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GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Biology Specification A

BYA6 Physiology and the Environment

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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 <u>active site</u>;
<u>Only</u> 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) <u>Maintains</u> concentration gradient (over whole length of gill) / diffusion can occur over whole gill;
<u>More</u> oxygen enters blood (/ <u>more</u> CO_2 leaves);
<u>More</u> (aerobic) respiration / <u>more</u> 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 <u>movement</u> / faster <u>movement</u> / 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 2nd convoluted tubule / collecting duct) / increases water permeability / adds aqua porous;

Evidence: observe increasing concentration (of dissolved substances) (in 2nd 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) <u>different types</u> of (cone) cells / types 6 and 7 sensitive to <u>different</u> wavelengths / <u>different</u> frequencies / <u>different</u> 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_2;
Increased H^+ ion concentration (in RBC);
(H^+ ions) cause more O_2 to be released from Hb / HbO_2 dissociates more readily / Hb affinity for O_2 is reduced;
Use of O_2 by muscle lowers O_2 concentration so more rapid diffusion of O_2 from RBC / more dissociation of HbO_2;
[Need 'increased' / 'more' ONCE only – if not, max 2] max 3

(b) (i) CO_2 enters blood / more CO_2 in blood / lactic acid (formed);
allow lactate
Forms carbonic acid / H^+ ions;
Not just 'CO_2 is acidic' 2

(ii) Hb combines with H^+ ions / releases H^+ ions; 1

Total 6 marks

Question 7

(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 C.O. = H.R. x 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_2 supply (to muscles);
Increases glucose supply (to muscles);
Increases CO_2 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^+ inside cell no longer less than concentration in gut lumen / no longer a concentration gradient;
No (facilitated) diffusion of NA^+ ions possible / amino acid absorption requires diffusion of Na^+ 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 Ψ / Ψs;
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 epidemis;
Lowers Ψ / Ψs 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 → 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
Think 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