PEARSON EDEXCEL IAL BIOLOGY · YBI11

BIOLOGY



MARK SCHEME

UNIT 5: RESPIRATION, MUSCLES AND THE INTERNAL ENVIRONMENT

SCORE	PERCENTAGE
/213	%

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Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(a)	A calculation showing the following steps: • determination of tidal volume (1) • calculation of volume of air in 1 min (1) • calculation of volume of air in one hour (1)	(500-150) = 350 350 x 12 = 4.2 (dm^3 min^{-1}) Accept 4200 (cm^3 min^{-1}) (4.2 x 60) = 250 dm^3 $hour^{-1}$ Accept (4200 x 60) = 250000 cm^3 ($hour^{-1}$) max 2 marks if no units / or incorrect units accept answer in standard form 2.5×10^5	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes the following point: • (cardiac) diastole (1)		(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	• 100	accept 1.67 beats per second accept range 100 - 125	(1)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An answer that includes three of the following points: Similarity • both traces have the same {PQRST/ described} wave (1) • R wave of similar height (1) Differences • normal ecg shows a lower heart rate (1) • in the patient trace the gap between T & P is shorter (1)	both show clear PQRST wave accept converse accept converse	(3)

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes four of the following points: • {identification / isolation} of (corrected) AAT gene (1) • description of one enzyme used to insert gene (1) • adenoviruses can enter host cell (1) • and combine their own genetic material with that of the cell (1) • therefore a functional AAT protein can be produced (1)	E.g. cut the adenovirus DNA using the same restriction endonuclease / insert the gene into the adenovirus DNA using DNA ligase adenovirus acts as a vector	(4)

Q2.

Question number	Answer	Additional guidance	Mark
(a)	C is the correct answer • a high glomerular filtration does not enable the camel to reduce water loss • a slow release of ADH does not enable the camel to reduce water loss		Computer **(1)**

Question number	Answer	Additional guidance	Mark
(b)(i)	A calculation with the following steps • calculation of water use each day for camel and buffalo (1) • correct difference in dm3 to two significant figures(1)	(57 x 850) = 48450 cm^3 (150 x 697)= 104550 cm^3 (104550 - 48450) ÷ 1000 = 56 (dm^3) 56.1= 1 mark Power of 10 error 1 mark eg 561 150-57=93 and then dividing by 1000 to get 0.093 = 1 mark	Graduate **(2)**

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points: • credit one adaptation / environmental condition (1) • credit second adaptation / environmental condition (1)	accept different habitat accept different environmental condition	**Expert** **(2)**

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes three of the following points: • (overall)l both fresh water and sea water increased (mean) mass (of kangaroo rats) (1) • fresh water increased (mean) mass (of kangaroo rats) more than sea water • credit any calculated change in mass over days/ or daily change (1)	can piece together from separate descriptions of data accept fresh water caused the highest increase in(mean) mass e.g. 6 g difference between fresh and no water / 0.5 g difference between fresh and salt water / decrease of {0.2/0.6/1.8} g after 2 days / increase of {0.5 / 1} g after 16 days Fresh 0.83% and sea 0.42% daily	Expert **(3)**

Question number	Answer	Additional guidance	Mark
(d)	An answer that includes two of the following points: • (nephron has) long(er) loop of Henle (1) • higher concentration of ions in the medulla (1) • (kidneys/tubule/ DCT and collecting duct/ loop of Henle}) reabsorb {large quantities of / more } water (1)	accept reference to counter current multiplier accept ADH results in increased absorption of water accept increased permeability to water in DCT and collecting duct accept ADH causes insertion of {water channels / aquaporins} in DCT and collecting duct	Expert **(2)**

Q3.

Question number	Answer	Mark
(a)(i)	The only correct answer is **B** A is not the correct answer C is not the correct answer D is not the correct answer	1

Question number	Answer	Mark
(a)(ii)	The only correct answer is **B** A 0.7 is not the correct answer C 1.3 is not the correct answer D 2.2 is not the correct answer	1

Question number	Answer	Mark
(a)(iii)	The only correct answer is **B** A is not the correct answer as lactate production does not decrease C is not the correct answer as lactate production does not decrease D is not the correct answer as oxygen consumption does not increase.	1

Question number	Answer	Additional guidance	Mark
(b)	A calculation showing the following steps: • calculation of mouse and seal metabolic rate • quotient calculated	20/10 = 2 $cm^3g^{-1}h^{-1}$ 18200/5000000 = 0.0036 $cm^3g^{-1}h^{-1}$(0.00364) 2/0.0036 = 555.56/556/549.45/549/549.5 Correct answer gains all 2 marks	2

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes the following points: **Indicative content** • No direct relationship between body mass and lactate production • The larger the size of the crocodile the lower the rate of lactate production • Highest rate of lactate production in 20kg crocodiles • Smallest crocodiles have same rate of lactate production as 50kg crocodiles • Comment on the link between aerobic and anaerobic respiration **Description of named responses** • As crocodiles were exercising vigorously the aerobic pathway cannot keep up. • ATP generated anaerobically in glycolysis using glycogen stores in the muscle. • Energy used to allow the crocodile to move very rapidly, if only for a short time. **Chemical nature of responses** • I mol of glucose from glycogen generates 3 mols of ATP and 2 mols of lactate • Detailed description of anaerobic pathway in glycolysis • Detailed description of aerobic pathways **Detailed mechanism of responses** Level 1: Description of (a minimum of 2 specific) results from experimental data.		6
	Level 2: All of level 1 plus reference to chemical nature of anaerobic or aerobicrespiration Level 3: All of level 2 plus detailed mechanism for anaerobic and aerobic respiration		

Q4.

Question number	Answer	Additional guidance	Mark
(a)(i)	B phosphorylation of hexoses		**Computer** **(1)**

Question number	Answer	Additional guidance	Mark
(a)(ii)	C increases, causing a decrease in blood pH		**Computer** **(1)**

Question number	Answer	Additional guidance	Mark
(b)(i)	A as molecules containing 2 carbon atoms produced by the link reaction		**Computer** **(1)**

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points • double membrane structure with cristae (1) • (mitochondrial) matrix identified as location of Krebs cycle reactions (1)	ALLOW Krebs cycle if arrow points to correct location. Allow without arrow labelled	**Graduate** **(2)**

Question number	Answer	Additional guidance	Mark
(b)(iii)	A description that includes five of the following points: • hydrogen atoms are transported to the electron transport chain (1) • by (the coenzymes) NAD **and** FAD (1) • electrons pass along the electron transport chain releasing energy (1) • that is used to move protons to the intermembrane space (1) • protons diffuse (back into the mitochondrial matrix) through ATP **synthase** (1) • (catalysing) the formation of ATP from ADP and Pi (1)	ALLOW hydrogen ions and electrons ALLOW reduced NAD/NADH/$NADH_2$ and reduced FAD/FADH/ $FADH_2$ ALLOW H^+ /Hydrogen ions IGNORE ATPase ALLOW Phosphorylating ADP ALLOW correct equation	**Expert** **(5)**

Q5.

Question number	Answer	Additional guidance	Mark
(a)	An answer that includes the following points: • glycolysis completed correctly (1) • Krebs cycle completed correctly (1) • Oxidative phosphorylation completed correctly (1)	Accept products written in long hand eg Adenosine Triphosphate. **Stage** / **One other product** glycolysis / pyruvate / reduced NAD/NADH Krebs cycle / reduced NAD/NADH/FAD/FAD carbon dioxide/CO_2 oxidative phosphorylation / water / H_2O/ NAD/FAD	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes the following points: • correct number 80 O_2 (1) • correct number 57 CO_2 (1)		(2)

Question number	Answer	Additional guidance	
(c)(i)	Choose an item. Correct answer C A is incorrect as energy is not released from ATP in theconversion of ADP to ATP B is incorrect as energy is not released from ATP in thephosphorylation of ADP D is incorrect as energy is not released from ATP in the loss ofadenosine molecules from ATP		(1)

Question number	Answer	Additional guidance	
(c)(ii)	A calculation showing the following steps: • calculation of energy from 38 ATP (1) • calculation of percentage of energy from glucose (1)	38 x 30.51 (1159.38) (1159.38/2867.48 x 100) = 40.43% Accept 40.4 Do not accept 40.5 or 40 Correct answer without working gains 2 marks	(2)

Question number	Answer	Additional guidance	Mark
(c)(iii)	An answer that includes the following points: • lost as heat (1) • increasing body temperature (1)	Both points may be in the same sentence	(2)

Question number	Answer	Additional guidance	Mark
(d)	A description that includes two of the following points: • oxygen is terminal electron acceptor / accepts electronsfrom electron transport chain (1) • forms H_2O / accepts H^+ from reduced NAD/FAD (1)	**Accept** electrons cannot be passed along electron transport chain if no $O_2$to accept them (1)	(2)

Q6.

Question number	Answer	Mark
(a)	An answer that includes the following point: B 1 is the correct answer • A, 0 is not the correct answer as the third statement only is correct • C, 2 is not the correct answer as the third statement only is correct • D, 3 is not the correct answer as the third statement only is correct	

Question number	Answer	Additional guidance	Mark
(b)(i)	A calculation showing the following steps: • calculation of cardiac output / min (1) • conversion to dm^3 and output per hour and given to two significant figures (1)	(77x70) = 5390 ((5390 x 60) /1000)) = 320 Correct answer gains 2 marks x60 first and do the x70 afterwards. e.g. 1 mark for 4620 if they don't get the correct answer	**(2)**

Question number	Answer	Additional guidance	Mark
(b)(ii)	A calculation showing the following steps: • calculation of cardiac output (1) • correct unit stated (1) • calculation of cardiac index (1)	mp1 for (1.49 x 2.8)= 4.2 /4.17 / 4.172 mp2 for $dm^3min^{-1}m^{-2}$ ACCEPT $dm^3\ m^{-2}\ min^{-1}$ ACCEPT dm^3 per min per m^2 Mp3 for (6.9/1.92) =3.5 / 3.49 / 3.489 ACCEPT values / units in working if table is empty (or by formula)	**(3)**

Question number	Answer Additional guidance	Mark
(b)(iii)	An answer that includes the following points: **Indicative content** - description from graphs and experimental data **Heart rate:** • as the concentration of adrenaline increases, the increase in heart rate increases in both groups • this increase is (slightly) {greater in the older group of people / lower in younger people} • at all concentrations of adrenaline the older group have greater {change/heart rate} / at all concentrations of adrenaline the younger group have smaller {change/heart rate} --- • but there are no error bars to judge whether or not this difference is significant • due to stated effect of aging on heart - weaker muscle/effect on SAN/lower stroke volume **Cardiac index:** • as the concentration of adrenaline increases, the increase in cardiac index increases in both groups • the increase is the same at {20 / 40} ng kg^{-1} min^{-1} • at concentrations above 40 ng kg^{-1} min^{-1} the increase is {lower in older people / greater in younger people} • overall the increase cardiac index is {lower for the older people / greater for younger people} --- • due to lower cardiac output / increased body surface area/lower stroke volume / (accept converse for younger people) • but there are no error bars to judge whether or not this difference is significant	**(6)**

Change in blood pressure

- blood pressures decrease and then increase in both groups (as adrenaline concentration increases)
- a concentration of 20 ng kg^{-1} min^{-1} decreases the blood pressure in both groups
- a concentration of **{84-120} ng kg^{-1} min^{-1}** increases the blood pressure in older people
- in older people lower change in blood pressure (in response to higher concentrations of adrenaline) / converse for younger people

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- due to stated changes of aging on heart muscle/ blood vessels/baroreceptors
- no overlap of error bars between older and younger people indicate that these differences are significant (at all concentrations of adrenaline) / the error bars overlap for some concentrations for older people meaning that these differences are not significant / the error bars do not overlap for some concentrations for younger people meaning that these differences are significant

Level 1:

1 or 2 graphs commented on changes in heart rate/cardiac index/blood pressure as concentration of adrenalin increases

Level 2:

2 or 3 graphs commented on, including details of the effect of adrenaline on older people

Level 3:

All 3 graphs commented on, including details of the effect of adrenaline on older people and discussion of the significance of the data.

Q7.

Question number	Answer	Additional guidance	Mark
(a)	A 1 is the correct answer B not 2 as only the collecting duct is affected by ADH C not 3 as only the collecting duct is affected by ADH D not 4 as only the collecting duct is affected by ADH		(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	• ultrafiltration	Accept glomerular ultrafiltration	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	• microvilli		(1)

Question number	Answer	Additional guidance	Mark
(c)(i)	A calculation that has the following stages: • Correctly calculating the radius • Correctly calculating the cross-sectional area (1)	2.355, accept 2.36 17.43, accept 17.5	(2)

Question number	Answer	Additional guidance	Mark
(c)(ii)	• Correct calculation of the difference, must include the correct units (1)	1.97, difference in mm^2 0.0197, difference in cm^2, accept 0.02.Allow ECF from 4(c)(ii)	(1)

Question number	Answer	Additional guidance	Mark
(d)	An answer that includes three of the following points: • proximal tubule has role in selective reabsorption (1) • named relative concentration change by reabsorption (1) • comment on protein channels for reabsorption/ suggestedmechanism for reabsorption (1) • named relative concentration change by secretion (1)	e.g. 100% of glucose e.g. 70x increase for urea	(3)

Question number	Answer	Additional guidance	Mark
(e)	A two-step calculation: • Calculation of urine in one hour • Correct total for 24 hours to two s.f.	(0.83 x 60 = 49.8) (Accept 60x24x0.83) 1195.2 for onemark $1.2dm^3$	Graduate (2)

Q8.

Question number	Answer	Additional guidance	Mark
(a)	• correct magnification (1) • magnification given in correct standard form (1)	(98±1 ÷ 0.00075) = 130 600 1.3×10^5 / 1.31×10^5 / 1.306×10^5 ACCEPT $97 \div 0.00075 = 1.29 \times 10^5$ $99 \div 0.00075 = 1.32 \times 10^5$ Correct answer scores full marks	**(2)**

Question number	Answer	Additional guidance	Mark
(b)(i)	C 3 nmol mg^{-1} min^{-1} A, B and D are not correct because the correct answer is 60 ÷ 20 = 3		**(1)**

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes four of the following points: Sample 1: • (carbon dioxide is produced) because pyruvate can be used (as a substrate) for {aerobic respiration / link reaction} (in mitochondria) (1) Sample 2: • ADP increases rate of (aerobic) respiration (1) • because there is (sufficient) ADP for synthesis of ATP (1) Sample 3: • the pyruvate transport inhibitor stops pyruvate being taken into the {mitochondria/matrix} (1)	ACCEPT pyruvate releases carbon dioxide when forming acetyl CoA ACCEPT ADP increases rate of Krebs cycle ACCEPT ADP is converted to ATP ACCEPT ADP is not limiting ACCEPT the pyruvate transport inhibitor stops pyruvate entering {link reaction / Krebs cycle} ACCEPT pyruvate is not converted into acetyl CoA / acetyl CoA doesn't **form** (in sample 3)	**(4)**

Question number	Answer	Additional guidance	Mark
(c)(i)	An explanation that includes the following points: • slow twitch muscle fibres have more mitochondria (than fast twitch muscle fibres) (1) • because they rely on (ATP from) aerobic respiration (1) • (slow twitch fibres have more mitochondria) because oxygen supply is sufficient / more capillaries carrying oxygenated blood / cells contain (more) myoglobin (1)	ACCEPT converse ACCEPT fast twitch relies on (ATP from) {anaerobic respiration / creatine phosphate} ACCEPT converse	**(3)**

Question number	Answer	Additional guidance	Mark
(c)(ii)	A description that includes the following points: • ATP binds to the myosin head (1) • {releasing the myosin head from the actin strand/breaking the cross-bridge} (1) • ATP is hydrolysed (by the myosin head) (1) • providing energy to move the myosin head {back/upright} (1)	ACCEPT ATP broken down into ADP ACCEPT change shape of myosin head / return to original position Do not accept the power stroke	**(4)**

Q9.

Question number	Answer	Additional guidance	Mark
(a)	A description that includes four of the following points: • Chemoreceptors detect {pH of blood / blood CO_2 concentration} (1) • send (fewer) impulses to the {respiratory centre / ventilation centre / medulla} (1) • decreased frequency of impulses to {intercostal muscles/diaphragm} (1) • allowing (breathing muscles) to {relax / contract less frequently} (1) • rate set by the {respiratory centre / ventilation centre / medulla / pons} (1) **OR** • As air enters the lungs, stretch receptors in the lungs are activated (1) • Send impulses to inhibit inspiratory centre (1)	Do not accept message / signal ACCEPT impulses sent via parasympathetic nervous system	**(4)**

	• (resulting in) {no/fewer} impulses to {intercostal muscles/diaphragm} (1) • allowing (breathing muscles) to {relax / contract less frequently} (1) • rate set by the {inspiratory centre / expiratory centre / medulla / pons} (1)	ignore ventilation centre	

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes three of the following points: • receptors on post-synaptic membrane (1) • (receptors) have (different) three-dimensional shapes/ are specific for (different) neurotransmitters (1) • description of response once the neurotransmitter has bound to the receptor (1)	ACCEPT {ion channel / gates} on post-synaptic membrane ACCEPT (receptors have) complementary shape to specific neurotransmitter e.g. opening of sodium channels / causing an action potential / depolarising membrane / inhibitory neurotransmitter prevents {depolarisation /action potential}	**(3)**

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes two of the following points: • release neurotransmitters (1) • that act on white blood cells / (stimulate) {spleen/thymus/lymph nodes} (1) • to {release (more/ less) cytokines / release white blood cells into blood / recruit white blood cells from blood} (1)	ACCEPT release of named neurotransmitter e.g. noradrenaline / adrenaline / epinephrine / acetylcholine ignore release of chemicals ACCEPT release (more/ less) of named chemical e.g. histamine	**(2)**

Question number	Answer	Additional guidance	Mark
(d)	An explanation that includes the following points: • record ECG before and (for 10 minutes) after changing {posture / position} (1) • count the number of a named peaks in one minute (1) • description of how POTS is identified (1)	ACCEPT calculate heart rate e.g. {heart rate / peaks per minute} will increase by 30 bpm / heart rate will be above 120 bpm (within 10 minutes of posture change)	**(2)**

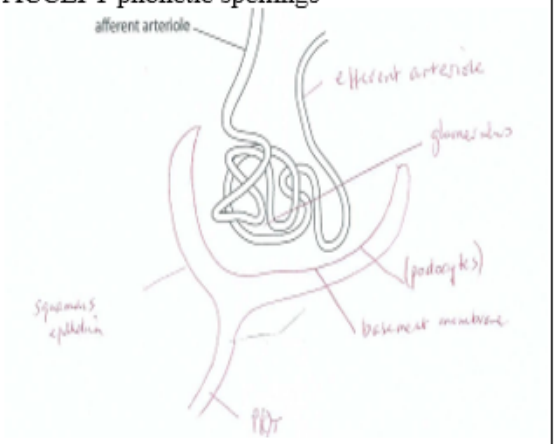
Question number	Answer	Additional guidance	Mark
(e)	An explanation that includes four of the following points: • bolus acts as a stimulus/ receptor detects bolus (1) • motor neurone transmits (electrical) impulse to (smooth) muscle (1) • detail of how nerve impulse stimulates muscle contraction (1) • therefore {circular muscle contracts / longitudinal muscles relax} {around/above} bolus (1) • therefore {circular muscle relax / longitudinal muscles constrict} in {front/below} of bolus (1)	ACCEPT description of food stretching gut wall ACCEPT release of neurotransmitter ACCEPT {circular muscle contracts / longitudinal muscles relax} in {propulsive / proximal} segment ACCEPT {circular muscle relax / longitudinal muscles constrict} in receiving segment	**(4)**

Question number	Answer	Additional guidance	Mark
(f)	• inadequate blood supply to a {tissue / organ} (1)	ACCEPT a named organ e.g. heart ACCEPT {inadequate / decreased / no} blood supply	**(1)**

Question number	Answer	Additional guidance	Mark
(g)	An answer that includes one of the following points: • mutation (in gene expressed by embryological ENS) (1) • (embryological ENS) do not have surface {antigens/ receptors} that allow them to locate to bowel (1)	ACCEPT so embryological ENS do not differentiate (into working neurones) ACCEPT conditions in the bowel may not be suitable for the growth of the embryonic cells	**(1)**

Question number	Answer	Additional guidance	Mark
(h)	An explanation that includes three of the following points: • environmental factor changes conditions in the gut / causes a change in the gut flora (1) • therefore microbial {chemicals/toxins} released (1) • (chemicals / toxins / microbes) stimulate an {inflammatory response / immune response} (1) • explanation of how the inflammatory response occurs (1)	ACCEPT new microorganism / pathogen / microbe / bacteria ACCEPT release of {histamine / cytokines} e.g effect of histamine such as vasodilation / oedema occurs / recruitment of inflammatory cells / recruitment of white blood cells	**(3)**

Q10.

Question number	Answer	Additional guidance	Mark
(a)(i)	• correct shape given (1) • one correct labelled feature (1) • second correctly labelled structure (1)	cup shaped around glomerulus doesn't need to completely envelop / must have PCT possible labels: efferent arteriole glomerulus PCT proximal (convoluted)tubule/ tube podocytes basement membrane squamous epithelium ACCEPT phonetic spellings  	(3)

	Answer	Mark
(a)(ii)	The correct answer is B • A is not the correct answer because amylose is not found in blood • C is not the correct answer because haemoglobin is too big a molecule to be filtered • D is not the correct answer because prothrombin is too big a molecule to be filtered	(1)

	Answer	Mark
(a)(iii)	The correct answer is D • A is not the correct pathway • B is not the correct pathway • C is not the correct pathway	**(1)**

Question number	Answer	Additional guidance	Mark
(b)	A description that includes the following points: • occurs in proximal (convoluted) tubule (1) • using {transport molecules / transporters/ active transport} (in the membrane of the nephron) (1) • (co transport) with sodium ions (1) • diffuse into blood (capillaries) {down /along} concentration gradient (1)	ACCEPT channel proteins / carrier proteins ignore ref to sodium pump ACCEPT facilitated diffusion	**(3)**

Question number	Answer	Additional guidance	Mark
(c)	The correct answer is C • A is not the correct answer • B is not the correct answer • D is not the correct answer		**(1)**

Q11.

Question number	Answer	Additional guidance	Mark
(a)(i)	Choose an item. D sensory neurone is correct A is not correct because a motor neurone does not continuea reflex action after the receptor. B is not correct because the relay neurone does not continuea reflex action after the receptor. C is not correct because a Schwann cell does not continue areflex action after the receptor.		(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	Choose an item. C is the correct answer receptor → spinal cord → muscle B is not correct because muscle → receptor → brain is not thecorrect pathway C is not correct because muscle → spinal cord → brainis not the correct pathway D is not correct because spinal cord → brain → Muscle is notthe correct pathway.		(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	A description that includes three of the following points: • reference to use of sodium potassium pump (1) • the sodium ion channels are closed • the membrane is relatively permeable to potassium ions(1) • at rest high potassium ions (K^+) inside the axon, highsodium ions (Na^+) outside axon	Potassium channels open	(3)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points: • pressure deforms cell membranes in the Paciniancorpuscle • an influx of sodium ions into the axon • details of the (action potential in the axon)	Accept disrupts, changes cell membrane Do not accept damages If they refer to opening the sodium channels it could be an alternative to second point	(3)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An answer that includes three of the following points: • the threshold (potential) has been reached • results in action potential • action potentials are all or nothing (1)	Accept since either they occur fully orthey do not occur at all	(3)

Q12.

Question number	Answer	Additional guidance	
(a)	A description that includes two of the following points: • calcium ions bind to troponin (1) • causing tropomyosin to move (1) • allowing the myosin (head) to bind (1)	ACCEPT change in shape ACCEPT exposing the myosin binding site /allowing actomyosin bridges to form	(2)

Question number	Answer	Additional guidance	
(b)	An explanation that includes the following points: • many mitochondria allows more (aerobic) respiration(1) • many myoglobin molecules allowsgreater (store)of oxygen (1) • larger capillary network ensures good supply of {oxygen/ glucose} (1) • slow sustained contraction allows longerperiods ofexercise / race for longer(1)	ACCEPT more ATP produced ACCEPT in context endurance events / decrease in {fatigue / tiredness}	(4)

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes the following points: • exercise increases the rate of heat loss (1) • (eventually) the rate of heat loss reaches its maximum (1)	ACCEPT the rate of heat loss levels off	(2)

Q13.

Question number	Answer	Additional guidance	Mark
(a)	A calculation showing the following steps: • identification of heart rate at 5 and 12.5 minutes fordrug B (1) • calculation of percentage change for drug B • correct answer	accept calculation of percentage decrease HR at 5= 30/31 HR at 12.5 = 57/57.5/58 57-30/30 x100 = 57.5-30/30 x100= 57-31/31 x100= 58-30/30 x100= 58-31/31 x 100= 90.0/91.67/83.87/93.3/87.09 Correct answers gain all 3 marks	3

Question number	Answer	Additional guidance	Mark
(b)	An answer that includes three of the following points: Similarity • both drugs have an effect on the heart rate over thetime period (1) • with both the greatest effect in first 3 minutes (1) Difference • change in heart rate with drug A levels off (between7-10mins) drug B still increasing at 15mins (1) • drug B reduces heart rate more than drug A	do not piece together accept increase drug B has greater effect than drug A	3

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes three of the following points: • stress increases heart rate (1) • because cardiovascular centre stimulates the SAN (1) • (both) drugs decrease frequency of impulses from SAN (1) • inhibiting the (change/ increase) in heart rate (1) • drug B has a greater effect (on the SAN)(1)	accept converse	3

Q14.

Question number	Answer	Additional guidance	
(a)	A calculation showing the following step: • width mm/length mm (1) • x actual length nm (1)	(24.5/75) = 0.33 (0.33 x 2000) = 653 accept 24/25 as width 75/76/77 as length range 619 - 667	(2)

Question number	Answer	Additional guidance	
(b)	A description that includes three of the following points: • reference to chemiosmosis (1) • electrons passed between (electron carriers / electron acceptors) releasing energy (1) • energy used to move protons (out of matrix) into inter membranal space (1) • role of stalked particle in generation of ATP from ADP and Pi (1)	electrons passed along ETC correct reference to ATP synthase in generation of ATP	(3)

Question number	Answer	Additional guidance	
(c)	A description that includes two of the following points: • hydrolysis of {ATP / bonds}(1) • releases energy (1)		(2)

Q15.

Question number	Answer	Additional guidance	Mark
(a)	An answer showing the following steps: • correct figures taken from graph (1) • correct calculation of percentage change (for fit person) (1) • correct difference given to an appropriate number ofdecimal places (1)	170 – 90 ACCEPT 80 ((170 – 90) ÷ 170) x 100 = 47.06 % 47.06 – 16 = 31.06 % Final answer 31 %ACCEPT 31.1 %	**(3)**

Question number	Answer	Additional guidance	Mark
(b)	An answer showing the following steps: • value of mx (1) • value of y (1) • correctly rounded to a whole number with units (1)	 (-65 ÷ 240) × 300 = -81.25 = (-65 ÷ 240 × 300) + 190 = 108.75 109 bpm Accept range 107-111	 **(3)**

Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes three of the following points: • fit person has greater lung capacity (1) • fit person (can produce) a greater cardiac output (1) • more effective gas exchange and transport of oxygen tomuscles (1) • therefore more rapid reduction of oxygen debt (1)		**(3)**

Question number	Answer	Additional guidance	Mark
(d)	A description that includes the following points: • cardiovascular control centre in the medulla oblongata (1) • detects change in blood pH (following exercise) (1) • as blood pH increases (more) impulse are sent via the parasympathetic nerve (1) • slowing (the rate of impulses from) the SAN (1)	 Accept increase in lactate / CO_2 Accept vagus nerve	**(4)**

Q16.

Question number	Answer	Mark
(a)	B inner mitochondrial membrane	**(1)**

Question number	Answer	Mark
(b)(i)	An explanation that includes any two of the following points: • no ATP will be produced by the electron transport chain (1) • because electrons will not be passed onto the oxygen (1) • therefore {reduced NAD will not be reoxidised / the electron transport chain will stop} (1)	(2)

Question number	Answer	Mark
(b)(ii)	An explanation that includes the following points: • there will be no ATP production from reduced NAD (1) • there will be some ATP produced from reduced FAD because electrons from reduced FAD enter the electron transport chain after the site of inhibition of rotenone (1)	(2)

Question number	Answer	Mark
(b)(iii)	An explanation that includes the following points: • because the inhibitors affect the ETC, which is not used in anaerobic respiration (1) • therefore the same quantity of ATP will be produced from substrate level phosphorylation in glycolysis (1)	(2)

Q17.

Question number	Answer	Additional guidance	Mark
(a)	An answer that includes two of the following points: • positive feedback results in an increase in the change (of the variable) (1) • negative feedback results in a decrease in thechange (of the variable) (1)	can be phrased in many ways eg. change from normal	2

Question number	Answer	Additional guidance	Mark
(b)	The only correct answer is **D** ***A*** *is not the correct answer as thermoregulation is continuallyrequired.* ***B*** *is not the correct answer as the body continually generates heat* ***C*** *is not the correct answer as more heat being gained than lost means body is not in equilibrium.*		1

Question number	Answer	Additional guidance	Mark
(c)(i)	An explanation that includes the following points: • creatinine is a small molecule (1) • therefore can be forced through the {pores / basement membrane} (1) • as a result of high pressure in the glomerulus (1)	ACCEPT ultrafiltration occurs for mp1 / ignore anyRMM figures allow through fenestrations	3

Question number	Answer	Additional guidance	Mark
(c)(ii)	A calculation showing the following step: • correct answer given to 3 significant figures (1)	accept 1960/15x60 = 2.18mg min^{-1} 1960/15 = 131	1

Question number	Answer	Additional guidance	Mark
(d)(i)	An answer that includes three of the following points: 1. general comment about all patients after surgery 2. comment on difference in 2 groups – can use figures 3. comment using SD 4. comment on largest change after surgery	ACCEPT ref to error bars	3

Question number	Answer	Additional guidance	Mark
(d)(ii)	A calculation showing the following steps: • calculation of difference surgery makes for non-diabetic and type II diabetic (1) • correct number calculated (1)	0.32 0.7 0.7 – 0.32 = 0.38 correct answer gains 2 marks	2

Q18.

Question number	Answer	Additional guidance	Mark
(a)(i)	A cortex		**Computer** **(1)**

Question number	Answer	Additional guidance	Mark
(a)(ii)	A W		**Computer** **(1)**

Question number	Answer	Additional guidance	Mark
(a)(iii)	C Y only		**Computer** **(1)**

Question number	Answer	Additional guidance	Mark
(b)	An answer that includes the following points: • (urea) forced out by high pressure (of the blood) (1) • caused by afferent blood vessel greater diameter than efferent blood vessel in the glomerulus (1) • through pores in the (basement) membrane (1)	IGNORE any other mechanism other than ultrafiltration ALLOW arteriole NOT artery ALLOW reference to podocytes /glomerular fenestrations	**Expert** **(2)**

Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes the following points: • less water available in deserts (1) • (Kangaroo rat conserves water) by producing more concentrated urine (1) • needs to actively transport more sodium ions into (the extracellular fluid of) medulla (1) • therefore needs more mitochondria to produce more ATP (1)	ALLOW Less water available for kangaroo rat ALLOW {more water reabsorbed / filtered out} producing more concentrated urine IGNORE sodium	**Expert** **(3)**

Q19.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes the following point B is the correct answer • A is not the correct answer • C is not the correct answer • D is not the correct answer		(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An answer that includes the following point: B is the correct answer • A is not the correct pathway • C is not the correct pathway • D is not the correct pathway		(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes three of the following points: • heart rate decreases when diving (1) • the longer the whale is diving the lower the heart rate (1) • the difference between maximum heart rate at the surface and minimum heart rate in dive increases as dive duration increases (1)	accept ref to max and min HR	(3)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes three of the following points: • relevant physiological change during a dive described (1) • {pH/oxygen / carbon dioxide concentrations} in the blood monitored by {chemoreceptors /sensors} (1) • increase in impulses from medulla to SAN (1) • increase impulses from SAN leading to increased heart rate (1)	E.g. blood oxygen decreases / {CO_2/lactate} increases /pH decreases / oxygen debt develops accept increased depolarisations	(3)

Q20.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes the following point: B is the correct answer • A is not the correct answer as adrenal glands do not produce ADH • C is not the correct answer as the medulla oblongata does not produce ADH • D is not the correct answer as the pituitary gland does not produce ADH		**(1)**

Question number	Answer	Additional guidance	Mark
(a)(ii)	An answer that includes the following point: B is the correct answer • A is not the correct answer as ADH does not act on the capillaries • C is not the correct answer as ADH does not act on the proximal tubules • D is not the correct answer as ADH does not act on the ureters		**(1)**

Question number	Answer	Additional guidance	Mark
(a)(iii)	An answer that includes the following point: C is the correct answer • A is not the correct answer as the countercurrent multiplier does not control plasma volume • B is not the correct answer as habituation is a behavioural response • D is not the correct answer as control of plasma volume is not a positive feedback		**(1)**

Question number	Answer	Additional guidance	Mark
(a)(iv)	• osmoreceptors	ACCEPT osmotic receptor	**(1)**

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes the following points: • increasing concentration of the gibberellin increases {length / growth} (of all internodes) (1) • increase is mostly in the length of the first internode (1)	ACCEPT positive correlation ignore gibberellin increases plant growth unqualified ACCEPT {least / smallest} effect on the last/3rd internode	**(2)**

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes three of the following points: • gibberellin {enters the nucleus / binds to cell surface receptors} (1) • gibberellin {acts as a transcription factor / activates transcription factor} (1) • effect of transcription factor (1) • (causing) cell elongation / cell division (and causes internode elongation) (1)	ACCEPT secondary messenger e.g. activates protein synthesis / stimulates amylase production / amylase breaking starch down into glucose for respiration	**(3)**