



General Certificate of Education

Biology 6411
Specification A

BYA6 Physiology and the Environment

Mark Scheme

2007 examination - June series

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Question 1

- | | | |
|-----|--|-------|
| (a) | Hydrolysis; | 1 |
| | Use of water;
To break glycosidic bonds/bonds joining glucose molecules/
condensation bonds;
<i>Accept links for bonds. Accept suitable labelled diagram.</i> | 2 |
| (b) | (Acid conditions) in stomach denature amylase/ alter tertiary structure/alter
charge on active site/ alter shape of active site;
Starch (molecule) will not bind with active site/ will not form ES complexes;
As shapes no longer complementary; | 2 max |
| | Total | 5 |

Question 2

- | | | |
|-----|---|---|
| (a) | Taxis – movement towards or away from a (directional) stimulus;
Kinesis – response (to a change in intensity of stimulus) involving change in
amount of movement/ repeated change in direction; | 2 |
| (b) | (i) 3; | 1 |
| | (ii) Less than 5% probability;
That results are due to chance; | |
| | OR | |
| | Greater than 95% probability;
That results have some cause other than chance;
<i>Ignore references to significant differences and rejecting null hypothesis)</i> | 2 |
| | Total | 5 |

Question 3

- | | | |
|-----|--|---|
| (a) | 1500 (kJ); | 1 |
| (b) | (i) Increase in core/body temperature;
Sweat more / vasodilation/ role of hypothalamus; | 2 |
| | (ii) Core temperature still high/ residual evaporation; | 1 |
| | Total | 5 |

Question 4

- (a) (i) Mitosis as the extra cells produce body cells/growth/formation of – not sex cells; 1
- (ii) Correct answer 450% (however derived) scores 2 marks
Incorrect answer, but evidence of working using both **medians** – 1 mark 2
- (b) Correct ref to lack of competition for food;
Correct ref to protein (e.g. adults don't need protein as no growth/ larvae need protein for growth);
Correct ref to carbohydrates (e.g. both need an energy source);
Sugars supply adults with ready source of energy/ sugars can be respired; 2 max
- Total 5

Question 5

- (a) Inhibition of secretion of gastric juice by stomach /stimulation of secretion of pancreatic juice/ stimulation of secretion of bile; 1
- (b) (i) Secretin molecule has complimentary shape to receptor molecules;
Only found (in plasma membranes) in certain cells; 2
- (ii) Non-competitive inhibitor binds to allosteric site and alters shape of active site;
Substrate cannot bind / cannot form enzyme-substrate complexes; 2

Question 6

- (a) Maintains concentration gradient / difference in concentrations (of respiratory gases/O₂/ CO₂); 1
- (b) (i) Ammonia is toxic;
Ammonia could damage cells if transported in that form / if enzyme present elsewhere/ if ammonia produced elsewhere;
Release of ammonia from glutamine in gills;
Ammonia lost from gills/ to surrounding water; 3 max
- (c) Urea is less toxic than ammonia and can be retained temporarily;
Less water lost in excretion / water conserved (during drought); 2
- Total 6

Question 7

- (a) In depolarisation phase:
 (Stimulus) increases permeability of axon membrane to Na^+ /
 (stimulus) allows more Na^+ to enter/ Na^+ channels open;
 Decreases polarity/electro-negativity of axon membrane/
 membrane depolarised;
 Threshold reached;
 More Na^+ ion channels opened / large amount of Na^+ enter;
Idea of positive feedback
 In repolarisation phase:
 K^+ channels open/ K^+ leaves/ membrane more permeable to K^+ ;
 Repolarisation; 4 max
- (b) Calcium ions enter presynaptic cell;
 Vesicles containing neurotransmitter move to fuse with presynaptic membrane;
 Neurotransmitter released into/ diffuses across synaptic cleft;
 Binds with receptor on postsynaptic membrane; 3 max
- (c) (i) Summation; (once only)
 (Summation) means cannot distinguish between stimuli from different rod
 cells linked to same bipolar cell;
 Decreases acuity;
- (ii) (Summation of) sub-threshold stimuli produces threshold stimulation;
 Increases sensitivity;
 Max 2 if changes to acuity and sensitivity not described 4 max
- (d) 1. Synapses between Q and R and sensory neurone are exactory;
 2. Stimulation of groups of rods linked to Q and R / groups of rods B and C
 results in frequent impulses;
 3. Synapses between P and S and sensory neurone are inhibitory;
 4. Output from P and S inhibits initiation of action of action potentials/nerve
 impulses in sensory neurone;
 5. Output from all/PQRS balances or cancels;
 6. As less frequent impulse; 4 max
Second mark in each pair is dependant on first

Total 15

Question 8

(a) (i) Water loss and uptake rise in (early) morning and fall in (late) afternoon; 1

(ii) Stomatal opening with daylight;
 Water diffuses out of stomata;
 Water drawn out of xylem (vessels) in leaves by osmosis;
 Creates negative pressure/tensions in water in xylem;
 Pulls water in xylem upwards;
 Water molecules cohere;
 Column of water;
 Water able to enter xylem in root;
 Water potential (*Accept osmotic*) gradient / water movement across root/
 into root; 5 max

(iii) Larger leaves / larger surface area (for water loss) or thinner leaves/
 shorter diffusion distance; (Larger $C_2 - C_1$ cancels)
 Rate of diffusion $\propto$ (*allow* $\Rightarrow$) $\frac{\text{Surface area} \times C_2 - C_1}{\text{Diffusion distance}}$

OR Rate of diffusion $\propto$ surface area (as relevant);

OR Rate of diffusion $\propto \frac{1}{\text{Diffusion distance}}$ (as relevant);

OR environmental conditions constant so $(C_2 - C_1)$ constant; 2

(b) *Note: candidates need the feature and the explanation for each mark*

Presence of thick (waxy) cuticle presents a barrier to diffusion/
 evaporation;

Sunken stomata reduce concentration gradient of water (vapour) /
 allow build up of high water (vapour) concentration/ build up of moist air outside
 stomata;

Reduced numbers of stomata reduce the area for loss of water (vapour);

'hairy stomata reduce concentration of gradient of water vapour / allow build up
 of high water vapour / moist air outside stomata';

Reduced leaf area reduces number of stomata;

Leaf curling reduces concentration gradient of water vapour/ allows build up of
 high water vapour concentration/ moist air outside stomata;

CAM photosynthesis close stomata during day; 3 max
(Ignore references to C4 photosynthesis)

- (c) Lipid yields more H₂O per gram / per unit mass;
Lipid yields more ATP/energy per gram / per unit mass;
(Reverse argument for carbohydrate)

Examples of calculations:

For H₂O: Lipid yield: $\frac{288}{256} = 1.125\text{g}$ glucose yield: $\frac{108}{180} = 0.6\text{g}$;

For energy Lipid yield: $\frac{3913}{256} = 15.29\text{kJ}$ glucose yield $\frac{1178}{180} = 6.54\text{kJ}$;

For ATP Lipid yield: $\frac{130}{256} = 0.51$ molecules glucose yield $\frac{38}{180} = 0.21$;

Please bear in mind that candidates must perform two calculations for one mark, so don't penalise if they are obviously in the right area and just haven't rounded correctly (for example)

Candidates may also:

- Quote ratios of yields of H₂O /energy/ATP
- Quote amounts of H₂O/ energy/ ATP for equal masses (e.g. 100g or 180g)

4 max

Total 15

Question 9

- (a) (Quaternary structure) is several tertiary structures/ polypeptides held together;
plus any four other points
 (Primary structure) is chain of amino acids/ many amino acids;
 Joined by peptide bonds;
 (Secondary structure) is α -helix/ β -pleated sheet;
 Held in shape by hydrogen bonds;
 (Tertiary structure) is final shape of polypeptide chain/further folding of secondary structure;
 Held in place by ionic/disulphide/hydrogen bonds; 5 max
- (b) Haemoglobin from lugworm:
 Dissociation curve is shifted to left;
 Fully saturated with oxygen at low pO_2 / is able to bind with oxygen at low pO_2 ;
 Has higher affinity for oxygen than human haemoglobin;
 Releases oxygen under very low pO_2 found in tissues; 4 max
(Allow reverse arguments for human oxyhaemoglobin)
- (c) 1. Activity increases concentration of plasma/blood CO_2 / decreases pH of plasma/blood;
 2. Detected by sensors in aorta/carotid artery/medulla;
 3. Impulses to cardiovascular centre/medulla;
 4. (Increased number of) impulses along cardiac nerve/accelerator / sympathetic nerves to SA node / adrenaline in blood to SA node;
 5. Increased number of impulses from SA node;
 6. Heart rate increases;
 7. Cardiac output = heart rate x stroke volume; 4 max
- (d) (Dilation of arterioles) allows increased blood flow/ faster flow;
 Increased oxygen carriage;
 To compensate for decreased saturation of Hb; 2 max
- Total 15