

## Mark schemes

1

- (a) (i) 1. Moves out of the way when calcium ions bind;  
*1. Accept shape change with Ca<sup>2+</sup>*  
*1. Don't accept just "calcium"*
2. Allowing myosin to bind (to actin) / crossbridge formation;  
*1. Accept presence of calcium ions leads to movement instead of binds*  
*Accept references to troponin*
- (ii) 1. Head (of myosin) binds to actin and moves / pulls / slides actin past;  
**Q**
2. (Myosin) detaches from actin and re-sets / moves further along (actin)  
*1. Accept myosin power stroke (to move actin)*  
*1. Accept push*  
*1. Accept crossbridges form instead of myosin head binds to actin*  
*1. Must refer to myosin head or crossbridges*
3. This uses ATP;
- (b) (i) 1. (Glycogen broken down) gives (lots of) glucose for glycolysis / anaerobic respiration;  
*1. Give if context of anaerobic respiration clear*
2. Glycolysis / anaerobic respiration not very efficient / only yields 2 ATP per glucose;  
*2. Accept anaerobic respiration is a quick source of ATP for exercise*  
*2. Accept very little ATP*
- (ii) 1. (Many capillaries) give high concentration / lots of oxygen / shorter diffusion pathway for oxygen / large surface area for oxygen exchange / diffusion / good glucose supply with little glycogen present;
2. Allows high rate of / more aerobic respiration **OR** prevents build-up of lactic acid / (muscle) fatigue;  
*3. Accept idea of aerobic respiration during endurance events / long periods of exercise*

2

2 max

2

2

[8]

2

(a) Three changes described;;;

*Neutral nucleus shrinks, since it doesn't*

Eg

1. Formation / growth of vacuole;
2. Formation of starch grains / amyloplasts;  
*2. Accept starch grains get bigger*
3. Movement of grains / amyloplasts towards bottom of cell;  
*Note – list rule applies*
4. Cells get longer / wider / larger;

3 max

(b) 1. Grows sideways before starch grains form;

**Q**

2. Bending starts when / as grains form;
3. More bending as grains increase in number;  
*3. Ignore starch grain growth references*
4. More elongation (of cells) / growth (of roots) downwards as starch grains increase / move;
5. Bending starts before grains move down;
6. Could be related to vacuole;  
*6. Ignore references to nucleus*

3 max

(c) 1. (IAA) at bottom of root / where IAA concentration high inhibits expansion / elongation (of cells);

*2 and 3 need reference to expansion / elongation, not just growth*

2. (IAA) at top of root / where IAA concentration low leads to expansion / elongation (of cells);  
*2. Accept less inhibition*

2

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3

- (a) 1. Positive correlation between sucrose and dopamine concentrations / higher concentration of sucrose, more dopamine;

*Q NB question is 'How do these ...', not 'Do these ....*

*1. Ignore simple statements of numbers from graph without description of trend*

2. So (dopamine) makes them want to drink / eat more (sucrose);

3. Positive feedback because drinking / eating leads to wanting to drink / eat (even) more;

*3. It must be a clear statement of why this example is positive feedback, not inferred from points 1 and 2*

3

- (b) 1. (Refractory period) leads to discrete / separate nerve impulses / time when another nerve impulse can't happen;

**OR**

(Refractory period) limits number of impulses per second / frequency of nerve impulses;

2. When maximum frequency reached / exceeded, no further increase in information / all (higher) concentrations of sucrose seem the same;

2

- (c) 1. (Negative feedback) stops desire / wish to eat / appetite;

*1. Accept stops dopamine release (in this context)*

*1. Accept makes them feel full*

2. (This) limits amount eaten / stops eating;

*2. Accept prevents constant eating*

3. Prevents / reduces risk of obesity / too much energy intake;

*3. Accept prevents vomiting*

*Accept descriptions based on what would happen in absence of the feedback mechanism - or if stomach empty for points 1 and 2*

3

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4

- (a) 1. Causes sodium ion channels to open;

*1. Reject if wrong sequence of events*

2. Sodium ions enter (cell and cause depolarisation);

*Reject sodium on its own only once*

2

- (b) 1. (If not removed) keeps binding (to receptors);  
*Accept answers based on what happens if it is transported out – ie what should happen*
2. Keeps causing action potentials / depolarisation (in post-synaptic membrane);  
*2. Accept keeps Na<sup>+</sup> channels open(ing)*

2

- (c) 1. Movement in all groups (about) same before MDMA;  
**Q**
2. MDMA increases movement in Group **L**;  
*2. Accept normal mice for L*
3. Group **K** shows MDMA causes movement;  
*3. Accept K is a control*
4. No / little increase in mice without receptor / Group **M**;

3 max

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5

- (a) 1. Glucose oxidase and peroxidase;  
*Both enzymes required*
2. Dye (with colour A);  
*Reject 'dye with colour B'. Ignore named dyes*

2

- (b) 1. Concentration is given as a range (for each colour) / measurement is not precise;
2. Only measures glucose concentration above normal / above 170 (mg 100 cm<sup>-3</sup>) (in blood);
3. 170 (mg 100 cm<sup>-3</sup>) is an average figure / concentration for loss to urine varies (between people);
4. Difficult to match colour against chart / colour match is subjective;

2 max

[4]

6

- (a) Treatment requires person receiving insulin (in some way);  
*Accept descriptions e.g. insulin injection*  
*Reward idea that insulin must be received, not that it isn't being produced*

1

- (b) 1. No / fewer / abnormal receptors on (cell) membrane;  
 2. (So) fewer (glucose) transport proteins;  
 3. (So) less glucose can enter (cells);  
 4. (So) less glucose converted to glycogen;  
*Accept no / fewer enzymes (for this conversion) are activated*  
 5. (So, without treatment) blood glucose concentration not lowered when high / above normal;  
*Accept converse*

3 max

- (c) 1. Movement uses muscles;  
 2. Movement increases (rate of) respiration;  
 3. Respiration uses glucose / respiration reduces blood glucose concentration;

2 max

- (d) 1. Identification of  $195 \pm 2$  and  $113 \pm 2$ ;  
 2. Answer within range of 1.67 to 1.77 (times greater);  
*Ignore numbers after two decimal places*  
*Correct answer = 2 marks*

2

- (e) 1. Meal / uncontrolled intake v 75 g glucose / controlled intake;  
*Must have both sides of the story for each point. Marking guidance shows researcher's method first*  
*Idea of could eat anything in meal as against just glucose*  
 2. (Concentration) measured over 6 hours / 6+ hours / longer v measured at 2 hours;  
 3. (After intake) regular monitoring / several measurements v only measured once / at 2 hours only;  
 4. No fasting v fasting before test;  
*Credit other descriptions of fasting e.g. went without food as opposed to didn't have to*  
 5. Not (necessarily) at rest v remained at rest;  
 6. Tested during afternoon v tested in morning;  
*Accept idea of tested at different times of the day*

3 max

- (f)
1. Pre-diabetics are at risk of developing diabetes / some pre-diabetics reach a concentration of  $180 \text{ (mg } 100 \text{ cm}^{-3}\text{)}$  after a meal;
  2. Some pre-diabetics will now be classed as diabetic;
  3. Detection leads to treatment (sooner);
  4. Diabetes damages the body / is life-threatening;
- Accept examples of damage e.g. blindness, heart disease*

3 max

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1. Diabetics have (blood glucose) concentration greater than  $140 \text{ mg cm}^{-3}$  / than her estimate / estimate suggests she is pre-diabetic;
  2. Colour change is subjective / blood on test strip masks colour change;
  3. Concentration given as a range / estimation is not reliable;
  4. May not have fasted;
  5. May not have had a drink with 75 g glucose;
  6. Only one test carried out;
- No mark for valid or not valid*

[3]

8

- (a) One suitable factor;
- Not health or lifestyle*
- E.g. Age / no heart condition / not on medication;
- Accept BMI / smokers / diet / fitness / race etc. – has to affect heart rate or blood pressure*

1 max

- (b) Patients were at rest / not moving / not using muscles / in standardised position / controlled conditions;
- Accept same position as sleeping*
- Ignore relaxed*

1

- (c)
1. Caused by pressure / surge of blood;
- Ignore pulse rate equals heart rate*
2. From (one) contraction / beat of (left) ventricle / heart;
- Reject right ventricle*
- Ignore pumps / pumping*

2

- (d) 1. Monitor records heart rate over long period of time / all the time / more data collected;  
*Ignore reference to continuously as in stem*  
*Ignore anomalies can be discarded*
2. Anomalies in recording have less effect;  
*Ignore more accurate / reliable mean*
3. Recording pulse rate for one minute only may give an anomalous / atypical result;
4. Errors when trying to count pulse for one minute / human error;
5. Monitor records HR over a range of activities during the day / pulse rate only records for a single set of conditions;

2 max

- (e) 1. Men with condition always have higher heart rates;  
*Accept blood pressure references for heart rate*
2. But no direct measurements of blood pressure;  
*Accept – no stats analysis to show significance*
3. Only one investigation / test / need more studies;  
*Ignore references to 'yes' and 'no' throughout*
4. Using different recording methods / conditions (in each case so cannot compare results);
5. Men without condition also have increased / higher heart rate in doctor's surgery;

2 max

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1. SAN → AVN → bundle of His / Purkyne fibres;  
*1. Mark for correct sequence*
2. Impulses / electrical activity (over atria);
3. Atria contract;
4. Non-conducting tissue (between atria and ventricles);
5. Delay (at AVN) ensures atria empty / ventricles fill before ventricles contract;
6. Ventricles contract from apex upwards;

5 max

[5]

10

- (a) (i) UGC;
- (ii) TGCTAC;

1

1

- (b) (DNA) contains introns / non-coding bases / mRNA only contains exons / coding bases;

*Assume that 'it' refers to DNA*

*Neutral: DNA contains introns and exons*

*Neutral: 'splicing'*

*Neutral: pre-mRNA contains introns*

*Ignore refs. to start and stop codons*

1

- (c) Different primary structure / amino acid sequence / amino acid coded for;

*Reject: different amino acids produced / formed*

*Neutral: refs. to bonds*

1

- (d) 1. Acetylcholine not broken down / stays bound to receptor;
2. Na<sup>+</sup> ions (continue to) enter / (continued) depolarisation / Na<sup>+</sup> channels (kept) open / action potentials / impulses fired (continuously);
3. (Intercostal) muscles stay contracted / cannot relax;

*'Muscles contract' is not enough*

*Accept: diaphragm stays contracted / cannot relax*

3

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- (a) (i) Decreases;

*Accept any word that means a decrease e.g. shorter / narrower / smaller etc*

1

- (ii) Nothing / stays the same length / does not change;

1

- (b) 1. Two marks for correct answer of 29545-30455;

*Correct answer = 2 marks outright. Range allows for a 1mm error in measuring*

2. One mark for incorrect answers in which candidate clearly divides measured width by actual width;

*Ignore rounding up*

2

(c) (Idea ATP is needed for:)

1. Attachment / cross bridges between actin and myosin;  
*Accept the role of ADP in attachment*
2. 'Power stroke' / movement of myosin heads / pulling of actin;  
*Not just 'filaments slide' as given in the question stem*
3. Detachment of myosin heads;
4. Myosin heads move back / to original position / 'recovery stroke'

3 max

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12

- (a) 1. (Oxygen / carbon dioxide) detected by chemoreceptors / (pressure) detected by baroreceptors;
2. Medulla / cardiac centre involved;  
*Accept a valid equivalent e.g. cardioacceleratory centre*
3. More impulses to SAN / along sympathetic nerve;  
*Neutral: signals / messages*  
*Accept: acceleratory nerve*  
*Need idea of 'more impulses' directly, not by implication*

3

- (b) (i) 1. To ensure results are due to omega-3 / fatty acids (only) / not due to something else in the oil;  
*Neutral: Idea of comparing groups / results*
2. Placebo linked to mental / psychological effect;  
*Neutral: reference to a control group / placebo (unqualified)*

1 max

- (ii) 1. Lower / greater change of heart rate for Group A;  
*Ignore references to methodology*
2. (Differences) are real / reliable / significant / not due to chance;
3. As bars do not overlap / values are not shared;

3

[7]

13

- (a) 1. Adenylate cyclase activated / cAMP produced / second messenger produced;
2. Activates enzyme(s) (in cell so) glycogenolysis / gluconeogenesis occurs / glycogenesis inhibited;  
*2. Neutral: 'glucose produced' as given in the question stem*  
*Accept: correct descriptions of these terms*

2

- (b) (i) 1. Glucose / sugar in food would affect the results;  
*1. Accept references to starch / carbohydrate*  
*Or*
2. Food / eating would affect blood glucose (level);  
*Or*
3. (Allows time for) blood glucose (level) to return to normal;  
*3. Neutral: allows time for insulin to act*

1 max

- (ii) Type 2 diabetes is a failure to respond to insulin / still produces insulin / is not insulin-dependent;

1

- (iii) (For) – 3 max

*A maximum of three marks can be awarded for each side of the argument*

1. Avoids injections / pain of injections;
2. Long(er) lasting / permanent / (new) cells will contain / express gene;  
*Ignore references to methodology e.g. sample size not known*
3. Less need to measure blood sugar / avoids the highs and lows in blood sugar;
4. Less restriction on diet;

- (Against) – 3 max

5. Rats are different to humans;
6. May have side effects on humans;  
*6. Accept: virus may be harmful / disrupt genes / cause cancer*
7. Long(er) term effects (of treatment) not known / may have caused effects after 8 months;
8. (Substitute) insulin may be rejected by the body;

4 max

[8]