

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

## MARK SCHEME for the October/November 2006 question paper

### 9700 BIOLOGY

9700/04

Paper 4 (Theory 2), maximum raw mark 60

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

The grade thresholds for various grades are published in the report on the examination for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2006 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



|        |                               |          |       |
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| Question | Expected Answers  | Marks |
|----------|---|-------|
| 1 (a)    | (carbohydrates)<br>1 less reduced / less hydrogen / less C-H bonds ; $R H_2$<br>2 for, aerobic respiration / ETC / NAD / ATP ;<br>3 less energy ;<br>4 per, unit mass / mole ; <i>accept figs for 3 and 4</i><br>5 carbohydrate has lower energy density ;; <i>accept as alternative to 3 &amp; 4 for 2 marks</i>   | 3 max |
| (b)      | carbohydrate = 1.0 ;<br>lipid = 0.6 – 0.8 ;   | 2     |
| (c)      | RQ remains stable between 3°C and 10°C / AW ;<br>rise between 10°C and, 20°C / 25°C ;<br>0.74 to, 0.76 / 0.8 ; <i>accept difference for figs marks</i><br>sharp rise, between 25°C and 27°C / after 25°C ;<br>0.8 to 0.91 / peaks at 0.91 ; <i>3 max</i><br><br>at low temperatures hamster uses lipids ;<br>reason ; e.g. more heat generated from lipid respiration<br>at higher temperatures more carbohydrates are used ; | 4 max |
| (d)      | anaerobic respiration / conversion of carbohydrate to fats as animal hibernates;  | 1     |

[Total: 10]

|               |                                      |                 |              |
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| <b>Question</b>  | <b>Expected Answers</b>   | <b>Marks</b> |
|------------------|---|--------------|
| <b>2 (a) (i)</b> | black : red ;<br>1 : 1 ;  | <b>2</b>     |
| <b>(ii)</b>      | black : copper : red ;<br>2 : 1 : 1 ;   | <b>2</b>     |
| <b>(iii)</b>     | red : copper ;<br>3 : 1 ;   | <b>2</b>     |
| <b>(b) (i)</b>   | test / back, cross ;<br>with, copper / $A^tA^t$ / homozygous recessive ;  | <b>2</b>     |
| <b>(ii)</b>      | if all offspring red, homozygous ;<br>if some offspring copper, heterozygous ;<br>ref. equal proportions of offspring ; | <b>4 max</b> |

*mark (i) and (ii) together*

**[Total: 10]**

|        |                               |          |       |
|--------|-------------------------------|----------|-------|
| Page 4 | Mark Scheme                   | Syllabus | Paper |
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| Question | Expected Answers  | Marks |
|----------|---|-------|
| 3 (a)    | control / maintain, water / solute, concentration / potential ;<br>of, body fluids / internal environment / cells ;   | 2     |
| (b)      | <p>1 <b>B / C</b>, lower <math>\psi</math> than <b>A</b> ;<br/><i>accept C lower <math>\psi</math> than B</i><br/><i>accept <math>\psi</math> gets more negative as fluid moves down descending limb</i></p> <p>2 comparative figs ;</p> <p>3 water moves out by, diffusion / osmosis ;</p> <p>4 into, medulla tissue / tissue fluid ;</p> <p>5 <b>D / E</b>, higher <math>\psi</math> than <b>C</b> ;<br/><i>accept <math>\psi</math> gets less negative as fluid moves up ascending limb</i></p> <p>6 comparative figs ;</p> <p>7 <math>\text{Na}^+</math> / <math>\text{Cl}^-</math>, move out ;</p> <p>8 into, medulla tissue / tissue fluid ;</p> <p>9 by active transport ;</p> <p>10 <b>A and E</b> same <math>\psi</math> / AW ;<br/><i>penalise once for no units</i><br/><i>allow either 4 or 8</i></p> | 5 max |
| (c)      | receptor – hypothalamus ;<br>effector – pituitary gland / cells or walls of collecting duct ; <b>R</b> anterior pituitary   | 2     |

[Total: 9]

|               |                                      |                 |              |
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| <b>Question</b> | <b>Expected Answers</b>   | <b>Marks</b> |
|-----------------|---|--------------|
| <b>4 (a)</b>    | similar morphological, physiological, biochemical and behavioural features ;<br>( <i>minimum 3 for mark</i> )<br>interbreed / reproduce ;<br>produce fertile offspring ;<br>occupy same niche ;<br>reproductively isolated;   | <b>2 max</b> |
| <b>(b)</b>      | isolating mechanism – land barrier / AW ; <i>accept geographical isolation</i><br>type of speciation – allopatric ;   | <b>2</b>     |
| <b>(c)</b>      | 1 geographical barriers / description ;<br>2 barrier to gene flow ;<br>3 no interbreeding / separate breeding populations / reproductively isolated ;<br>4 (gene) mutations occur / new alleles ;<br>5 different selection pressures / e.g. of selection pressure ;<br>6 ref. natural selection / description ;<br>7 change in allele frequency / OWTTE ;<br>8 develop different chromosome numbers / ref. polyploidy ; | <b>4 max</b> |

**[Total: 8]**

|               |                                      |                 |              |
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| <b>Question</b> | <b>Expected Answers</b>  | <b>Marks</b>      |
|-----------------|--|-------------------|
| <b>5 (a)</b>    | 5.0 – 5.5 ;<br>µm ;<br><i>accept correct values for mm, cm or m</i>  | <b>2</b>          |
| <b>(b)</b>      | <ol style="list-style-type: none"> <li>1 plant produces ABA ;</li> <li>2 (due to) high temperature ;</li> <li>3 (due to) reduced water supply / water loss / drought ;</li> <li>4 guard cells lose K<sup>+</sup> ;</li> <li>5 ref. water potential gradient ;</li> <li>6 guard cells lose water ;</li> <li>7 loss of turgor causes stomatal closure ;</li> <li>8 AVP ; e.g. stress hormone / different thickness of cell wall / ABA binds to receptors on guard cells</li> </ol> | <b>4 max</b>      |
| <b>(c)</b>      | (rate of transpiration due to) difference in relative humidity inside and outside, stomata / leaf ;<br>in still air / low wind speed, external water vapour remains close to stomata / AW ;<br>reduced, concentration gradient / water potential gradient ;  | <b>2 max</b>      |
|                 |  | <b>[Total: 8]</b> |

|               |                                      |                 |              |
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- 6 (a)** Describe how the structure of neurones speeds up the transmission of action potentials. [6]
- (b)** Explain, using a named example, how sensory receptors in mammals convert energy into action potentials. [9]

[Total: 15]

- (a)**
- 1 myelin sheath / schwann cell ;
  - 2 insulates, axon / dendron ;
  - 3 impermeable to  $\text{Na}^+$  /  $\text{K}^+$  ;
  - 4 depolarisation only at nodes of Ranvier ;
  - 5 ref. local circuits ;
  - 6 action potentials 'jump' from node to node ;
  - 7 saltatory conduction ;
  - 8 speed increased by 50 times /  $0.5 \text{ ms}^{-1}$  to  $100 \text{ ms}^{-1}$  ;
  - 9 axons with large diameter / giant axon ;
  - 10 reduce resistance ;
  - 11 elongated, axon / dendron / neurone ;
- 6 max**

- (b)**
- 12 ref. specific example ; e.g. pacinian corpuscle / rod / cone / hair cell
  - 13 correct stimulus ; e.g. touch / pressure light / sound
  - 14 detail of receptor response ; e.g. deformation of pacinian corpuscle membrane
  - 15 stimulus causes  $\text{Na}^+$  channels to open ;
  - 16  $\text{Na}^+$  enters cell ;
  - 17  $\text{K}^+$  channels open ;
  - 18  $\text{K}^+$  leaves cell ;
  - 19 depolarisation ;
  - 20 receptor / generator potential ;
  - 21 greater than threshold leads to, action potential / impulses ;
  - 22 less than threshold only localised depolarisation ;
  - 23 increased stimulus leads to increased frequency of action potentials ;
  - 24 AVP ;
- apply max 8 for points 15 - 24*
- 9 max**

**Total 15**

|               |                                      |                 |              |
|---------------|--------------------------------------|-----------------|--------------|
| <b>Page 8</b> | <b>Mark Scheme</b>                   | <b>Syllabus</b> | <b>Paper</b> |
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- 7 (a) Describe the transfer of energy to ATP during photosynthesis. [6]
- (b) Describe the process of oxidative phosphorylation. [9]

[Total: 15 ]

- (a)
- 1 light absorbed by chlorophyll / AW ;
  - 2 ref. photosystems ;
  - 3 ref. harvesting clusters / accessory pigments ;
  - 4 reaction centre / P680 / P700 ;
  - 5 excitation of electrons / AW ;
  - 6 ETC ;
  - 7 idea of different energy levels ;
  - 8  $\text{ADP} + \text{P}_i \rightarrow \text{ATP}$  ;
  - 9 cyclic / non-cyclic, photophosphorylation ;
  - 10 chemiosmosis / ATP synthase / description ;
- 6 max**

- (b)
- 11 reduced NAD / FAD ;
  - 12 passed to ETC ;
  - 13 hydrogens removed ; **R H<sub>2</sub>**
  - 14 split into  $\text{H}^+$  and  $\text{e}^-$  ;
  - 15  $\text{e}^-$  passed to carriers ;
  - 16  $\text{H}^+$  stays in mitochondrial matrix ;
  - 17 oxygen final  $\text{e}^-$  carrier ;
  - 18 joins with  $\text{H}^+$  / reduced ; **R H<sub>2</sub> / hydrogen**
  - 19 forms water ;
  - 20 ref. energy levels of carriers ;
  - 21 energy available to convert ADP and  $\text{P}_i$  to ATP ;
  - 22 occurs three times ( for each reduced NAD ) / ref. total yield ;
  - 23 chemiosmosis / ATP synthase / description ;
- 9 max**  
**[Total: 15]**