

Question Number	Answer	Acceptable answers	Mark
5(a) (i)	homeostasis / thermoregulation / osmoregulation		(1)

Question Number	Answer	Acceptable answers	Mark
5(a) (ii)	D 37 °C		(1)

Question Number	Answer	Acceptable answers	Mark
5(b)	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> • (travel along) sensory neurones (1) • axons / dendrons (1) • as electrical / electric impulses (1) • across synapses (gap between two neurones) (1) • using neurotransmitters (1) • reference to spinal cord /CNS (1) • reference to myelin sheath (1) 	<p>dendrites</p> <p>accept signals for impulses</p> <p>ignore electronic</p>	(4)

Question Number	Indicative Content	Mark
QWC	<p>*5(c) An explanation of thermoregulation in response to a low external temperature</p> <ul style="list-style-type: none"> • hypothalamus detects a drop in the blood's temperature • vasoconstriction • blood vessels near the surface of the skin constrict • reduce blood flow to the skin • reduce heat loss via radiation • hair erector muscles contract • raises hairs on body to trap a layer of insulating air between cold environment and body surface • reduce heat loss via conduction • shivering will occur • skeletal muscles contract and relax involuntarily • produces respiratory heat to warm up body • hypothalamus detects a rise in the blood's temperature • reference to negative feedback 	(6)
Level	0 No rewardable content	
1	<p>1 - 2</p> <ul style="list-style-type: none"> • a limited explanation is provided for one of the methods of raising body temperature • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	<p>3 - 4</p> <ul style="list-style-type: none"> • a simple explanation of two of the methods of raising body temperature or one method explained in detail, alternatively a limited explanation of all three methods • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	
3	<p>5 - 6</p> <ul style="list-style-type: none"> • a detailed explanation of at least one of the methods of raising body temperature with a simple explanation of two others • most of the steps are identified and are in a logical order and reference may be made to hypothalamus and negative feedback • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	

Question Number	Answer	Acceptable answers	Mark
6a(i)	C <input checked="" type="checkbox"/> hypothalamus		(1)

Question Number	Answer	Acceptable answers	Mark
6(a)(ii)	<p>An explanation linking four of the following:</p> <p>vasodilation occurs when the body is hot (1)</p> <p>blood vessels near the surface of the skin widen / the blood vessels increase the amount of blood flow near the surface of the skin (1)</p> <p>vasoconstriction occurs when the body is cold (1)</p> <p>blood vessels near the surface narrow /the blood vessels reduce the blood flow near the surface of the skin (1)</p>	<p>accept: description of shunt valve (1)</p>	(4)

Question Number	Answer	Acceptable answers	Mark
6(b)	osmoregulation		(1)

Question Number		Indicative Content	Mark
QWC	*6(c)	<p>An explanation to include some of the following points:</p> <p>lowering blood glucose concentrations</p> <ul style="list-style-type: none"> • insulin is released • from the pancreas • into the bloodstream • causing glucose to be converted to glycogen • stored in the liver / muscle tissue • blood glucose concentrations are lowered <p>raising blood glucose concentrations</p> <ul style="list-style-type: none"> • glucagon is released • from the pancreas • into the bloodstream • causing glycogen to be converted to glucose • glucose released into the bloodstream • blood glucose concentrations are raised 	(6)
Level	0	No rewardable content	
1	1 - 2	<ul style="list-style-type: none"> • a limited explanation of either lowering or raising glucose concentrations in the blood • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3 - 4	<ul style="list-style-type: none"> • a simple explanation of both lowering and raising glucose concentrations in the blood or a detailed explanation of one of them • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	
3	5 - 6	<ul style="list-style-type: none"> • a detailed explanation of both raising and lowering blood glucose concentrations including the role of the hormones and the role of glycogen. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	

Total for question 6 – 12 marks

Question number	Answer	Mark
9(a)	C	(1)

Question number	Answer	Mark
9(b)(i)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks):</p> <ul style="list-style-type: none"> ultrafiltration occurs in the glomerulus where the liquid part of the blood passes into the Bowman’s capsule (1) reabsorption takes place as it travels through the proximal convoluted tubule into the loop of Henle (1) finally urine production occurs in the collecting duct and excess fluid and sodium ions are removed (1) 	(3)

Question number	Answer	Mark
9(b)(ii)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> the kangaroo rat lives in the desert so it needs to retain as much water as possible (1) as most water is reabsorbed in the loop of Henle, a longer loop gives more surface area for water reabsorption (1) 	(2)

Question Number	Indicative content	Mark
*9(b)(iii)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;">AO2 (6 marks)</p> <p>water content</p> <ul style="list-style-type: none"> • increased ADH causes more water to be reabsorbed into the bloodstream • prevents dehydration • decreased concentrations of ADH cause less water reabsorption • greater volume of urine produced • at 0.0 mol/dm^{-3} of sodium ions the volume of ADH stored is at its highest • so the lowest amount of ADH is released • water levels in the body are regulated <p>sodium ions</p> <ul style="list-style-type: none"> • as sodium ion concentration increases the levels of ADH stored decrease • at 0.25 mol/dm^{-3} ADH stored reduced by 5 au • so a small amount of water is reabsorbed • at 0.50 mol/dm^{-3} ADH stored reduced by a further 30 au • a greater amount of water is reabsorbed • the volume of ADH stored remains stable at 8 au • causing the maximum amount of water to be reabsorbed • preventing dehydration when sodium levels are high 	(6)

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	<ul style="list-style-type: none"> • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	<ul style="list-style-type: none"> • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	<ul style="list-style-type: none"> • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the

		<p>context of the question.</p> <ul style="list-style-type: none"> Lines of reasoning are supported by sustained application of relevant evidence. (AO2)
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Question number	Answer	Mark
10(a)(i)	B	(1)

Question number	Answer	Mark
10(a)(ii)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> the bacteria convert the ammonia into nitrites then nitrates maintaining the pH (1) (this prevents an increase in pH) which would cause enzymes to denature and kill the fish (1) 	(2)

Question number	Answer	Mark
10(a)(iii)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark):</p> <ul style="list-style-type: none"> the aquatic plant will take up nitrates by active transport (1) against the concentration gradient/from where there is a low concentration to where there is a high concentration of nitrates (1) 	(2)

Question Number	Answer	Acceptable answers	Mark
3 (a)(i)	<p>A description including two of the following points</p> <ul style="list-style-type: none"> • initial /at the start increase in concentration (1) • 06.00 to 08.00 / 12.00 to 13.00 (1) • decrease in concentration after 08.00 / fall in concentration between 08.00 and 12.00 (1) • increased again at 13.00 (1) 	accept specific times eg. at 8.00 concentration high	(2)

Question Number	Answer	Acceptable answers	Mark
3(a) (ii)	<ul style="list-style-type: none"> • increase due to food intake (1) • decrease due to glucose being used up / stored /insulin released / doing exercise(1) 	<p>accept 8:00 or 13:00 for increase</p> <p>answers must be linked to idea of increase or decrease not simply eating food</p>	(2)

Question Number	Answer	Acceptable answers	Mark
3(a)(iii)	C glycogen in the liver		(1)

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	substitution (1) $1.50^2 = 2.25$ or $67.5 / 1.5^2$ (1) evaluation (1) $67.5 \div 2.25 = \text{BMI of } 30$	accept 45 (1) (as this is the correct calculation without squaring the 1.5) give full marks for correct answer, no working	(2)

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	An explanation including the following points <ul style="list-style-type: none"> • physical activity can be performed (to reduce glucose levels) (1) • diet can be controlled (to reduce glucose levels) (1) • take medication (orally or injected) (1) 	accept insulin/ metformin for medication	(3)

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	B – 1.1		(1)

Question Number	Answer	Acceptable answers	Mark
3 (a) (ii)	continuous (data / variation)		(1)

Question Number	Answer	Acceptable answers	Mark
3(a) (iii)	$\frac{18}{60}$ (1) $0.3 \times 100 = 30(\%)$ (1) Or $0.33 \times 100 = 33(\%)$ (1)	correct answer 2 marks	(2)

Question Number	Answer	Acceptable answers	Mark
3(b) (i)	An explanation to include four of the following: <ul style="list-style-type: none"> • hypothalamus controls body temperature(1) • causing the body to sweat (more) (1) • (sweating cools the body by) evaporation of water / sweat (1) • vasodilation (of blood vessels) (1) • heat lost by radiation (1) • this is called negative feedback (1) 	explanation of vasodilation – more blood flowing near surface of skin hairs lie flat on skin (so no insulation) (1)	(4)

Question Number	Answer	Acceptable answers	Mark
3(b) (ii)	An explanation to include two of the following: <ul style="list-style-type: none">• muscles (contract and relax)(1)• friction (1)• releasing heat by respiration (1)		(2)

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	2.7	Allow -2.7 (°C)	(1)

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	<p>a comparison to include the following linked points</p> <p>(Rebecca's) brain temperature fluctuated / stayed similar / did not change very much (1)</p> <p>(whereas) finger temperature decreased (1)</p>	Ignore references to brain temperature going up	(2)

Question Number	Answer	Acceptable answers	Mark
5(a)(iii)	<p>an explanation to include three of the following points</p> <p>heat lost to the environment /from finger (1)</p> <p>less blood delivered to the skin's surface/finger (1)</p> <p>narrowing of the arterioles near the skin's surface (1)</p> <p>vasoconstriction (1)</p> <p>less heat loss by radiation(1)</p>	<p>accept ref to temperature gradient</p> <p>accept more blood flow to vital organs</p> <p>accept blood vessels for arterioles</p>	(3)

Question Number	Indicative Content	Mark	
QWC	*5(b)	<p>A explanation to include some of the following</p> <ul style="list-style-type: none"> • homeostasis / regulation of the body's internal environment • controlled by the hypothalamus / thermoregulatory • hypothalamus / thermoregulatory centre monitors blood temperature • negative feedback mechanism • sweat rate increases • sweat glands will release sweat on to skin surface • evaporation of this sweat / water will remove heat energy from skin • hairs on skin's surface lay flat • no trapping of insulating air layer so body loses heat • vasodilation occurs • widening of the arterioles / blood vessels eq, near the skin delivers warm blood to skin surface • body loses heat by radiation 	(6)
Level	0	No rewardable content	
1	1 - 2	<ul style="list-style-type: none"> • a limited explanation of at least one method of thermoregulation • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3 - 4	<ul style="list-style-type: none"> • a simple explanation including at least two methods of thermoregulation • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	
3	5 - 6	<ul style="list-style-type: none"> • a detailed explanation of at least 3 methods of thermo regulation. Use of the term vasodilation or including information on the process of homeostasis • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	

Total for Question 5 = 12 marks

Question number	Answer	Notes	Marks
1 (a) (i)	B homeostasis		(1)

Question number	Answer	Notes	Marks
1 (a) (ii)	An explanation linking the following: water evaporates (1) heat / energy removed (1)	Accept sweat/oils for water Accept heat released/lost	(2)

Question number	Answer	Notes	Marks
1 (b)	An explanation including three of the following: <u>vasoconstriction</u> / blood vessels narrow/constrict(1) (blood vessels) near to the (surface of the) skin (1) this reduces blood flow (1) so less heat lost by <u>radiation</u> (1)		(3)

Question number	Answer	Notes	Marks
1 (c)	A description linking two of the following: (brain contains the) <u>hypothalamus</u> (1) (brain/hypothalamus) detects changes in temperature (1) by {receiving/sending} information via {nerve endings / sense organs / skin receptors / effectors} (1)		(2)

(Total for Question 1 = 8 marks)

Question number	Answer	Notes	Marks
2 (a)	any value from 22.00 hours to 23.00 hours	accept from 10 pm to 11 pm	(1)

Question number	Answer	Notes	Marks
2 (b)	<p>An explanation linking four of the following:</p> <p>blood glucose levels increases (1)</p> <p>(increased glucose means) insulin is released (1)</p> <p>(insulin is released) from the pancreas (1)</p> <p>(insulin stimulates the) conversion of glucose into glycogen (1)</p> <p>glycogen is stored in the liver (1)</p>	Accept glucose absorbed into the blood	(4)

Question number	Answer	Notes	Marks
2 (c)	<p>An explanation linking three of the following points:</p> <p>glycogen levels lower / graph would be flatter (1)</p> <p>a person with type 2 diabetes does release insulin / the amount of insulin released is not enough (1)</p> <p>but <u>cells</u> have become resistant to insulin (1)</p> <p>so no / less glucose is converted to glycogen (1)</p>	Accept <u>cells</u> do not respond to insulin	(3)

(Total for Question 2 = 8 marks)

Question Number	Answer	Acceptable answers	Mark
6a (i)	B – the glucose content of their blood		(1)

Question Number	Answer	Acceptable answers	Mark
6a (ii)	<p>An explanation linking three of the following points:</p> <ul style="list-style-type: none"> • (the hormone) insulin (1) • (insulin)is injected (into subcutaneous fat) (1) • use a low carbohydrate /healthy diet (1) • (increase) exercise (1) • to lower blood glucose levels / when blood glucose levels get too high / regulate glucose levels(1) 	use of epipen	(3)

Question Number	Answer	Acceptable answers	Mark
6b	<p>Body Mass Index calculation:</p> <p>$120/1.8^2$ (1)</p> <p>37 (1)</p>	ecf for correct manipulation with incorrect figures	(2)

Question Number		Indicative Content	Mark
QWC *6(c)		<p>An explanation including the following points in a logical order:</p> <ul style="list-style-type: none"> • a reflex response is an involuntary response • reflex responses do not involve the brain • reflex responses involve sensory neurones • reflex responses involve relay neurones • reflex responses involve motor neurones • relay neurones are in the spinal cord • impulses travel along neurones as electrical signals • the axon is insulated by the myelin sheath • which ensures the electrical signal does not lose energy • at the junction between two neurones there is a synapse • the message is carried across the synapse by neurotransmitters • the message travels from the stimulus along the axon and dendron of the sensory neurone to the spinal cord • the reflex arc is important to keep the body safe 	(6)
Level	0	No rewardable content	
1	1-2	<ul style="list-style-type: none"> • A limited written explanation of some of the neurones involved in the reflex arc or a limited explanation of how messages /impulses are transmitted as electrical signals • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3-4	<ul style="list-style-type: none"> • A simple explanation of the neurones involved in the reflex arc in the correct order, with the method of transmission along neurones, one neurone may be missing or a detailed description of all of the neurones in the reflex arc and the role of the CNS • the answer communicates ideas showing some evidence of clarity and organisation and mostly uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	
3	5-6	<ul style="list-style-type: none"> • A detailed explanation of the neurones involved in the reflex arc in the correct order, with the method of transmission along neurones including the role of the synapse and/or myelin sheath. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	