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.

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

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

[Total: 10]

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

[Total: 9]

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

Question		Expected Answers	Marks
5	(a)	5.0 – 5.5 ; µm ; *accept correct values for mm, cm or m*	2
	(b)	1 plant produces ABA ; 2 (due to) high temperature ; 3 (due to) reduced water supply / water loss / drought ; 4 guard cells lose K^+ ; 5 ref. water potential gradient ; 6 guard cells lose water ; 7 loss of turgor causes stomatal closure ; 8 AVP ; e.g. stress hormone / different thickness of cell wall / ABA binds to receptors on guard cells	4 max
	(c)	(rate of transpiration due to) difference in relative humidity inside and outside, stomata / leaf ; in still air / low wind speed, external water vapour remains close to stomata / AW ; reduced, concentration gradient / water potential gradient ;	2 max
			[Total: 8]

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 Na^+ / 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 ms^{-1} to 100 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 Na^+ channels to open ;
16 Na^+ enters cell ;
17 K^+ channels open ;
18 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

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 ADP + Pi → 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_2
14 split into H^+ and e^- ;
15 e^- passed to carriers ;
16 H^+ stays in mitochondrial matrix ;
17 oxygen final e^- carrier ;
18 joins with H^+ / reduced ; **R** H_2 / hydrogen
19 forms water ;
20 ref. energy levels of carriers ;
21 energy available to convert ADP and Pi to ATP ;
22 occurs three times (for each reduced NAD) / ref. total yield ;
23 chemiosmosis / ATP synthase / description ; **9 max**

[Total: 15]