Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Biology

Higher level

Paper 2

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Section A

Question			Answers	Notes	Total
1.	**a**		erythrocyte percentage increased ***AND*** body mass reduced/smaller increase in mass ✓		**1**
1.	**b**		a. increases endurance «in relation to the control» ✓ b. higher force/endurance at every testing time/throughout ***OR*** smaller decreases in force «over time» ✓ c. the magnitude of the difference is similar throughout the five minutes experiment/testing ✓ d. differences are «statistically» significant ✓ e. endurance of control is «approximately» 35 % versus endurance of hypoxia «approximately» 55 % «after 5 minutes» ✓	*Accept* $\pm$ *5 % for both percentages*	**2 max**
1.	**c**		a. diaphragm more endurance/stronger/generates more force for more ventilation/inspiration ✓ b. right ventricle mass increases to pump more blood ✓ c. erythrocyte percentage increases to transport oxygen ✓ d. less growth/body mass which reduces oxygen demand ✓	*Reject "loss of body mass"* *The physiological reason is required for each mark*	**2 max**
1.	**d**	**i**	a. hypoxia increases the concentration of sodium–potassium pumps ✓ b. nitric oxide needed for/stimulates «production of» sodium-potassium pumps ✓ c. nitric oxide synthase inhibitor reduces the concentration of pumps ***OR*** concentration of pumps reduced by inhibiting nitric oxide production ✓	*Award up to* ***[1]*** *for a conclusion on lines labelled 1* *and up to* ***[1]*** *for a conclusion on the lines labelled 2*	**2 max**
1.	**d**	**ii**	a. resting potential restored faster ✓ b. increases the «maximum» frequency/rate of contractions ***OR*** can contract again sooner ✓	*Accept shorter refractory period for mpa* *Do not accept faster contraction/depolarization/ repolarization*	**1 max**

(continued…)

(Question 1 continued)

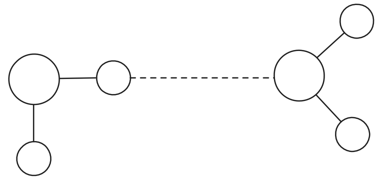
Question			Answers	Notes	Total
1.	**e**	**i**	reduces «force of» twitch ***AND*** peak tetanic contraction ✓		**1**
	e	**ii**	a. decrease in volume/atrophy/loss of cells/less muscle fibres/less tissue in the diaphragm ✓ b. SA to volume ratio increased to make oxygen uptake into muscle/cells faster ✓	*Do not accept reduction in area of diaphragm*	**1 max**
1.	**f**		a. not effective because body mass lost ✓ b. effective because body mass still increases/rats still grow ✓ c. not effective because contractions/force exerted by diaphragm decreases d. effective because more sodium-potassium pumps so more/faster rate of diaphragm/muscle contractions ✓ e. effective because endurance of diaphragm increases ✓ f. effective because mass of right ventricle increases ✓ g. effective because erythrocyte percentage increases ✓	*For each marking point the candidate must make it clear whether they are arguing for adaptation being effective or not. This can be done by giving the physiological benefit of a change, for example greater mass of right ventricle so more blood pumped.*	**3 max**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**g**		*advantages*: a. small size ***OR*** easy to look after in research labs ✓ b. short lifespan ***OR*** study can extend over several generations ✓ c. can be killed «to get experimental results» if benefits of research justify it ✓ d. «mammalian» so similarities with humans ✓ e. fewer ethical objections than if humans are used/not ethical to subject humans to hypoxia/does not cause harm to humans ✓ *disadvantages*: f. ethical objections ***OR*** wrong to cause suffering to animals/rats ✓ g. rat physiology/anatomy not same as human ✓	*Accept any one of the advantages* *Accept any one of the disadvantages*	**2 max**

Question			Answers	Notes	Total
2.	a		a. electron microscope has greater resolution/magnification ✓ b. 70nm is too small/viruses are too small to be viewed by a light microscope ✓		**1 max**
2.	b		a. viruses are not living ✓ b. viruses lack metabolism/lack enzymes «for metabolism»/lack cell walls ✓ c. antibiotics target metabolic «pathways»/cell wall production ✓	*Accept cell wall structure affected*	**2 max**
2.	c		produce/secrete antibodies ✓		**1**
2.	d	i	a. antigen injected into mouse/mammal/host ✓ b. B cells/B lymphocytes/plasma cells «obtained/extracted from host» ✓ c. fusion «of plasma cell» with myeloma cell/tumour cell ✓ d. division «of hybridoma cells» to produce a clone ✓	*Accept animal*	**2 max**
2.	d	ii	produce monoclonal antibodies ***OR*** diagnosis of diseases/malaria/cancer/HIV ***OR*** treatment of rabies ***OR*** blood and tissue typing ***OR*** pregnancy testing ***OR*** targeting of cancer cells «with a chemotherapy drug» ***OR*** treatment of infection if too late for vaccination/successful immune response ✓	*Only accept the first use of hybridoma cells given in the answer* *Not treatment of malaria*	**1**

Question			Answers	Notes	Total
3.	a		a. similar water molecule drawn with oxygen on one molecule facing hydrogen on the other water molecule ✓ b. one hydrogen bond drawn as a dotted/dashed line between the two water molecules and labelled ✓	*O and H do not need to be labelled but must be positioned correctly* *eg*: 	**2**
3.	b		a. water molecule is polar ***OR*** water has «weak» positive and negative charges ✓ b. substances that dissolve in water are hydrophilic ✓ c. water forms hydrogen bonds with <u>polar</u> substances ✓ d. positive/hydrogen side/pole of water attracted to negative <u>ions</u> ***OR*** negative/oxygen side/pole attracted to positive <u>ions</u> ✓ e. glucose/other example dissolves because it is polar ***OR*** sodium chloride/other example dissolves because ions are attracted to water ✓		**3 max**

(continued…)

(Question 3 continued)

Question			Answers	Notes	Total
3.	**c**		a. secreted when blood/plasma is hypertonic/too concentrated/water content too low ✓ b. makes walls of collecting duct/distal convoluted tubule «more» permeable to water ✓ c. more aquaporins in membranes «of collecting duct cells» ✓ d. more water reabsorbed from filtrate/from urine/more water returned to blood ✓ e. small volume of concentrated urine excreted ✓		**3 max**

4.	**a**	**i**	Filicinophyta/Filicinophytes/Pteridophytes ✓	*Accept Pteridophyta although it is now an invalid taxon* *Reject "ferns"*	**1**
4.	**a**	**ii**	a. have roots stem and leaves ✓ b. pinnate leaves/leaves divided «repeatedly» into leaflets ✓ c. have vascular tissue/xylem and phloem ✓ d. produce spores/sporangia ***OR*** no flowers/fruits/seeds ✓		**2 max**
4.	**b**		a. water is split/breaks ✓ b. using energy from light ✓ c. electrons «from photolysis» pass to photosystem II ✓ d. oxygen is a «waste» product ✓ e. hydrogen ions/protons are produced ✓	*Allow answer given as an equation*	**3 max**

Question			Answers	Notes	Total
5.	a		a. occurs during prophase I/during meiosis ✓ b. <u>homologous</u> chromosomes form bivalents/pair up ✓ c. breakage and rejoining of chromatids ✓ d. exchange «of DNA/alleles» between <u>non</u>-sister chromatids/homologous chromosomes ✓		**2 max**
5.	b		a. «linked genes are» on the same chromosome ✓ b. Mendel ‘s genes were on different chromosomes ✓ c. linked genes are inherited together ***OR*** no independent assortment ✓ d. «linked genes» only separated by crossing over ***OR*** fewer recombinants than with unlinked genes ✓	*Reject sex-linkage*	**2**

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. mitochondria and chloroplasts are similar to prokaryotes ✓ b. «host» cell took in another cell by endocytosis/by engulfing «in a vesicle» ✓ c. but did not digest the cell/kept the «ingested» cell alive ***OR*** symbiotic/mutualistic relationship «between engulfed and host cell» ✓ d. chloroplasts and mitochondria were once independent/free-living «organisms» ✓ e. DNA «loop» in chloroplast/mitochondrion ✓ f. division/binary fission of chloroplast/mitochondrion ✓ g. double membrane around chloroplast/mitochondrion ✓ h. 70s ribosomes «in chloroplast/mitochondrion» ✓	*Allow "taking in" in place of "engulfing"* *Award up to **[2]** for evidence from mpe to mph*	**4 max**

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
6.	**b**		a. both result in haploid cells/gametes ✓ b. both involve mitosis at the start/in the «germinal» epithelium ✓ c. both have cell growth «before meiosis» ✓ d. both involve «two divisions of» meiosis ✓ e. both involve differentiation to produce a gamete ✓ f. both are stimulated by hormones ***OR*** spermatogenesis stimulated by testosterone and oogenesis stimulated by FSH ✓	*A table is not required but both statements in one row of the table must either be explicitly stated or clearly implied to award the mark*	**8 max**

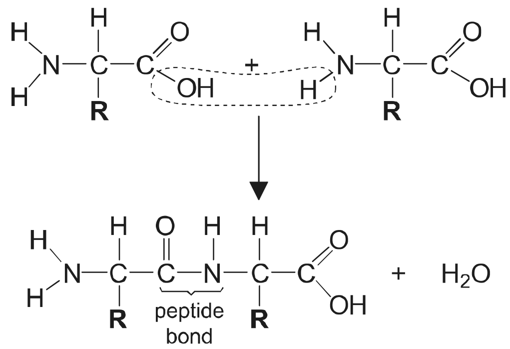
	Oogenesis	***Spermatogenesis***	
g.	in the <u>ovaries</u>	in the <u>testes</u>	✓
h.	starts «in germinal epithelium» during embryo/fetus development	starts during puberty/adolescence ***OR*** continuously starting «in germinal epithelium»	✓
i.	pauses occur in prophase I/prophase II/ metaphase II	no pauses	✓
j.	large quantity of cytoplasm in egg/ cytoplasm split unequally	small quantity of cytoplasm «per sperm»/equal division of cytoplasm	✓
k.	one cell/egg «per meiosis» ***OR*** some become polar bodies	four sperm «per meiosis» ***OR*** all cells become sperm	✓
l.	one «usually» at a time/per month/per menstrual cycle	many/far more/millions daily	✓
m.	released on about Day 14/in middle of menstrual cycle/at ovulation	released continuously «from testis» ***OR*** by ejaculation/intercourse	✓
n.	stops at menopause	goes on throughout adult life/until death	✓

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
6.	**c**		a. crop plants/domesticated animals/livestock produced by selective breeding ✓ b. specific example of a domesticated animal/crop plant and the wild species from which it was developed ***OR*** specific example of a domesticated animal/crop plant and the features in it which have been improved «compared with the wild species» ✓ c. artificial selection/crossing selected varieties/eliminating undesirable varieties ✓ d. «selective breeding/artificial selection can cause» significant/rapid change over time/from the original wild species ✓ e. «changes due to selective breeding/artificial selection» shows natural selection can cause change/evolution «in a species» ✓	*For example dogs have been developed from wolves*	**3 max**

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

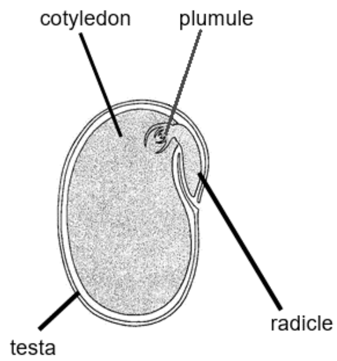
Question			Answers	Notes	Total
7.	a		a. at least one of the amino acid structures completely correct ✓ b. peptide bond shown with N–C and C=O and N–H correct ✓ c. release of water clearly shown ✓		**3**
7.	b		a. DNA is transcribed ***AND*** mRNA is translated ✓ b. transcription produces RNA ***AND*** translation produces polypeptide/protein ✓ c. RNA polymerase used in only in transcription and ribosomes only in translation ✓ d. transcription in the nucleus «of eukaryotes» and translation in the cytoplasm ✓ e. tRNA needed for translation but not transcription ✓ f. nucleotides linked in transcription and amino acids in translation ***OR*** sugar-phosphate/phosphodiester bonds in transcription and peptide bonds in translation ✓	*Disallow the first mark, if a candidate gets transcription and translation the wrong way round, but allow marks after that up to* ***[3 max]***	**4 max**

(continued…)

(Question 7 continued)

Question			Answers	Notes	Total
7.	**c**		a. excreted as uric acid ✓ b. excretion by Malpighian tubules ✓ c. nitrogenous waste/ammonia «accumulates» in hemolymph ✓ d. nitrogenous waste/ammonia absorbed by Malpighian tubules ✓ e. ammonia converted to uric acid ✓ f. conversion to uric acid requires energy/ATP ✓ g. high solute concentration in Malpighian tubules ***OR*** active transport of ions/Na^+/K^+ into Malpighian tubules ✓ h. water absorbed by osmosis flushes uric acid/nitrogenous waste to «hind» gut ✓ i. water/ions reabsorbed from the feces and returned to hemolymph ✓ j. uric acid precipitates/becomes solid/forms a paste so can pass out with little water ✓ k. uric acid excreted/egested with the feces ✓ l. water conservation/osmoregulation ***OR*** reduces mass of water «in body» ✓ m. uric acid is non-toxic ✓		**8 max**

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

Question			Answers	Notes	Total
8.	a		a. radicle/embryo root shown tapering to a root tip ✓ b. plumule/embryo shoot shown with embryonic leaves «in a dicot seed» ***OR*** plumule/embryo shoot shown tapering to a shoot tip «in a monocot seed» ✓ c. seed coat/testa shown with a double line ✓ d. cotyledon/endosperm shown as a large structure «for food storage» ✓ e. embryo shown with both embryo root and shoot visible ✓	*Accept any dicot or monocot seed* *eg:*  *Award **[1]** for any of the structure clearly drawn and labelled* *Award mpe only if mpa and mpb have not been awarded and the labelling line points clearly to the plumule or radicle or both*	**3 max**

(continued…)

(Question 8 continued)

Question			Answers	Notes	Total
8.	**b**		a. roots/root hairs absorb water ✓ b. water is absorbed by osmosis ✓ c. solute concentration inside the root is higher/water potential is lower «than in the soil» ✓ d. due to active transport of ions/minerals into the root ✓ e. transport of water in xylem vessels ✓ f. flow/stream of water from roots to leaves ✓ g. water movement in xylem due to pulling force/transpiration pull/suction/negative pressure potential ✓ h. cohesion/hydrogen bonds between water molecules «allows water to be pulled up in xylem» ✓ i. transpiration in leaves generates tension/pulling forces/suction ✓ j. evaporation of water from «leaf» cell walls ✓ k. adhesion of water to «leaf» cell walls/cellulose creates tension «forces» ✓ l. lignin in xylem walls/thickened xylem walls prevent collapse/resist tension ✓ m. «movement of water in xylem is a» passive process ✓	*Not adhesion to xylem walls in mpk and the adhesion must be linked to creating tension*	**8 max**

(continued…)

(Question 8 continued)

Question			Answers	Notes	Total
8.	**c**		a. formed from dead plant material/leaves/mosses/*Sphagnum* ✓ b. formed in waterlogged sites/bogs/mires/swamps ✓ c. where bacteria/fungi/saprotrophs are not active/are inhibited ✓ d. organic matter not fully decomposed ✓ e. «occurs» in acidic conditions ✓ f. «occurs» in anaerobic conditions ✓ g. «very» slow process/takes a long time ✓	 *Reject anaerobic respiration*	**4 max**

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