| Question | | | Answer | Marks | Guidance |
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| 1 | (a) | | (the) removal of metabolic waste, from the body;; | 2 | **The word metabolic must be present for both marks** |
| | (b) | (i) | link reaction<br>**AND**<br>krebs / citric acid, cycle | 1 | **Both needed** |
| | | (ii) | **1** *idea that* compounds are decarboxylated;<br><br>**and then any two from:**<br><br>**2** pyruvate is decarboxylated/converted to acetate;<br><br>**3** citrate decarboxylated/converted to 5 carbon compound;<br><br>**4** carbon compound decarboxylated/converted to 4 carbon compound; | 3 | **IGNORE** the names of stages<br>**DO NOT CREDIT** acetyl coA<br><br>**ACCEPT** $\alpha$ - ketoglutarate<br><br>**ACCEPT** $\alpha$ - ketoglutarate is decarboxylated to succinate<br>**Note:** 'pyruvate is decarboxylated to acetate' would instantly score 2 marks, mp 1 and 2 |
| | (c) | | (carbon dioxide is removed by) ventilation;<br><br>**and then any two from:**<br><br>excess carbon dioxide, is toxic;<br><br>affects oxygen transport;<br><br>respiratory acidosis; | | **IGNORE** breathing<br><br>**ACCEPT** correct description, i.e. forms hydrogencarbonate ions, forms carbaminohaemoglobin<br>**ACCEPT** correct symptoms, i.e. can cause headaches, confusion, drowsiness etc |

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| | **(d)** | | liver; | **1** | **DO NOT CREDIT** hepatocytes, hepatic cells, etc – question asks for **organ** |
| | **(e)** | | ammonia;<br><br>arginine;<br><br>water;<br><br>water; | **4** | **IGNORE** molecular structures, i.e. $H_2O$, throughout – question asks for **names** |
| **2** | **(a)** | | thylakoid membrane; | **1** | |
| | **(b)** | | absorb different wavelengths of light;<br><br>chlorophyll-a is the only primary pigment;<br><br>(they are/reflect) different colours;<br><br>example of accessory pigment; | **2** | **ACCEPT** frequencies, but **DO NOT CREDIT** colours<br><br>**ACCEPT** any valid example |
| | **(c)** | **(i)** | **any two from:**<br><br>use a light source;<br><br>*idea that* syringe should be pulled to produce a bubble of gas in the tube;<br><br>measure length/volume of the bubble;<br><br>use different light intensities | **2** | <br><br>**ACCEPT** lamp or any suitable example<br><br><br><br>**ACCEPT** $\pi r^2 l$ for volume of the bubble |
| | | | | **1 QWC** | **any two words spelt and used correctly: intensity; volume; length; measure;** |

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| | | **(ii)** | **L1:** bubble size may be inaccurate;<br>**S1:** ensure no air bubbles in the tube;<br><br>**L2**: other sources of light may influence readings;<br>**S2:** use an enclosed environment for readings;<br><br>**L3**: *idea that* changes in light intensity will cause changes within the plant;<br>**S3**: allow plant to acclimatise;<br><br>**L4:** nitrogen gas / carbon dioxide may enter the tube;<br>**S4**: ensure no air bubbles in the tube;<br><br>**L5:** water bath may change temperature over time;<br>**S5:** use thermometer to check the temperature **and** method to maintain temperature | **4** | **2 marks max for limitations (L). Do not credit methods to overcome the limitations (S) unless the corresponding L mark has been awarded**<br><br>**ACCEPT** examples, i.e. place equipment within a box with a hole for light<br><br>**ACCEPT** $N_2$ and $CO_2$<br><br>**S5:** must give a suitable method here, i.e. add hot or cold water to the water bath, etc |
| | **(d)** | | 1.4<br>2.4<br>3.0<br>3.4<br>3.0<br>2.2;; | **2** | **2 marks for correct averages all given to one decimal place; 1 mark for correct averages to an inconsistent number of decimal places OR at least <u>three</u> correct averages but all values given to one decimal place.** |

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| | **(e)** | | **any three from:**<br>as temperature increases, the rate of photosynthesis increases, until 20 degrees;<br><br>after 20 degrees, the rate of photosynthesis declines;<br><br>rate of photosynthesis decreases faster than it increased;<br><br>suitable illustration using data;<br><br>**any three from:**<br><br>as temperature increases (to 20 degrees), enzymes gain more kinetic energy **AND** form more enzyme-substrate complexes;<br><br>optimum temperature for photosynthetic enzymes is (around) 20 degrees;<br><br>enzymes begin to denature as temperature increases beyond 20 degrees; | **4** | **ACCEPT** correct higher level references to gradients, rates of change, etc<br><br>**Minimum of two data sets should be given with their units**<br><br>**ACCEPT** ESC<br><br>**IGNORE** enzymes work best at 20 degrees, vague<br><br>**DO NOT CREDIT** enzymes die / all enzymes denature at 20 degrees, etc |
| **3** | **(a)** | | gluconeogenesis; | **1** | |
| | **(b)** | | glycogenesis; | **1** | |
| | **(c)** | | adrenal medulla; | **1** | |
| | **(d)** | | target tissue; | **1** | |
| | **(e)** | | countercurrent multiplier; | **1** | |
| **4** | **(a)** | | *idea that* (it is) a disease where the body cannot control blood glucose concentrations / levels; | **1** | **DO NOT CREDIT** condition, unqualified |

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| | **(b)** | | hyperglycaemia is where blood glucose concentrations / levels are too high;<br><br>hypoglycaemia is where blood glucose concentrations / levels are too low; | **2** | |
| | **(c)** | | less effective secondary defence;<br><br>more susceptible to infection; | **2** | **ACCEPT** weaker, but **DO NOT CREDIT** no secondary defence<br><br>**ACCEPT** higher level answers, i.e. reference to neutropenia or symptoms of it |
| | **(d)** | | bacteria (may) use glucose for respiration / named cell process;<br><br>(hence) bacteria can thrive off excess glucose; | **2** | **IGNORE** references to neutropenia (as already discussed in **(c)**)<br>**ACCEPT** any correct prokaryotic cellular process that uses bacteria<br><br>**If no marks scored, award 1 mark for the *idea that* more bacteria will grow** |
| | **(e)** | | **any two from:**<br><br>cheaper, to manufacture insulin than to extract it from animals;<br><br>fewer ethical / moral objections to using insulin produced by bacteria, than using insulin extracted from animals;<br><br>less chance of rejection / allergic reaction; | **3** | <br><br>**IGNORE** cheap<br>**IGNORE** cheaper alone, unqualified<br><br>**ACCEPT** examples of objections |

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| | | | lower risk of infection;<br><br>exact copy of human insulin;<br><br>**any two from:**<br><br>bacteria must be genetically modified;<br><br>potential reduction in the diversity of strains of bacteria;<br><br>genetically modified bacteria may transfer genes to other bacteria which may mutate with unknown effects; | | <br><br><br><br>**ACCEPT** genetically engineered<br><br>**DO NOT CREDIT** lower biodiversity<br><br>**ACCEPT** examples, i.e. bacterial conjugation |
| **5** | **(a)** | | *idea that* (negative feedback is) a homeostatic mechanism;<br><br>causes a reversal of any changes, in conditions | **2** | **ACCEPT** allows a constant internal environment to be maintained<br><br>**ACCEPT** examples, i.e. if the temperature is too high, negative feedback will bring the temperature back down, to the optimum |
| | **(b)** | | hormone<br>**AND**<br>*idea that* (it) controls concentration of water, in the blood;<br><br>if the concentration of water is too low, ADH is released; | **2** | **Both points needed for the first marking point**<br><br><br>**ACCEPT** ora |

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| | **(c)** | | sodium (ion) channels open;<br><br>depolarisation;<br><br>threshold potential reached;<br>*reference to* all or nothing response; | **2** | **IGNORE** references to voltage-gated channels, not relevant to question<br><br>**ACCEPT** voltage across membrane reaches -50mV ( ± 10mV) |
| | **(d)** | | action potential travels down the axon of the neurone;<br><br>*idea that* diffusion of sodium ions along axon will cause more sodium channels along the neurone to open (and further depolarisation);<br><br>action potential arrives at terminal bulb **AND** causes calcium ions to enter;<br><br>vesicles containing ADH, move to / fuse with, membrane (of terminal bulb);<br><br>(ADH released by) exocytosis; | **4** | **ACCEPT** propagates<br><br>**DO NOT CREDIT** references to salutatory conduction<br>**ACCEPT** local currents of sodium ions **IF** candidates states that they will then cause more sodium channels to open |
| | **(e)** | | (they are) short(er);<br><br>*idea that* they do not need fast transmission; | **1** | **ACCEPT** hormones not needed reflexively / immediately / hormones can be released over time etc |

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| | **(f)** | | **U1:** action potentials move along the axon as a wave;<br><br>**U2a:** sodium ions diffuse along axon, away from the region of higher concentration;<br>**U2b:** (this causes) more sodium channels to open / further depolarisation along the neurone;<br><br>**U3:** action potential travels along entire axon;<br><br>**U4:** all or nothing response<br><br>(in a non-myelinated neurone:)<br><br>**C1:** no saltatory conduction;<br><br>**C2:** depolarisation does not occur only at the nodes of Ranvier;<br><br>**C3:** transmission of action potential is slower<br><br>**C4:** AVP | **5** | **Maximum of 3 U marks**<br><br>**U2b can only be awarded in conjunction with U2a**<br>**ACCEPT** references to local currents of sodium ions<br><br>**ACCEPT** ora throughout<br><br>**ACCEPT** descriptions of saltatory conduction<br><br>**ACCEPT** gaps between Schwann cells<br><br>**ACCEPT** any valid comparison between the transmission of action potential along the two neurones |
| | | | **QWC** | **1** | **Any three terms spelt AND used correctly:**<br>axon, neurone, action potential, ions, diffuse/diffusion, current, Schwann (cells), nodes of Ranvier, saltatory conduction, depolarisation |

Guidance:

Marking points are separated by semi-colons (;). Commas are used to separate marking points and information on **all** sides of the commas must be present for the marking point to be awarded. Terms that are underlined with a solid line must be present to score the marking point and those underlined with a wavy line need not be present themselves, but the idea should be clear.