Markscheme

May 2017

Biology

Higher level

Paper 2

18 pages

Section A

Question			Answers	Notes	Total
			<table><tr><td></td><td colspan="2">Mouth</td><td colspan="2">Kidney</td></tr><tr><td></td><td>In water</td><td>Out</td><td>In water</td><td>Out</td></tr><tr><td>Ammonia</td><td>0.29</td><td>0.30</td><td>0.63</td><td>0.54</td></tr><tr><td>Urea</td><td>0.90</td><td>1.56</td><td>0.07</td><td>0.73</td></tr></table>		
1.	**a**		a. urea ✓ b. for both mouth and kidney ✓ c. percentage change/change in μmol day^{-1} g^{-1} greater with urea/other acceptable numerical comparison ✓		**2**
	b		a. both higher/increased on emergence from/with turtle out of water ✓ b. both increased by <u>0.66</u> **«**μmol^{-1} g^{-1} when turtle emerges from water**»** ✓ c. % increase is higher in kidney / kidney 940 % versus mouth 73/75 % / increase is higher proportionately higher in kidney / kidney x10 versus mouth nearly double/x1.73 ✓ d. urea excretion by mouth greater than kidney out of water **«**despite larger % increase in kidney excretion**»** ✓		**3**

Question			Answers	Notes	Total
	c	**i**	decrease **«**when head is submerged**»** <u>and</u> increase when head is out of water ✓		**1**
		ii	a. oxygen absorbed from water/exchanged for urea when head dipped in water **«**so oxygen concentration decreases**»** ✓ b. lungs cannot be used with head in water / can **«**only**»** be used with head out of water ✓ c. oxygen from water **«**in mouth**»** used in **«**aerobic cell**»** <u>respiration</u> ✓ d. oxygen from air dissolves in water when head out of water **«**so oxygen concentration increases**»** ✓		**2 max**
	d		a. urea transporter is present ✓ b. less urea **«**excreted**»**/ lower rate **«**of urea excretion**»** / excretion almost zero when phloretin/inhibitor was present ✓		**2**

Question			Answers	Notes	Total
1.	**e**		a. <u>mRNA</u> only in mouth and tongue/in mouth and tongue but not esophagus intestine kidney or bladder ✓ b. <u>bands</u> / <u>lines</u> indicate mRNA for/expression of urea transporter gene ✓ c. <u>urea transporter gene</u> expressed / <u>urea transporters</u> in mouth/tongue / not expressed/made in esophagus/intestine/kidneys/bladder ✓ d. mRNA/transcription/gene expression/urea transporters higher in <u>tongue</u>/more in <u>tongue</u> **«**than mouth**»**✓		**2 max**
	f	**i**	salt solution is control because it does not contain a nitrogenous/excretory waste product / it matches the salt concentration of the turtle / the turtle's body already contains salt / because the turtle lives in salt water/salt marshes / because nothing has been altered ✓		**1**
		ii	a. ammonia is **«**highly**»** toxic/harmful ✓ b. ammonia is more toxic than urea/converse ✓ c. ammonia converted to urea ✓ d. urea concentration raised **«**by injecting ammonia**»** ✓ e. difference between ammonia and urea **«**possibly**»** not **«**statistically**»** significant ✓		**2 max**

Question			Answers	Notes	Total
		g	*Problems:* a. urea becomes more concentrated **«**in small pools**»** / lower concentration gradient **«**between tongue/mouth and water**»** ✓ b. less water available for urine production/excretion by kidney ***OR*** less water in ponds for mouth rinsing/more competition for pools (to use for mouth rinsing) ✓ *Behaviour to overcome problems:* c. **«**still able to**»** dip mouth into/mouth rinse in water/pools ✓ d. **«**still able to**»** excrete urea **«**though the mouth**»** in the small pools ✓ e. more conversion of ammonia to urea/urea excretion rather than ammonia✓ f. more urea transporters/expression of urea transporter gene ✓ g. urea excreted **«**in mouth/via microvilli**»** by active transport/using ATP ✓ h. excretion with little/no loss of water ✓		**3 max**

Question			Answers	Notes	Total
2.	**a**	**i**	DNA <u>and</u> histone ✓		**1**
		ii	methylation/acetylation/phosphorylation/epigenetic tags/modification of nucleosome tails/N-terminal tails ✓		**1**
	b		a. binding/carrying/transporting amino acid/amino acids / to hold the polypeptide chain **«**during translation**»** ✓ b. anticodon / to bind with a codon **«**on mRNA**»** / to translate mRNA ✓		**2**
	c		a. **«**proteins from free ribosomes remain/are used in the**»** <u>cytoplasm</u>/<u>cell</u> ✓ b. **«**proteins from bound ribosomes**»** pass into ER/Golgi apparatus/lysosomes / are secreted/pass out of cell / **«**are used**»** outside cell ✓		**2**

Question			Answers	Notes	Total
3.	**a**		a. spontaneous generation is life appearing from nothing/from non-living/cells only come from pre-existing cells/life ✓ b. broth/culture medium **«**for bacteria**»** **«**used/placed**»** in flasks ✓ c. broth boiled/sterilized **«**in some flasks**»** to kill microbes ✓ d. no clouding/signs of bacteria growth/reproduction/microbes did not appear **«**in flasks of boiled broth**»** ✓ e. after necks of flasks snapped boiled broth became cloudy/growth **«**of microbes**»** ✓ f. because microbes from the air contaminated the **«**boiled**»** broth ✓ g. curved necks allowed exposure to air but prevented entry of microbes ✓	*Allow bacteria or organisms instead of microbes.*	**3 max**
	b	**i**	movement / locomotion ***OR*** feeding/nutrition ✓	*If student has multiple answers do not accept the second answer if the first one is incorrect.*	**1**
		ii	homeostasis ***OR*** maintain osmotic balance / osmoregulation / expels **«**excess**»** water / maintains **«**cell**»** water content ✓	*If student has multiple answers do not accept the second answer if the first one is incorrect.*	**1**

Question			Answers	Notes	Total
	c		*Advantages* a. **«**adult stem cells**»** can divide **«**endlessly**»** / can differentiate ✓ b. **«**adult stem cells**»** can be used to repair/regenerate **«**tissues**»** ✓ c. fewer ethical objections **«**than with embryonic stem cells**»** ✓ d. adult source not killed / **«**source**»** would not have grown into new human / no death of embryos used to provide stem cells ✓ e. adults can give **«**informed**»** consent for use of their stem cells ✓ f. no rejection problems / patient's own cells used ✓ g. less chance of cancer/**«**malignant**»** tumor development **«**than with embryonic stem cells**»** h. most tissues in adults contain some stem cells ✓ *Disadvantages* i. difficult to obtain/collect/find in adult body/; ✓ j. some **«**adult**»** tissues contain few/no stem cells/very few available ✓ k. (adult stem cells) differentiate into fewer cell types **«**than embryonic cells**»**/WTTE ✓	*Maximum **[2]** if only advantages or only disadvantages are included.*	**3 max**

Question			Answers	Notes	Total
4.	**a**		increases the greenhouse effect/global warming/temperatures **«**on Earth**»** ✓		**1**
	b		a. organisms/community plus the environment / biotic and abiotic **«**components**»** ✓ b. interactions ✓ c. ecosystems show sustainability ✓ d. nutrients are recycled in ecosystems ✓ e. energy flows through ecosystems ✓ f. producers **«**are part of all ecosystems**»** ✓ g. decomposers/saprotrophs **«**are part of all ecosystems**»** ✓		**2 max**

Question			Answers	Notes	Total
	c	i	a. active transport/pumps used to load sugars/sucrose into phloem/companion cells/sieve tubes ✓ b. loading in sources/unloading in sinks ***OR*** sucrose/sugars moved from source to sink ✓ c. active transport moves H^+ out of phloem/sieve tubes **«**to make H^+ gradient in the leaf/source**»** ✓ d. H^+ gradient used for co-transport of sucrose into phloem/sieve tubes/companion cells ✓	*Accept protons or hydrogen ions instead of H^+ ions.* *Accept the equivalent of mpc and mpd for unloading in the sink.*	**2 max**
		ii	a. transpiration/evaporation of water causes suction/tension ✓ b. water sucked/drawn out of <u>xylem</u> **«**in leaf**»** ✓ c. water moves up in xylem ✓ d. due to suction/tension/pulling forces ✓ e. cohesion of water/hydrogen bonds between water molecules ✓ f. movement from roots to leaves ✓ g. water enters root by osmosis/due to higher solute concentration inside root ✓		**3 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
5.	**a**		a. NAD/FAD carries/is reduced by gaining **«**two**»** H **«**atoms**»**/**«**two**»** electrons ✓ b. reduced NAD produced in glycolysis/link reaction/Krebs cycle ✓ c. reduced NAD/FAD delivers electrons/hydrogen **«**atoms**»** to ETC ✓ d. ETC is in mitochondrial inner membrane/cristae ✓ e. electrons release energy as they flow along the chain/from carrier to carrier ✓ f. electrons from ETC accepted by oxygen/oxygen is the final electron acceptor ✓ g. proteins in the inner mitochondrial membrane/electron carriers act as proton pumps ✓ h. protons pumped into intermembrane space/proton gradient across inner mitochondrial membrane/proton concentration higher in intermembrane space than in matrix ✓ i. energy **«**from electrons**»** used to pump protons into intermembrane space/generate a proton gradient / high H^+ concentration is a store of **«**potential**»** energy ✓ j. ATP synthase in inner mitochondrial membrane/cristae ✓ k. energy released as protons pass down the gradient/through ATP synthase ✓ l. ATP synthase converts ADP to ATP/phosphorylates ADP ✓ m. oxidative phosphorylation **«**is ATP production using energy from oxidizing foods**»** ✓	*Accept H^+ but not H/hydrogen in place of protons in any part of the answer.* *Accept NADH or FADH in place of reduced NAD or FAD.*	**8 max**

Question			Answers	Notes	Total
5.	**b**		a. receptor/binding site for <u>hormone</u>/<u>neurotransmitter</u> ✓ b. cell-to-cell communication / cell recognition ✓ c. channels **«**for passive transport**»** / facilitated diffusion ✓ d. pumps / active transport ✓ e. cell adhesion ✓ f. **«**immobilized**»** enzymes/enzymes embedded in the membrane ✓ g. electron transport / electron carriers ✓		**4 max**
	c		a. metabolism is all <u>enzyme-catalyzed</u> reactions in a cell/organism/is <u>anabolism</u> plus <u>catabolism</u> ✓ b. anabolism is synthesis of polymers/complex/larger molecules/larger substances **«**from smaller molecules/monomers**»** ✓ c. catabolism is breaking down **«**complex**»** molecules/substances **«**into simpler/smaller ones/into monomers**»** ✓		**3 max**

Question			Answers	Notes	Total
6.	a		a. «immumoglobulins are/function as» antibodies ✓ b. variety of binding sites / variable regions for binding ✓ c. specific to antigens on bacteria/viruses/pathogens ✓ d. constant region aids destruction of the bacteria/virus/pathogen ✓ e. attracts phagocytes/macrophages to engulf pathogen ✓ f. bursting pathogen cells/agglutination/neutralizing toxins/other example of the action of antibodies ✓	*Award marks for an annotated diagram.*	**3 max**
	b		a. protect against/kill/inhibit growth of microorganisms/bacteria/prokaryotes ✓ b. bacteria/prokaryote processes blocked but not processes in eukaryotes/other organisms ✓ c. block metabolic pathways/DNA replication/DNA transcription/translation/ribosome functioning/cell wall formation ✓ d. do not protect against viruses as they have no metabolism/are non-living ✓ e. antibiotics fail to protect if bacteria have resistance ✓ f. can be used in humans/animals because antibiotics do not affect eukaryotic cells/bacterial metabolism is different ✓		**4 max**

Question			Answers	Notes	Total
6.	**c**		a. myofibrils **«**in muscle fibers/cells**»** ✓ b. sarcomeres **«**are the repeating units in muscle/myofibrils**»** ✓ c. sarcomeres arranged end to end / sarcomeres shorten during muscle contraction ✓ d. actin and myosin/overlapping protein filaments/diagram to show sarcomere with actin and myosin overlapping ✓ e. dark and light bands **«**in sarcomeres**»**/diagram to show this/light bands narrower when muscle is contracted ✓ f. thick filament is myosin and thin filament is actin/diagram to show this ✓ g. nerve impulses stimulate contraction/cause depolarization of sarcolemma/ T-tubules/trigger release of calcium from sarcoplasmic reticulum ✓ h. calcium ions released from sarcoplasmic reticulum/bind to troponin ✓ i. troponin causes tropomyosin to move/exposes binding sites on actin ✓ j. myosin **«**heads**»** form cross bridges with/bind to actin ✓ k. myosin heads move/change angle/swivel/cock / myosin heads cause the power stroke ✓ l. myosin filaments pull actin towards center of sarcomere/more overlap between actin and myosin/Z-lines move closer ✓ m. ATP is used **«**to provide energy**»**/cause cross-bridges to break/cause movement of myosin heads/cause filaments to slide/cause muscle contraction ✓ n. intercostal/abdominal/diaphragm muscles contract **«**to cough**»** ✓	*Marks can be awarded for any point made clearly on an annotated diagram.*	**8 max**

Question			Answers	Notes	Total
7.	a		*Genes* a. <u>mutation</u> changes genes/causes genetic differences ✓ b. genes can have more than one <u>allele</u>/multiple <u>alleles</u> ***OR*** <u>alleles</u> are different forms/versions of a gene ✓ c. different <u>alleles</u> **«**of a gene**»** give different characters ***OR*** variation in <u>alleles</u> between individuals ✓ d. eye colour/other example of **«**alleles of**»** a gene affecting a character ✓ e. <u>alleles</u> may be <u>dominant</u> or <u>recessive</u> ***OR*** <u>dominant alleles</u> determine trait even if <u>recessive allele</u> is present ✓ f. both alleles influence the characteristic with codominance ***OR*** reference to polygenic inheritance ✓ g. all members of a species are genetically similar/have shared genes ***OR*** certain genes expressed in all members of a species ✓ h. reference to epigenetics/methylation/acetylation / not all genes are expressed **«**in an individual**»** ✓ i. genes are inherited from parents/passed on to offspring/passed from generation to generation ✓		**7 max**

(continued…)

(Question 7a continued)

Question			Answers	Notes	Total
7	**a**		*Chromosomes* j. same locus/same position of genes ***OR*** same sequence of genes/same genes on each chromosome **«**in a species**»** ✓ k. same number of chromosomes **«**in a species**»**/all humans have 46 chromosomes/differences in chromosome number between species ✓ l. some individuals have an extra chromosome/Down syndrome/other example of aneuploidy ***OR*** polyploidy divides a species/creates a new species ✓ m. X and Y/sex chromosomes determine the sex/gender of an individual ✓ n. meiosis/independent assortment/fertilization/sexual reproduction give new combinations **«**of chromosomes/genes**»** ✓		

Question			Answers	Notes	Total
7.	b		a. speciation is the splitting of a species **«**into two species**»** ✓ b. reproductive isolation/lack of interbreeding ✓ c. isolation due to geography/**«**reproductive**»** behavior/**«**reproductive**»** timing ✓ d. polyploidy can cause isolation ✓ e. gene pools separated ✓ f. differences in/disruptive selection cause traits/gene pools to change/diverge ✓ g. gradualism / speciation/changes accumulating over long periods ✓ h. punctuated equilibrium / speciation/changes over a short time period ✓		**4 max**
	c		a. similar structure but different function **«**in homologous structures**»** ✓ b. pentadactyl limbs/limb with five digits/toes / other example ✓ c. similar bone structure/example of similarity of bones **«**in pentadactyl limbs**»** but different uses/functions ✓ d. two examples of use of pentadactyl limb by a vertebrate group ✓ e. suggests a common ancestor **«**and evolutionary divergence**»** ✓ f. process called adaptive radiation ✓		**4 max**