

AQA, OCR, Edexcel

A Level

A Level Biology

Stimuli, Response and the
Nervous System Answers

Name:

M M E

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Total Marks:

M1.(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**

[8]

M2.(a) 1. (Taxis is) movement towards / away from a stimulus / a directional response / movement (to a stimulus);

2. (Move towards) temperature they were used to / cultured in;
Movement towards temperature they were used to
= 2 marks

2

max

(b) 1. Hungry, so seeking food / in absence of food respond to temperature;

*Ignore references to temperature and enzymes
Must be stated not inferred from other statements*

2. Move towards temperature they were used to / cultured in;
 3. Associate (this temperature) with food;
*Accept they think food is here
Stated not inferred*
 4. (Then) stay in this temperature; 3 max
- (c)
1. (Dim) worms live in soil / dark / affected by bright light / dim light is like normal environment / what they are used to;
 2. (Even) because worms might move towards / away from bright light / to avoid creating light gradient / prevent worms showing phototaxis / all parts of surface exposed to same light;
Accept to avoid kinesis due to light
 3. (Dim light) ensures heat from light not a variable / heat from lamp could kill / dry out worms;
Not just to control variables / factors 2
max [7]
- M3.(a)**
1. (Increased pressure) deforms / changes stretch-mediated sodium (ion) channel;
 2. (Sodium channels open and) sodium ions flow in;
Accept Na⁺
 3. Depolarisation (leading to generator potential).
Accept correct description of depolarization 3
- (b) Value between 2.17:1 and 2.29:1;
*Accept rounding up to 2.2 or 2.3
Accept: number without : 1
Correct working showing answer but incorrect rounding in answer line = 1*
- Values between 117 to 119 and between 52 to 54 found but ratio wrong way round = 1 mark.
*Wrong way round gives answer between 0.35:1
and 0.46:1* 2
- (c)
1. Parasympathetic greater effect than sympathetic;
Ignore: descriptions of graph
 2. Parasympathetic keeps heart rate down / lower / decreases heart rate (as blood pressure increases);
 3. Sympathetic keeps heart rate up / higher / increases heart rate

(as blood pressure increases);
 2. and 3. Accept converse for blood pressure decreases

4. Parasympathetic greatest / greater effect at high blood pressure / sympathetic greatest effect at low blood pressure.
 3 max [8]

M4. (a) B – It is the 2nd contraction / occurs (immediately) after A / occurs after atrium;
 Larger / more force / more pressure;

2

(b)
$$\frac{60}{\text{time for 1 cycle}}$$

= 37 to 38

allow 1 mark if correct working shown

max 2

- (c) (i) (Heart rate) reduced;
 (Stroke volume) no effect;

2

- (ii) Reduced because $\text{C.O.} = \text{H.R.} \times \text{S.V.}$ / connection argument based on reduced H.R.;

1

- (iii) Parasympathetic;

1

- (d) (i) 1. Coordination via medulla (of brain) / cardiac centre;
 2. (Increased) impulses along sympathetic (/ cardiac accelerator) nerve
 3. To S.A. node / pacemaker;
 4. More impulses sent from / increased rate of discharge of S.A. node / pacemaker;

Not "beats"; not "speeds up"

4

- (ii) In exercise – More energy release / more respiration / actively respiring muscles / for aerobic respiration;
 Higher cardiac output – Increases O₂ supply (to muscles);
 Increases glucose supply (to muscles);
 Increases CO₂ removal (from muscles) / lactate removal;
 Increases heat removal (from muscles) / for cooling;

If no "increase" – max 2 marks

3

[15]

- M5.(a)**
1. Membrane more permeable to potassium ions and less permeable to sodium ions;
 2. Sodium ions actively transported / pumped out and potassium ions in. 2
- (b)
1. (Pressure causes) membrane / lamellae to become deformed / stretched;
 2. Sodium ion channels in membrane open and sodium ions move in;
 3. Greater pressure more channels open / sodium ions enter. 3
- (c)
1. Threshold has been reached;
 2. (Threshold or above) causes maximal response / all or nothing principle. 2
- (d)
1. Less / no saltatory conduction / action potential / impulse unable to 'jump' from node to node;
 2. More depolarisation over length / area of membranes. 2

[9]

M6. (a) In table:

| |
|----------|
| D |
| B |
| C |

All 3 correct = 2 marks;;

2 correct = 1 mark;

0 or 1 correct = 0 marks

- 2
- (b) (i) myelin insulates / prevents ion movement; saltation / described re leaping node to node; 2
- (ii) cat has higher body temperature;
ignore references to homoiothermy' / warm-blooded
 faster diffusion of ions / faster opening of ion pores / gates / channels; 2
- (c) 1 increasing stimulus (potential) causes decrease in potential difference / rise in potential at P;
- 2 1 or 2 is sub-threshold / 1 or 2 does not give action potential / 3 or 4 is above threshold / 3 or 4 does give an action potential;
- 3 influx of Na⁺ ions; (*not just Na / sodium*)
- 4 voltage-gated channels (in axon membrane) opens / opens Na⁺ channels / membrane more permeable to Na⁺ (*NOT just Na / sodium*);

5 sufficient for stimulation of adjacent region of axon therefore impulse propagated (from P to Q);

5

(d) 1 X / Acetylcholine → opening of Na⁺ channels / increases Na⁺ permeability and Na⁺ ion entry into Z;

2 Y / Cl⁻ entry - lowers potential / increases potential difference / makes potential more negative;

3 X stimulates and Y inhibits (Z);

4 balance of impulses from X and Y determines whether Z fires action potential / determines whether potential rises above threshold;

4

[15]

M7. (a) (Nerve impulse causes) Ca²⁺ to enter presynaptic neurone/membrane;

(Ca²⁺ entry) causes fusion of vesicles with presynaptic membrane / causes exocytosis / release of transmitter; 2

(b) Vesicles / neurotransmitter / dopamine (only) in / from A;

OR

Receptors (only) on B;

1

(c) (i) Dopamine and cocaine have similar shapes (in part);

Cocaine can fit transporter;

Reject ref. to 'active site'

2

(ii) Cocaine blocks transport of dopamine out of gap / into A;

Dopamine concentration rises / is maintained / remains;

Ignore ref. to 'active site'

Continues to stimulate/bind to receptors;

Causes continued firing of impulses (in B);

3 max

[8]

M8.(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⁺ 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

[7]

- M9.(a)**
1. (In myelinated) action potential / depolarisation only at node(s);
 2. (In myelinated, nerve impulse) jumps from node to node / saltatory;
 3. (In myelinated) action potential / impulse does not travel along whole length;
The question is about speed of transmission, not repolarisation or related matters
Accept converse for non-myelinated

3

- (b)
1. Probability of obtaining this difference by chance;
Reject 'results' once only
This statement often split round 2.
 2. Is less than 5% / less than 0.05 / less than one in twenty;
Accept is 4.7% / 0.047 but reject less than 4.7% / 0.047
Accept correct greater than 95% / greater than 0.95 arguments
 3. Difference is significant;
Reject 'results' once only

2 max

- (c)
1. (All) dementia results lower (than control group) / non-dementia result higher;
 2. Error bars do not overlap so differences are (possibly) significant;
Neutral results
Accept not due to chance / statistically significant

In this context, accept references to standard deviation

3. Dementia may be due to other factors / not only due to a lack of myelin;
Accept suitable named factor e.g. genetic
4. (Because) big / significant differences in myelin in different dementia;
Not just 'different'
5. Only small sample sizes / only one study / more data required;

4 max

[9]

- M10.(a)**
1. Similarity – directional response (to a stimulus) / movement towards / away from a stimulus;
 2. Difference – taxis (whole) organism moves and tropism a growth (response).
Must be clear which one, taxis or tropism, they are referring to
Taxis occurs in animals / motile organisms and tropism occurs in plants

2

- b)
1. Grow in direction of / towards (pull of) gravity;
Accept: tropism for growth
Ignore: pulled by gravity
Accept: positively geotropic / gravitropic
 2. Grow away from salt;
Accept: negatively chemotropic / halotropic
1 and 2. Ignore: references to bends / moves
 3. Salt has more effect (than gravity).
Accept: converse statement for gravity
Note: all three points may appear in one sentence

3

- (c)
1. More carriers in (cell) **L** / lower in **R**;
*Accept: left for **L** and right for **R** / side nearer salt for **L***
 2. (So) less IAA in (cell) **L** / more IAA in (cell) **R**;
*Accept: more IAA moves out of **L** / less IAA moves out of **R***
 3. (So) more (elongation) growth in **L** / less (elongation) growth in **R**.
*Accept: less inhibition of growth in **L** / more inhibition of growth in **R**;*

3

[8]

- M11.(a)** One suitable suggestion; explained;
E.g.
1. Action potentials travel more slowly / don't travel;
Accept: fewer / no saltatory movement of potentials
 2. So delay in muscle contraction / muscles don't contract / muscles contract slow(er);
- OR**
3. Action potentials / depolarisation 'leaks' to adjacent neurones;
Accept: neurones not insulated
 4. So wrong muscle (fibres) contract.

2 max

- (b) Lipid-soluble / pass through phospholipid bilayer.
Not just 'pass through membranes'

1

- (c) 1. Prevents influx of calcium ions (into pre-synaptic membrane);
Need idea of moving into pre-synaptic membrane / synaptic knob
Accept Ca^{++} / Ca^{2+}
2. (Synaptic) vesicles don't fuse with membrane / vesicles don't release neurotransmitter;
Accept vesicles don't release acetylcholine
 3. Neurotransmitter does not diffuse across synapse / does not bind to receptors (on post-synaptic membrane);
Accept: sarcolemma / muscle membrane for post-synaptic membrane
 4. No action potential / depolarisation (of post-synaptic membrane) / sodium (ion) channels do not open / prevents influx of sodium ions.
Accept Na^{+}
Accept prevents depolarisation of muscle cell
Ignore: descriptions of events at post-synaptic membrane involving calcium ions and muscle contraction

4

- (d) 1. They won't affect synapses in brain;
2. They won't cause problems with the brain's function / won't damage brain;
Accept: suitable named problem e.g. hallucination
Ignore: unqualified references to 'side effects'
Accept: reference to addiction / harm of smoking (cannabis)
3. (So only the) muscle / neuromuscular junctions treated / affected.

2 max

M12. (a) (Ion) channel proteins open, sodium in;

Changes membrane potential / makes inside of axon less negative / positive / depolarisation / reaches threshold;

More channels open / positive feedback;

Accept other phrases for ion channel proteins providing that it is clear that it is something through which ions pass.

Reject carrier.

First marking point relates to opening.

Third point must relate to more (channels) opening.

3

(b) Potassium channels open;

Potassium out;

Sodium channels close;

Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question.

Reject pump

3

(c) Pump / active transport / transport against concentration gradient;

Of sodium from axon / sodium out / of potassium in;

Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question

2

M13.(a)

| Function | Name |
|--|-----------------------------------|
| Attaches to Z line at the end of the sarcomere | 1. Actin; |
| Breaks down ATP | 2. ATPase / myosin (head); |

| | |
|---|------------------------|
| Covers binding site on actin in relaxed myofibril | 3. Tropomyosin; |
|---|------------------------|

Accept water

Accept troponin

3

- (b) 1. Can't form myosin / thick filaments;
Neutral: prevents actin and myosin sliding filament action
2. Can't pull / can't move actin / slide actin past / (myosin) have to be joined / fixed to pull actin;
Accept: myosin can't pull on each other
3. Myosin moves / if attached doesn't move;
4. Can't move actin towards each other / middle of sarcomere / between myosin / can't shorten sarcomere / can't pull Z lines together.
Accept: contract for shorten

3

[6]

- M14.(a)** 1. Fields of view randomly chosen;
2. Several fields of view;
3. All same species (of animal / hamster);
*Reject general statements related to sample size.
All mark points relate directly to information provided in Resource A.
Accept 'all (Mesocricetus) auratus'.*
4. Same muscle / organ used / only diaphragm used;
5. Used at least 8 (animals) in each (age) group.

4 max

- b) (i) 15

Correct answer = 2 marks.

Allow 1 mark for showing

$$69 \div 4.6$$

OR

answer of 10 / 10.1 (correct calculation using fast in error.)

2

- (ii) 1. (Calculation) used mean (number of capillaries);
2. Variation in number of capillaries per fibre.
*Note: maximum of 1 mark for this question.
Ignore reference to an anomaly or calculation errors.*

1 max

(c) (i) (Removing diaphragm means) animals / hamsters are killed. 1

- (ii) 1. (Suggests) significant (difference) between young and adult;
MP1, MP2, MP4 and MP5 can include use of figures but check figures are used correctly.
2. (Suggests) not significant (difference) between adult and old;
Statements related to 'results being significant / not significant' do not meet the marking points. It is the difference that is significant or not. However, only penalise this error once.
3. For slow **and** fast fibres;
This MP can be given in the context of either MP1 or MP2 but only allow once. As well as this context there must be a reference to 'both' types of fibre.
4. (Suggests) significant (difference) between young and old for fast (fibres)
OR
(Suggests) not significant (difference) between young and old for slow (fibres);
All aspects of either approach required to gain credit.
5. (Suggests) significant (difference) where means \pm SD do not overlap
OR
(Suggests) not significant (difference) where means \pm SD overlap;
All aspects of either approach required to gain credit.
6. Stats test is required (to establish whether significant or not).

4 max

[12]

M15. (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

[7]

- M16.(a)**
1. Splitting / breakdown / hydrolysis of ATP;
2. (Muscle) contraction requires energy / ATP;
*Accept 'uses energy'. Reject idea of 'movement' of muscles requiring energy.
Reject suggestion that 'energy is produced'.*

3. Use of ATP by myosin.

*Accept a reference to any use of ATP by myosin.
No credit for any further detail.*

2 max

- (b) Fast because (lots of) ATPase allows rapid **hydrolysis** of ATP
OR
Slow because (lots of) ATPase allows rapid **synthesis** of ATP.
Accept either approach as some texts refer to ATPase as the enzyme at the end of the ETC in mitochondria.

1

- (c)
1. Need light to see colour / brown / yellow;
Requires reference to light.
2. Cannot see colour / brown / yellow with electrons / an electron microscope;
*Requires reference to electrons / electron microscope.
Accept 'see black and white with electrons / electron microscope'.*
3. No organelles are visible.
Accept appropriate named examples of organelles.

2 max

[5]

- M17.(a)** Hypothalamus. 1
- (b) 1. Water potential of blood will decrease;
2. Water moves from osmoreceptor into blood by osmosis. 2
- (c) 1. Permeability of membrane / cells (to water) is increased;
2. More water absorbed from / leaves distal tubule / collecting duct;
3. Smaller volume of urine;
4. Urine becomes more concentrated. 4
- (d) 115.2 / 115.3 (cm³ minute⁻¹). 1
- (e) Any **two** of the following for 1 mark:
Muscle / body mass
Ethnicity
Exercise
Kidney disease – do not accept 'health'. 1
- [9]**
- M18.(a)** 1. Release of glucagon;
2. Leads to formation of glucose in liver (cells);
Reject: glucagon breaks down glycogen, or any other biological molecule
3. From non-carbohydrates / amino acids / fatty acids.
Accept: gluconeogenesis / references to glycogen as source of glucose 3
- (b) 1. Mutant mice (mRNA suggests) make a lot of (the) enzyme;
Accept: PCK1 made (for enzyme made)
2. Mutant mice use kidney / intestine (cells) to make glucose;
Accept: use other organ (than liver)
3. Normal mice do this much less / normal mice use liver cells. 3
- (c) 1. Differences significant;
Reject: references to results being significant once
2. Probability of difference being due to chance less than 0.01 / 1% / 1 in 100 / probability of difference not being due to chance more than 0.99 / 99% / 99 in 100.
Ignore: references to 0.05 / 5% / 5 in 100 2
- [8]**
- M19.(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 ± 2 and 113 ± 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

[14]

M20.(a) In Diabetic person:

1. Lack of insulin / reduced sensitivity of cells to insulin;
2. Reduced uptake of glucose by cells / liver / muscles;
3. Reduced conversion of glucose to glycogen;
*Penalise zero / no
once only*

3

- b) (i) Leaves the blood at kidney;
Taken back into blood / reabsorbed (from kidney tubule);
Reject some reabsorption

(Reabsorbed) in 1st convoluted tubule;
Kidney / named part needs to be mentioned once

2 max

- (ii) Large amount / high concentration of glucose in filtrate;
Cannot all be reabsorbed / 1st convoluted tube too short to reabsorb
all of glucose / saturation of carriers;

2

- (c) Enzyme has specific shape to active site / active site has specific tertiary structure;
Only glucose fits / has complementary structure / can form ES complex;

2

- (d) Glucose in filtrate lowers water potential;
Ignore 'urine'. Accept increase solute potential

Lower Ψ gradient / less difference in Ψ filtrate – Ψ plasma;
Ignore 'concentration'

Less water reabsorbed by osmosis;

Accept diffusion of water. Reject no water reabsorbed if implied

3

- (e)
1. Glomerulus / Bowman's capsule / renal capsule;
 2. Basement membrane;
 3. Proteins are large (molecules) / proteins cannot normally pass through filter / proteins can only pass through if filter damaged;
- 3 [15]

- M21.(a)**
1. Blood pressure / hydrostatic pressure;
 2. Small molecules / named example;
 3. Pass through basement membrane / basement membrane acts as filter;
 4. Protein too large to go through / large so stays behind;
 5. Presence of pores in capillaries / presence of podocytes;
- 5

- (b)
1. High concentration of glucose in blood;
 2. High concentration in tubule / in filtrate;
 3. Reabsorbed by facilitated diffusion / active transport;
 4. Requires proteins / carriers;
 5. These are working at maximum rate / are saturated;
 6. Not all glucose is reabsorbed / some is lost in urine;

4 max

- (c) For general principle, applied to either example:

1. More water (from filtrate) reabsorbed / returned to blood / less lost in urine;
2. By osmosis;
3. From collecting duct / from end of second convoluted tubule;
4. Due to longer loop of Henle;

For loop of Henle, maximum 2 marks:

5. Sodium / chloride ions absorbed from filtrate in ascending limb;
6. Gradient established in medulla / concentration of ions increases down medulla;

For ADH, maximum 2 marks:

7. Acts on collecting duct / distal convoluted tubule / second convoluted tubule;
8. Makes cells more permeable / inserts aquaporins in plasma membranes;

Note: to score full marks, candidates must make one specific statement about

Loop of Henle and one about ADH.

6 max [15]

- M22.(a)** (Formation of glycogen)

1. Glucose concentration in cell / liver falls below that in blood (plasma) which creates / maintains glucose concentration / diffusion gradient;

2. Glucose enters cell / leaves blood by facilitated diffusion / via carrier(protein) / channel (protein);
Not just diffusion 2
- (b)
1. Insulin sensitivity similar to / not (significantly) different from those with diabetes;
No values for non-obese, so comparisons with 'normal' not possible
 2. Overlap of SDs;
Accept SE
 3. Their sensitivity (to insulin also) improved by GBS; 2 max
- (c)
1. Sensitivity (to insulin) does increase;
This part of the question concerns spread of data, not overlap of SDs
 2. But large SD / large variation (after GBS);
Accept use of figures / use of SD values to make this point.
Ignore ref to SE
 3. (So) some showing no / little change / get worse;
 4. Do not know what sensitivity to insulin is of non-diabetics (who are not obese);
Accept 'normal' as non-diabetic 3 max