UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9700 BIOLOGY

9700/43 Paper 4 (A2 Structured Questions), maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, 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, which would have considered the acceptability of alternative answers.

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UNIVERSITY of CAMBRIDGE
International Examinations

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question or guidance on the mark scheme)
AW	alternative wording (where responses may vary more than usual)
underline	actual word given must be used by the candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

1 (a) 1 pollution **;**

2 environment / habitat, change qualified **;** e.g. increase in water temperature / change in water pH

3 overfishing **;**

4 loss of food / more competition for food **;**

5 direct human interference qualified **;** e.g. pleasure boats [3 max]

(b) variety of / different / total number of, species **;**

genetic diversity of species / AW **;** [2]

(c) *any three from*

1 tourism / leisure **;**

2 economic benefits **;**

3 food for humans **;**

4 ref. resource / species, may have use in future / AW **;**

5 maintains, food webs / food chains **;** **A** description

6 nutrient cycling **;**

7 maintains, (large) gene pool / genetic variation **;** [3 max]

[Total: 8]

2 (a) 1 ref. differentiation / specialisation **;**

2 ref. Sertoli cell **;**

3 forms flagellum **;** **A** tail

4 detail (of flagellum) **;** e.g. microtubules

5 acrosome **;**

6 detail (of acrosome) **;** e.g. contains enzymes / modified lysosome

7 many mitochondria **;** [4 max]

(b) *accept normal or healthy for undamaged*
accept abnormal or unhealthy for damaged

1 undamaged sperm move into lower chamber **or** damaged sperm stay in upper chamber **;**

2 undamaged sperm have negatively charged (proteins) **or** damaged sperm lack negatively charged (protein) **;**

3 undamaged sperm are, attracted to positive plate / repelled by negative plate **;**
ora for damaged sperm

4 idea that undamaged sperm which have, moved / matured, slowly (in epididymis) **;**
ora for damaged sperm [3 max]

[Total: 7]

3 (a) (i) hybridoma ; [1]

(ii) 1 identical (antibodies) **or** produced by cloning ;

2 variable regions / antigen binding sites, all identical **or** (antibodies) are specific to one antigen ; [2]

(iii) *Mark text first*

1 (four) polypeptides ; *plural*

2 two heavy **and** two light chains ; **A** long and short

3 ref. disulphide, bridges / bonds ;

4 ref. variable regions / binding sites ; [3 max]

(b) (i) 1 HAT cannot be metabolised / AW ;

2 HAT inhibits mutant myeloma cells / AW ; [2]

(ii) 1 mouse spleen cells can metabolise HAT / AW ;

2 because they have suitable enzyme ; [2]

(iii) 1 so that only fused cells survive **or** unfused myeloma cells die ;

2 identifies, cells to be cloned / fused cells ; [2]

(c) 1 can be done at home / easy to use / non-invasive ;

2 cheap ;

3 result produced quickly ;

4 result likely to be accurate ;

5 can be done early in pregnancy ;

6 safe to use ; [4 max]

[Total: 16]

4 (a) 1 water lost by, evaporation / transpiration ;

2 no water uptake (by roots) ; [2]

(b) (i) 1 as water potential increases, oxygen uptake increases ;
must be stated

2 levels off (at 5 kPa / at 225 au) ;

3 figures ; *two water potential plus two oxygen uptake figures plus kPa* [2 max]

(ii) 1 succinate converted to oxaloacetate ;

2 dehydrogenation / oxidation ;

3 NAD, is reduced / accepts hydrogen ;

4 (hydrogens move to) ETC ;

5 hydrogen splits into protons and electrons ;

6 electrons pass along ETC ;

7 ADP + Pi ⟶ ATP ;

8 oxygen, receives protons and electrons / is final electron acceptor, to form water ; [4 max]

(c) (i) 1 water leaves mitochondrion ; **A** other named organelle

2 by osmosis / down water potential gradient ;

3 idea mechanical disruption to membranes ;

4 membranes made of <u>phospholipid</u> (bilayer) ;

5 hydrophilic heads / glycoproteins / glycolipids, form fewer hydrogen bonds with water ;

6 reduces, stability / fluidity (of membrane) ;

7 ref. (proteins with) hydrophilic channels ; [3 max]

(ii) 1 inner membrane (of mitochondrion) / cristae, site of ETC ;

2 fewer carriers held in position ;

3 fewer electrons pass along ETC ;

4 less ATP produced / less energy released ;

5 less oxygen required to act as electron acceptor ;

6 protons can move freely through the damaged inner membrane ;

7 proton gradient not formed ;

accept ora for less damaged membranes for marking points 2–7 [3 max]

(d) 1 extensive / deep, roots ;

2 <u>leaves</u> have small surface area ;

3 <u>leaves</u>, are curled / are waxy / have bulliform cells / have hinged cells ;

4 reduced stomata numbers / stomata in pits ; [2 max]

[Total: 16]

5 **(a)** 1 AAV2.5T infects more cells than AAV / AW ;

2 both increase until 20 days ;

3 AAV2.5T falls after 20 days but AAV remains steady ;

4 figures ; *two intensities on a single day* [2 max]

(b) 1 infected cells fluoresce (when luciferin added) ;

2 able to identify infected cells ; [2]

(c) 1 correct form of (CFTR) protein made ;

2 delivered to / inserted into, membrane ;

3 acts as chloride channel ;

4 chloride ions leave cell ;

5 water leaves cell ;

6 normal / less viscous, mucus formed ;

7 give credit to mention of one symptom reversed ;
e.g. no blockage of airways / less chance of infections [4 max]

[Total: 8]

6 (a) 86 **;;** **A** -86

accept suitable working for one mark e.g. $\frac{1400-190}{1400}\times 100$

or

accept 86.4 for one mark [2]

(b) 1 drought reduced available food **or** fewer small seeds produced **;**

2 finches with larger beaks survived **or** finches with smaller beaks died **;**

3 able to open tough fruits / ora **;**

4 able to feed on larger seeds / ora **;**

5 tough fruit / size of seed, acted as selection pressure **;** [3 max]

(c) directional / evolutionary **;**

selection pressure acts on one extreme (of range) **;** [2]

[Total: 7]

7 **(a)** 1 removal / elimination, of waste products ;

2 of metabolism ;

3 (which are) toxic ;

4 (or) substances excess (to requirements) ; [2 max]

(b) 1 homeostasis / AW ;

2 change in water potential ;

3 detected by (osmo)receptors ;

4 in hypothalamus ;

5 response via effector ;

6 ADH released ;

7 effect on collecting duct ;

8 return to, norm / set point ; [4 max]

(c) 1 blood diverted away from skin ;

2 less sweating ;

3 more water retained in body / high water potential in body ;

4 less water reabsorbed from collecting duct / AW ; [2 max]

[Total: 8]

8 (a) 1 high rate of photosynthesis at 430–435 nm **and** 655 nm wavelengths ;

2 idea of (high) absorption of light at these wavelengths ;

3 highest rate, at 430–435 nm ;

4 shorter wavelengths have more energy ;

5 low(er rate) in, middle range / 500–600, of wavelengths ;

6 low light absorption here ;

7 absorbed light used for photosynthesis ;

8 in light-dependent stage ; [4 max]

(b) (i) ATP ;

reduced NADP ; [2]

(ii) 1 ATP provides energy ;

2 reduced NADP, is reducing agent / provides hydrogen ;

3 for converting GP to TP ;

4 (ATP used to) regenerate RuBP ; [3 max]

(c) process / photosynthesis, affected by more than one factor ;

rate is limited by the factor nearest its minimum value / AW ; [2]

(d) 1 enters leaf through (open) stomata ;

2 by diffusion ;

3 substomatal air space ;

4 many air spaces in spongy mesophyll ;

5 spaces between palisade cells ;

6 dissolves in moisture on cell (walls) ;

7 enters through cell walls ; [4 max]

[Total: 15]

9 (a) 1 chiasma / crossing over ;

2 between non-sister chromatids ;

3 of, homologous chromosomes / bivalent ;

4 in <u>prophase 1</u> ;

5 exchange of genetic material / AW ; ***R*** *genes unqualified*

6 linkage groups broken ;

7 new combination of alleles ;

8 <u>independent assortment</u> (of homologous chromosomes) ;
R *random assortment*

9 at equator ;

10 (during) <u>metaphase 1</u> ;

11 possible mutation ;

12 random mating ;

13 random fusion / fertilisation of gametes ; [7 max]

(b) 14 phenotypic variation results from interaction of genotype and environment / VP = VG + VE ;

15 environment may modify expression of gene(s) ; *must be stated*

16 e.g. for size / mass / height ;

17 because, food / nutrient / ion, missing or in short supply ; **A** malnutrition

18 named, food / nutrient / ion, (missing or in short supply) ;

19 environment may, trigger / switch on, gene ; *must be stated*

20 ref. low temperature and change in animal colour ;

21 ref. high temperature and, curled wing in *Drosophila* / gender in crocodiles ;

22 ref. <u>UV</u> light and melanin production ;

23 ref. wavelength of light and, flowering / germination / fruit colour ;

24 other named trigger plus example ;

25 environment effect usually greater on polygenes / ora ;

26 environment may induce mutation affecting phenotype ; [8 max]

[Total: 15]

10 (a) 1 nucleotide **;**

2 adenine + ribose / pentose + three phosphates **;**

3 loss of phosphate leads to energy release / hydrolysis releases 30.5 kJ **;**

4 ADP + Pi ⟷ ATP (reversible reaction) **;**

5 small packets of energy **;**

6 small / water soluble, so can move around cell **;**

7 used by cells as immediate energy donor **;**

8 link between energy yielding and energy requiring reactions / AW **;**

9 high turnover **;**

10 two examples of use **; ;** e.g. active transport **/** muscle contraction **/** Calvin cycle /

11 protein synthesis [8 max]

(b) 12 Pyruvate, cannot enter mitochondrion / remains in the cytoplasm **;**

13 becomes, hydrogen acceptor / reduced **;**

14 by reduced NAD **;**

15 from glycolysis **;**

16 converted to lactate **;**

17 lactate dehydrogenase **;**

18 allows glycolysis to continue **;**

19 no, decarboxylation / CO_2 removed **;**

20 single step **;**

21 reversible reaction / converted back to pyruvate **;**

22 by oxidation **;**

23 ref. oxygen debt **;**

24 ethanol produced **;**

accept ora for marking points 19–23 [7 max]

[Total: 15]