

# GCE 2005

## *January Series*



# Mark Scheme

## Biology Specification A

### BYA6 Physiology and the Environment

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*Dr Michael Cresswell Director General*

**BYA6****Question 1**

- (a) (i) Liver / muscle / named example of muscle; 1
- (ii) Glucose uptake / glucose → glycogen / glucose → fatty acids / fat; 1
- (b) Enzyme has specifically shaped active site;  
Only glucose / binds to / forms E-S complex / is complementary;  
*Accept "Only glucose fits A.S" for 2 marks* 2

Total 4 marks

**Question 2**

- (a)  $\frac{10}{20}$  x measurement /  $\frac{1}{2}$  x measurement;  
 = 1.25 to 1.5;  
*allow 1 mark if correct working shown* max 2
- (b) Maintains concentration gradient (over whole length of gill) / diffusion can occur over whole gill;  
More oxygen enters blood (/ more CO<sub>2</sub> leaves);  
More (aerobic) respiration / more energy release in muscle / for swimming;  
*'more' needed ONCE only* 3

Total 5 marks

**Question 3**

- (a) Reduced rate of respiration / metabolism / chemical reactions;  
 Energy conservation / less energy lost / less heat lost / conservation of stored fat / glycogen / food; 2
- (b) Optimum / fast / increased / temperature for enzymes / metabolism / chemical reactions / respiration;  
 Optimum energy release for movement / faster movement / independent of environmental temperature; 2  
*Reject 'for faster activity'*

Total 4 marks

**Question 4**

- (a) Lower volume AND higher concentration;  
ADH increases water re-absorption (in 2<sup>nd</sup> convoluted tubule / collecting duct) / increases water permeability / adds aqua porous;  
  
Evidence: observe increasing concentration (of dissolved substances)  
(in 2<sup>nd</sup> convoluted tubule / collecting duct) / concentration increased c.f. ADH absent  
*Once only for full marks* 3
- (b) Protein molecule too large (to cross filter in healthy person);  
Protein can cross if filter is damaged / protein from damaged glomerulus enters filtrate; 2

Total 5 marks

**Question 5**

- (a) (i) 1 and 2 share neurone but 2 and 3 have separate neurones (to brain); 1  
*Ignore wrong names of neurones*
- (ii) 1 unit is sub-threshold / 3 units are above threshold / give sufficient depolarisation;  
(1 unit) No impulses / no action potential / in (sensory) neurone / does not stimulate (sensory) neurone / 3 units → impulses;  
(Spatial) summation / sufficient neurotransmitter released / from 3 receptors / insufficient N-T from one;  
*Reject 'temporal'* 3
- (b) (i) (Three) different types of (cone) cells / types 6 and 7 sensitive to different wavelengths / different frequencies / different colours;
- (ii) Impulses along separate neurone from each receptor cell / each receptor cell connects to separate neurone; 2

Total 6 marks

**Question 6**

- (a) (Increased) respiration produces (more) CO<sub>2</sub>;  
Increased H<sup>+</sup> ion concentration (in RBC);  
(H<sup>+</sup> ions) cause more O<sub>2</sub> to be released from Hb / HbO<sub>2</sub> dissociates more readily / Hb  
affinity for O<sub>2</sub> is reduced;  
Use of O<sub>2</sub> by muscle lowers O<sub>2</sub> concentration so more rapid diffusion of O<sub>2</sub> from  
RBC / more dissociation of HbO<sub>2</sub>;  
[Need 'increased' / 'more' ONCE only – if not, max 2] max 3
- (b) (i) CO<sub>2</sub> enters blood / more CO<sub>2</sub> in blood / lactic acid (formed);  
*allow lactate*  
Forms carbonic acid / H<sup>+</sup> ions;  
*Not just 'CO<sub>2</sub> is acidic'* 2
- (ii) Hb combines with H<sup>+</sup> ions / releases H<sup>+</sup> ions; 1

Total 6 marks

**Question 7**

- (a) B – It is the 2<sup>nd</sup> 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  $C.O. = H.R. \times S.V.$  / 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. Release of noradrenalin;  
5. More impulses sent from / increased rate of discharge of S.A. node / pacemaker;  
*Not “beats”; not “speeds up”*  
6. Increased heart rate / increased stroke volume; max 4
- (ii) In exercise – More energy release / more respiration / actively respiring muscles / for aerobic respiration;  
  
Higher cardiac output – Increases O<sub>2</sub> supply (to muscles);  
Increases glucose supply (to muscles);  
Increases CO<sub>2</sub> removal (from muscles) / lactate removal;  
Increases heat removal (from muscles) / for cooling;  
*If no “increase” – max 2 marks* 3

Total 15 marks

**Question 8**

- (a) (i) Conditioned reflex; 1
- (ii) Quick response / Short-lived response / requires use of nerve(s) / does not work if (vagus) nerve cut;  
*Ignore “learning”*  
Indirect stimulus / ref. response to sight; 2
- (ii) Normally a long-lasting response / secretion occurs over several hours;  
Response occurs even if nerve cut; 2
- (b) (i) Cuts in middle of protein / peptide / not at end / not terminal amino acid / produces polypeptides / smaller chains; 1
- (ii) Produces many ‘ends’ for exopeptidase action;  
Faster digestion (of protein);
- (iii) Stomach wall / gland / cells contain protein;  
Prevents digestion of / damage to cells; 2
- (c) (i) Lack of ATP;  
Pump = active transport / requires energy / ATP provides energy / transport is up concentration gradient; 2
- (ii) Concentration of Na<sup>+</sup> inside cell no longer less than concentration in gut lumen / no longer a concentration gradient;  
No (facilitated) diffusion of Na<sup>+</sup> ions possible / amino acid absorption requires diffusion of Na<sup>+</sup> ions into cell; 2
- (iii) Diffusion / facilitated diffusion; 1

Total 15 marks

**Question 9**

- (a) Apoplastic – Via cell walls / spaces external to cell membrane / external to cytoplasm / between cells;  
 As far as endodermis / Casparian strip / layer of wax;  
 Caused by transpiration pull;  
 Cohesion / hydrogen-bonding between water molecules;  
 Symplastic – Through cell surface membrane (of epidermis / root hair cell) / ref. vacuoles membrane;  
 High to low  $\Psi$  /  $\Psi$ s;  
 Diffusion / osmosis;  
 Cell-to-cell via plasmodesmata / via strands of cytoplasm;  
 Secretion / active transport of ions into xylem by endodermis;  
 OR  
 Active uptake of ions from soil at epidermis;  
 Lowers  $\Psi$  /  $\Psi$ s in xylem / increases osmosis into xylem;  
*[If symplast & apoplast are confused – max 5 marks]* max 6

- (b) 1. Diameter of trunk minimal at warmest / brightest time of day / midday = warmest / brightest;  
 2. Stomata open in light  $\rightarrow$  more water loss;  
 3. Water evaporates more when warm / more heat energy for water evaporation;  
 4. Hydrogen-bonding between water molecules;  
 5. Cohesion (/ described) between water molecules;  
 6. Adhesion (described) between water molecules and walls of xylem vessels;  
 7. (Xylem) pulled inwards by faster flow of water / pulled in by tension;  
 8. Reduced pressure at leaves / top of plant / pull from top / from leaves / tension from leaves / from top of plant due to transpiration / evaporation;  
 9. Water pulled up plant; max 6

(c)

Feature	Explanation
Thick cuticle / wax layer	waterproof / impermeable;
Sunken stomata	saturated layer of still air outside;
Hairy	saturated layer of still air outside;
Leaves small / reduced to spines / needles	reduced S.A. for water loss;
Leaves roll up in dry weather	less S.A. for water loss / stomata covered / saturated region of still air;
Reduced number of stomata	reduced S.A. for water loss;
CAM (/ Crassulacean Acid Metabolism)	stomata closed in light / in warm / only open in dark / when cool;

3 features but no explanations – max 1 mark

max 3

Total 15 marks