

Question		Expected Answer		Mark	Additional Guidance																												
1	(a)		<table border="1"> <thead> <tr> <th><i>motor neurone</i></th> <th><i>sensory neurone</i></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>cell body in CNS</td> <td>cell body , not in CNS / in PNS</td> <td>;</td> </tr> <tr> <td>2</td> <td>cell body at end (of neurone)</td> <td>cell body , not at end / in middle (of neurone)</td> <td>;</td> </tr> <tr> <td>3</td> <td>dendrites connect directly to cell body</td> <td>dendrites do not connect directly to cell body or dendrites at the end(s) of , dendron / axon</td> <td>;</td> </tr> <tr> <td>4</td> <td>long(er) axon</td> <td>short(er) axon</td> <td>;</td> </tr> <tr> <td>5</td> <td>dendron absent / no dendron</td> <td>dendron present</td> <td>;</td> </tr> <tr> <td>6</td> <td>ends at motor end plate</td> <td>starts at / connects to , (sensory) receptor</td> <td>;</td> </tr> </tbody> </table>	<i>motor neurone</i>	<i>sensory neurone</i>	1	cell body in CNS	cell body , not in CNS / in PNS	;	2	cell body at end (of neurone)	cell body , not at end / in middle (of neurone)	;	3	dendrites connect directly to cell body	dendrites do not connect directly to cell body or dendrites at the end(s) of , dendron / axon	;	4	long(er) axon	short(er) axon	;	5	dendron absent / no dendron	dendron present	;	6	ends at motor end plate	starts at / connects to , (sensory) receptor	;	3	<p>Award 1 mark for each correct side by side comparison. Comparative statements must be made on the same row.</p> <p>ALLOW two valid comparisons in the same pair of boxes, e.g</p> <table border="1"> <tr> <td>Cell body at end of neurone in the CNS</td> <td>Cell body in middle and in the PNS</td> </tr> </table> <p>= 2 marks</p> <p>mps 2, 3 and 4 can be taken from a labelled diagram All mps can be taken from annotated diagrams</p>	Cell body at end of neurone in the CNS	Cell body in middle and in the PNS
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Question		Expected Answer	Mark	Additional Guidance
1	(b)	<p>1 - 60 to -70 ;</p> <p>2 depolarisation ;</p> <p>3 <u>threshold potential</u> / <u>threshold value</u> ;</p> <p>4 all or nothing ;</p> <p>5 size / magnitude ;</p> <p>6 <u>frequency</u> ;</p>	6	<p>Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>1 ACCEPT any single figure or range (within this range) Must be a negative number</p> <p>4 ALLOW all or none</p> <p>5 ALLOW amplitude DO NOT CREDIT intensity / strength / value / potential difference / voltage</p>
Total			9	

Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)	0.0017 ; ;		<ul style="list-style-type: none"> • Correct answer, given to 4 dp = 2 marks • If answer not shown on answer line, CREDIT correct answer written in the appropriate space in the table. • If answer is incorrectly rounded or rounded to the wrong number of dp or written in standard form (1.7×10^{-3}) then award 1 working mark • If answer is incorrect then award 1 working mark for seeing $1 \div 576$ or $1 \div 24^2$
2	(a)	(ii)	<p>1 (internal) radius / diameter , of capillary tube ;</p> <p>2 cross-sectional area (of capillary tube) ;</p> <p>3 (use) $\pi r^2 h$;</p>	2	<p>1 ACCEPT radius / diameter , of bubble ACCEPT width of tube</p> <p>2 ACCEPT cross-sectional area of bubble</p>
2	(a)	(iii)	<p>1 (sodium) hydrogen carbonate ;</p> <p>2 bubble in , CO_2 / exhaled air ;</p> <p>3 dry ice ;</p>	1 max	<p>1 ACCEPT bicarbonate DO NOT CREDIT carbonate</p>

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Question			Expected Answer	Mark	Additional Guidance
2	(b)	(i)	<p><i>idea that some of the oxygen</i></p> <p>1 would dissolve in the water ;</p> <p>2 used in , respiration / oxidative phosphorylation ;</p> <p>3 may escape the collection apparatus ;</p> <p>4 trapped in , a bubble attached to / air spaces in , the leaf ;</p>	2 max	<p>1 IGNORE 'oxygen is in the water'</p> <p>2 IGNORE produces energy</p>
2	(b)	(ii)	<p>1 (nitrogen) was present in the air (spaces) in the , leaf / plant ;</p> <p>2 (nitrogen) leaves the plant with the oxygen ;</p> <p>3 <i>idea that</i> (nitrogen) comes out of solution / 'undissolved' (as less soluble in warm water) ;</p>	1 max	
2	(b)	(iii)	<p>1 higher than , expected / normal / in atmosphere ;</p> <p>2 (plant is) respiring / produces CO₂ during respiration ;</p> <p>3 CO₂ , has been added to water / is present in excess ;</p> <p>4 (CO₂) comes out of solution / 'undissolved' (as less soluble in warm water) ;</p> <p>5 less / low(er) , as some CO₂ will dissolve in , water / solution ;</p> <p>6 less / low(er) , as CO₂ used in photosynthesis ;</p>	3 max	<p>2 IGNORE produces energy</p> <p>5 DO NOT CREDIT if in context of lower than O₂ and N₂</p> <p>6 DO NOT CREDIT if in context of lower than O₂ and N₂</p>

Question		Expected Answer	Mark	Additional Guidance
2	(c)	<p><i>intensity</i></p> <p>1 in deeper water there is , less / lower , light <u>intensity</u> ;</p> <p>2 (these pigments) can absorb what (little) light there is ;</p> <p><i>wavelength</i></p> <p>3 not all wavelengths of light can penetrate or mainly shorter wavelengths can penetrate or (mostly) blue light (450 – 520 nm) penetrates ;</p> <p>4 (these pigments) can absorb wavelengths of light that can penetrate (deeper water) ;</p>	<p>2 max</p>	<p>IGNORE ref to photosynthesis (as 'photosynthetic' stated in Q)</p> <p>2 ACCEPT trap / harvest / capture IGNORE use / collect</p> <p>3 idea of restricted range of wavelengths able to penetrate (rather than wavelengths are different) ACCEPT 'higher frequency' instead of 'shorter wavelength'</p> <p>4 ACCEPT trap / harvest / capture IGNORE use / collect</p>
Total			12	

Question		Expected Answer	Mark	Additional Guidance
3	(a)	<p>1 less ventilation / <i>Idea of</i> difficulty in exhaling due to less recoil / small surface area for gaseous exchange / less oxygen entering capillaries / less oxygen entering blood ;</p> <p>2 less oxygen (reaching cells) for , (aerobic) respiration / oxidative phosphorylation ;</p> <p>3 (so) less ATP produced ;</p> <p>4 <i>idea of</i> increased acidity (as CO₂ / lactate builds up) interfering with / affects , enzymes / respiratory metabolism ;</p>	2 max	<p>IGNORE 'produces' energy in any mark point</p> <p>1 DO NOT CREDIT no oxygen</p> <p>2 DO NOT CREDIT no respiration</p> <p>3 DO NOT CREDIT no ATP</p>
3	(b)	<p>1 not enough / less , glucose uptake into <u>cells</u> ;</p> <p>2 not enough / less , glucose / substrate , for , respiration / ATP production ;</p> <p>3 glucose not , stored as / converted to , glycogen ;</p>	2 max	<p>ACCEPT 'sugar' for glucose</p> <p>IGNORE (excess) glucose lost in urine (as does not answer the Q)</p> <p>Only CREDIT ora if candidate clearly states that the sequence of events does not happen in this case</p> <p>1 DO NOT CREDIT no glucose uptake</p> <p>2 IGNORE produces energy DO NOT CREDIT no respiration / no ATP / no glucose</p>

Question		Expected Answer	Mark	Additional Guidance
3	(c)	<p>1 <i>idea of</i> slow rate of / sluggish , blood flow or low(er) blood pressure ;</p> <p>2 less / irregular amount of , oxygen (reaching cells) for , (aerobic) respiration / oxidative phosphorylation ;</p> <p>3 less glucose (reaching cells) for respiration ;</p> <p>4 (so) less ATP produced ;</p> <p>5 <i>idea of</i> increased acidity (as CO₂ / lactate builds up) interfering with / affects , enzymes / respiratory metabolism ;</p>	2 max	<p>IGNORE 'produces' energy in any mark point</p> <p>1 IGNORE 'heart doesn't beat strongly enough' or 'heart beat is inefficient' IGNORE ref to volume of blood without time/rate</p> <p>2 DO NOT CREDIT no oxygen / no respiration</p> <p>3 IGNORE sugar DO NOT CREDIT no glucose / no respiration</p> <p>4 DO NOT CREDIT no ATP</p>

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Question			Expected Answer	Mark	Additional Guidance
3	(d)	(i)	<p>1 less pyruvate for , link reaction / Krebs cycle or link reaction / Krebs cycle , cannot take place / reduced or only / mainly , glycolysis takes place ;</p> <p>2 no / little , oxidative phosphorylation ;</p> <p>3 less , energy / ATP , for muscle contraction / resulting in muscle weakness / for mental processes ;</p> <p>4 <u>anaerobic</u> respiration takes place ;</p> <p>5 lactate / decrease in pH , causing aching muscles ;</p>	3 max	<p>2 IGNORE produces energy</p> <p>3 DO NOT CREDIT no ATP IGNORE produces energy IGNORE muscle fatigue</p> <p>5 CREDIT 'lactic acid' instead of 'lactate' ACCEPT muscle cramps</p>
3	(d)	(ii)	<p>1 <i>idea that</i> B lymphocytes do not respond to cytokines (that have been produced) ;</p> <p>2 little , energy / ATP , for B cell , mitosis / clonal expansion ;</p> <p>3 little , energy / ATP , for , production / release , of antibodies ;</p>	1 max	
Total				10	

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(i)	islet(s) of Langerhans ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT α and β cells in islets of Langerhans DO NOT CREDIT α cells in islets of Langerhans DO NOT CREDIT β cells in islets of Langerhans</p>

Question		Expected Answer	Mark	Additional Guidance
4	(a)	(ii)		If endocrine and exocrine terms are muddled, then ignore endocrine and exocrine refs but only award max 2 for <u>both sections</u> and do not award the QWC mark.
		<p>use ✓¹</p> <p><i>endocrine</i></p> <p>H1 hormone(s) released directly into blood ; H2 beta / β , cells , secrete / produce / release , insulin ; H3 alpha / α , cells , secrete / produce / release , glucagon ;</p> <p>H4 islet / α and β , cells , detect / monitor , blood glucose concentration ; 3 max</p> <p>use ✓²</p> <p><i>exocrine</i></p> <p>E1 fluid / juice / secretion / enzymes , released into <u>duct</u> ;</p> <p>E2 (release triggered by) nervous / hormonal , stimulation ; E3 pancreatic secretions into , gut / small intestine / duodenum ; E4 alkaline / pH 8 / (sodium) hydrogen carbonate ; E5 containing 2 <u>named enzyme(s)</u> ; 3 max</p>	4 max	<p>H1 DO NOT CREDIT carried / transported , in H2 ACCEPT b cells H3 ACCEPT a cells DO NOT CREDIT incorrect spelling of glucagon H4 ACCEPT a and b cells α cells and β cells secrete glucagon and insulin = 2 marks α cells and β cells secrete insulin and glucagon = 0 marks</p> <p>E1 IGNORE substances DO NOT CREDIT carried / transported , in</p> <p>E5 CREDIT 2 enzymes but no more than 1 enzyme from each bullet point</p> <ul style="list-style-type: none"> • lipase • amylase / carbohydrase • trypsin / chymotrypsin / protease / trypsinogen / chymotrypsinogen
		QWC – technical terms used appropriately with correct spelling ;	1	<p>Do not award if endocrine & exocrine are muddled. Use of 3 terms from: hormone(s), beta, alpha, glucagon, islet(s), pancreatic, duodenum, enzyme(s), amylase, trypsin(ogen) / chymotrypsin(ogen)</p> <p>You should use the GREEN DOT to identify the QWC terms that you are crediting. Please insert a QWC symbol next to the PENCIL ICON, followed by a tick (✓) if QWC has been awarded or a cross (×) if QWC has not been awarded</p>

Question			Expected Answer	Mark	Additional Guidance
4	(b)		D A G H C F ; ; ; ;	4	All letters in correct sequence = 4 marks If letters are not all in the correct sequence, then mark as follows: D at the beginning and F at the end = 1 mark A somewhere before G = 1 mark G somewhere before H = 1 mark H somewhere before C = 1 mark
4	(c)	(i)	<p>1 <i>idea of plentiful / dependable , supply ;</i></p> <p>2 cheap ;</p> <p>3 not cruel to pigs / more ethical ;</p> <p>4 no religious objections / can be used by vegetarians ;</p> <p>5 reliable , quality / standard ;</p> <p>6 (exact match to) human insulin / no allergic reaction ;</p>	2	<p>Mark the first <u>two</u> advantages</p> <p>1 e.g. can meet demand / can be mass produced IGNORE ref to speed</p> <p>6 ACCEPT ref to not spreading prions IGNORE spread of disease from pigs / no rejection DO NOT CREDIT genetically identical insulin</p>
4	(c)	(ii)	<p>1 (has the potential to) cure / do more than manage , the condition ;</p> <p>2 long term effect / permanent / no need for repeated treatments ;</p>	1 max	<p>1 e.g. no need to restrict diet</p> <p>2 e.g. no need to inject insulin (regularly)</p>
Total				13	

Question		Expected Answer	Mark	Additional Guidance
5	(a)	<p>P cortex ;</p> <p>Q ureter ;</p>		<p>Mark the first answer for each letter. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>Q Correct spelling only DO NOT CREDIT incorrect spelling of ureter</p>

Question			Expected Answer	Mark	Additional Guidance
5	(b)	(i)	<p>1 ultrafiltration ;</p> <p>2 afferent arteriole is wider than efferent arteriole ;</p> <p>3 high blood pressure in glomerulus / high(er) hydrostatic pressure in glomerulus (than in Bowman's capsule) ;</p> <p>4 <i>idea that</i> endothelium / wall of capillary , has gaps to , allow / prevent , passage (of substances / cells) ;</p> <p>5 <i>idea that</i> basement membrane stops removal of , large molecules / cells ;</p> <p>6 podocytes / epithelial cells of Bowman's capsule , have (finger-like) projections / processes ;</p> <p>7 (projections) ensure gaps to allow passage (of substances) ;</p>	3 max	<p>4 e.g. fenestrations in capillary wall don't allow red blood cells to leave DO NOT CREDIT cell walls of capillaries</p> <p>5 e.g. basement membrane (only) allows small molecules to pass through</p>
			<p>QWC – technical terms used appropriately and spelt correctly ;</p>		1

Question			Expected Answer	Mark	Additional Guidance
5	(b)	(ii)	<p>1 (large) protein / amino acids , present ;</p> <p>2 blood (cells) present ;</p> <p>3 glucose present ;</p> <p>4 more water present / more dilute ;</p> <p>5 more , ions / salts / electrolytes , present ;</p> <p>6 (more) vitamins present ;</p>	2 max	<p>Mark as prose - award marks wherever they occur</p> <p>1 ACCEPT more , protein / amino acids ACCEPT appropriately named protein e.g. albumin / antibodies / immunoglobulins</p> <p>3 DO NOT CREDIT more glucose</p>
5	(c)	(i)	<p>protein / polypeptide ;</p>	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE alpha helix / intrinsic / transmembrane DO NOT CREDIT glycoprotein</p>
5	(c)	(ii)	<p>1 the ions (in solution) are too large to pass through the channel or the channel is too narrow for the ions (in solution) to pass through ;</p> <p>2 shapes not compatible ;</p> <p>3 <i>idea that</i> positive charge (in the channel) repels the (positively charged) ions ;</p>	2 max	<p>Mark the first <u>two</u> suggestions</p> <p>1 ACCEPT gap / hole for channel</p> <p>3 DO NOT CREDIT repels and/or attracts</p>
			Total	11	

Question			Expected Answer	Mark	Additional Guidance
6	(a)	(i)	<u>adrenal cortex</u> ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks IGNORE endocrine gland(s)
6	(a)	(ii)	inner mitochondrial membrane / crista / location described ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks e.g. between the inter-membrane space and the matrix IGNORE stalked particles / ATP synthetase
6	(b)	(i)	<u>positive feedback</u> ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks IGNORE respiratory acidosis / hyperventilation
6	(b)	(ii)	<u>cyclic photophosphorylation</u> ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks DO NOT CREDIT cyclic phosphorylation
6	(b)	(iii)	cell signalling ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks IGNORE homeostasis
Total				5	