absorbed **«**whereas diffusion can only even out concentrations**»** ***OR*** unidirectional/allows the direction of movement to be controlled ***OR*** allows a concentration gradient to be built up/potential energy to be stored/membrane potential to be generated/maintained ***OR*** allows a specific concentration to be maintained **«**in a cell**»** ✓		**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/ $\frac{1}{2}O_2 + 2$ electrons $+ 2H^+ \rightarrow H_2O$ ✓ 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 NADFAD 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^BX^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/*OWTTE* ✓ b. natural ecosystems can be sustainable over long periods of time/*OWTTE* ✓ 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**		a. polyploidy is having more than two sets of **«**homologous**»** chromosomes ✓ b. triploid has three sets/is 3n ✓ c. tetraploid has four sets/is 4n ✓ d. *Allium*/vizcacha rats/other named example**»** ✓ e. details of chromosome numbers in diploid and polyploid species in the example ✓ f. non-disjunction/failure of chromosome pairs to separate during meiosis ✓ g. diploid gamete **«**can lead to polyploidy**»** ✓ h. fusion of diploid and haploid gamete produces triploid cells ✓ i. DNA replication but no subsequent mitosis doubles the chromosome number/produces tetraploid **«**from diploid**»** ***OR*** fusion of two diploid gametes produces tetraploid/4n ✓ j. polyploid/tetraploid **«**crossed**»** with diploid/non-polyploid produces infertile offspring ✓ k. meiosis fails in triploids because **«**homologous**»** chromosomes cannot pair up ✓ 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 ✓ m. speciation by polyploidy is common in plants/commoner in plants than animals ✓ n. polyploid individuals tend to be larger ✓		**7 max**

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