



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

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# Mark scheme January 2004

## GCE

### Biology A/ Human Biology

### Unit BYA7

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**Question 1**

- (a) The minimal energy consumption required to maintain essential metabolism / the energy expenditure of the resting (stress-free postabsorptive) body / the minimum amount of energy needed to maintain essential body functions; per unit / given time; 2
- (b)
- |  |  |   |
|--|--|---|
|  |  | ✓ |
|  |  | ✓ |
|  |  | ✓ |
- All 3 correct = 1 1
- (c) shorter has a smaller SA: vol ratio / smaller SA: mass ratio; heat loss is a function of SA / shorter loses less heat; 2

Total 5 marks

**Question 2**

- (a)
- |           |                             |           |
|-----------|-----------------------------|-----------|
| gastrin;  |                             |           |
|           | duodenum / small intestine; | not ileum |
| secretin; |                             |           |
- 3
- (e) It is shorter/faster because of nerve impulses / transport along nerves rapid; Hormones travel through the blood stream (so are slower); 2

Total 5 marks

**Question 3**

- (a) thyroxine; 1
- (b) Answer 5 – 6 (%) = 2 marks  
Correct method + wrong answer = 1 mark 2
- (c) for synthesis of haemoglobin / Fe linked to Hb in answer; because of increased blood volume as body size increases; 2

Total 5 marks

**Question 4**

- (a) (i) blue because only blue-sensitive cones are stimulated; 1
- (iii) because both green and red (sensitive) cones stimulated;  
[reject mixing of light] 1
- (c) allele for colour vision confers an advantage to the organism;  
relevance (of colour vision) e.g. better foraging, detection of predators;  
therefore organisms with allele for colour vision more likely to survive  
to reproductive age/breed/have more offspring;  
and pass this gene/allele on to their offspring; max 3

Total 5 marks

**Question 5**

- (a) (Transports)  $\text{Na}^+$  out of the cell /  $\text{K}^+$  (transported) into the cell;  
by active transport / against gradient / pumped; 2
- (b) (i) each protein has a specific tertiary structure / (3D) shape;  
which allows one type of ion to pass through it;  
because the ions have different sizes / properties (**NOT** charge); max 2
- (ii) fewer protein B molecules, which (facilitate diffusion) of sodium ions;  
(must have both ideas) 1

Total 5 marks

**Question 6**

- (a) they are buffered / taken up by haemoglobin; 1
- (b) (the pH would decrease) affecting tertiary structure / denaturing of  
carbonic anhydrase / equilibrium would shift to left / eq.;  
less enzyme activity / slower reactions / reactions stop; 2
- (c) mature RBC's have no nucleus/DNA;  
or RER/ribosomes;  
therefore cannot synthesise proteins;  
no mitochondria;  
cannot produce ATP (to synthesise c.a.); max 2

Total 5 marks

**Question 7**

- (a) (i) actin (*accept* tropomyosin); 1
- (ii) myosin head; 1
- (b) (i)  $\text{Ca}^{2+}$  binds to [part of] the actin / troponin;  
this causes tropomyosin to be displaced;  
uncovers [myosin] binding sites [on actin] / allows actin to bind; max 2
- (ii) myosin heads bind to actin / cross bridge formation /  
actomyosin formed;  
myosin heads / crossbridges swivel / ratchet mechanism;  
causing actin to slide relative to myosin;  
energy provided by hydrolysis of ATP; max 3
- (c) (i) (number lightly stained fibres / total number of fibres) x 100;  
(actual numbers are 10/18 x 100) 1
- (ii) sample not representative / large enough;  
individual muscle fibres different sizes / contain different  
number of myofibrils; max 1
- (d) all some stain = 1  
fast dark and slow lighter = 2 2
- (e) change in base sequence in DNA;  
addition / deletion / substitution of a base in DNA of the gene  
which codes for myosin;  
change in amino acid sequence / primary structure;  
causes a different tertiary structure;  
which alters the binding properties of myosin; max 4

Total 15 marks

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**Question 8**

- (a) (i) it would fall / decrease; 1
- (ii) no more glycogen to respire;  
lipids or protein have to be used (for respiration);  
these have a lower RQ than carbohydrates; max 2
- (b) (i) the dietary C/H broken down to glucose / absorbed as glucose;  
glucose converted to glycogen in the liver / skeletal muscle;  
(promoted by) the hormone insulin; max 2
- (ii) during marathon glycogen converted to glucose;  
(promoted) by glucagon / adrenaline;  
glucose respired (aerobically) by the muscle cells; max 2
- (c) (i) heat is generated by muscle contraction / increased respiration /  
increased ATP hydrolysis; 1
- (ii) hypothalamus detects change;  
(increased rates of) sweating;  
heat lost by (the latent heat of) evaporation;  
vasodilation occurs;  
increased heat loss by convection and radiation; max 4
- (iii) at 25°C (accept converse for 10°C)  
(temperature regulation requires) blood to be directed to the skin;  
therefore less blood available to flow to the muscles;  
so there is a decreased supply of oxygen and glucose /  
removal of carbon dioxide (causing lower respiration rate);  
sweating lowers blood volume and therefore supply of  
metabolites to muscles; max 3

Total 15 marks

**Question 9**

- (a) midpiece of sperm contains mitochondria;  
which supply ATP;  
used by tail to provide motility;  
acrosome contains (digestive) enzymes;  
released when membranes ruptures;  
which digest a path through the zona pelucida/ corona radiata / eq.;  
haploid nucleus of sperm can enter egg cell (and fuse with nucleus);      max    4
- (b) Zygote formed from two haploid gametes;  
both contribute 23 chromosomes / same amount of DNA;  
all sperm DNA is nuclear DNA;  
only mother / only ovum contributes mitochondria / mitochondrial DNA;  
mitochondrial DNA in zygote is 1 656 900 kilobase pairs;      5
- (c) Feature and reason independent.  
max 3 of each.
- breakdown of membranes; therefore short diffusion distances;  
chorionic villi and lacuna; therefore large S/A for exchange;  
slow movement of blood at exchange surfaces; therefore increased  
time for diffusion;  
transport proteins present; for facilitated diffusion of glucose **OR**  
transport proteins present; for active transport of ions and a.a's;  
circulation; maintains concentration gradient;      max    6

Total 15 marks

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