UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9700 BIOLOGY

9700/41 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.

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

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1 **(a)** $\frac{(275 - 90)}{10}$ or $\frac{185}{10}$ or $\frac{1705}{10}$ for 1 mark

18.5 **;;** **A** 19 **R** 18 [2]

(b) 1 avoid disturbance to, nest sites/nesting females **;** **R** ref. to mating

2 protect, nest sites/young, from predators **;**

3 avoid sea pollution **;**

4 example of pollution **;** e.g. do not throw rubbish into sea / avoid discharge from boats/light pollution (beaches)

5 take care when fishing (with nets) **;**

6 stop hunting of adults **;** **A** trading ban on turtle products

7 captive breeding programmes/AW **;**

8 conservation areas/zoos **;**

9 education/ecotourism **;** [5 max]

[Total: 7]

2 **(a)** 1 hamster injected with, antigen/CD40 **;**

2 B cells/plasma cells, with ability to make antibody taken **;**

3 from spleen **;**

4 (B cells/plasma cells) fused with, tumour/cancer/myeloma, cell **;**

5 use of, fusogen/PEG **;**

6 (hybrid) cells cultured/AW **;** **R** use of fermenter

7 check cells for mAb production **;**

8 (antibody making) cells mass produced/AW **;** **A** use of fermenter [4 max]

(b) (i) *accept mouse survival for heart survival*

1 in **A**, 100% hearts survive 10 days **or** no heart survives 20 days **;**

2 in **D**, 100% hearts survive, 80 days/to end of investigation **;**

3 in **B**, 100% hearts survive 30 days **or** 10% hearts survive, 80 days/to end of investigation **;**

4 in **C**, 100% hearts survive 30 days **or** 75% hearts survive, 80 days/to end of investigation **;**

penalise once for no mention of percentage in mps 2, 3 and 4 [4]

(ii) 1 in **D**, both pathways/CD28 and CD40, blocked **;**

2 so T-cells cannot be cloned/no immune response **;**

3 in **B**, CD40 pathway is not blocked/only CD28 is blocked **;**

4 so T cells can still be cloned/immune response triggered **;** [2 max]

(c) 1 carry blood to, cardiac/heart, muscle/tissue/cells **;**

2 supply oxygen **;**

3 supply, nutrient/named nutrient **;**

4 for, energy release/respiration **;** **R** produce energy [3 max]

(d) *two of the following:*

1 diagnosis of, disease/named disease **;** e.g. gonorrhoea/HIV

2 treatment of disease **;** e.g. directing drugs to cancerous cells **A** <u>auto</u>immune disease but **not** tissue or blood typing

3 pregnancy testing/drug testing **;**

4 (passive) vaccine production **;** [2 max]

[Total: 15]

3 **(a)** **E** – spermatogonium/germinal epithelial cell **;**
F – secondary spermatocyte **;**
G – spermatid **;** **R** spermatozoa
H – Sertoli cell/nurse cell **;** [4]

(b) *Accept identification of cells from diagram.*

1 cell **E** mitosis **;**

2 (**E** / spermatogonia) increases in size/AW **;**

3 becomes a primary spermatocyte **;**

4 (primary spermatocyte) meiosis **I ;**

5 forms secondary spermatocyte(s) **;**

6 2n to n/diploid to haploid/halving chromosome number **;** [4 max]

[Total: 8]

4 **(a)** **(i)** **J** – epidermis/epidermal cell **;**
K – mesophyll (cell) **;**
L – bundle sheath (cell) **;** [3]

(ii) 1 mesophyll cells tightly packed/AW **;**

2 so O_2 cannot reach bundle sheath cells **;**

3 light independent stage/Calvin cycle **or** RuBP, in bundle sheath cells **;**

4 ref. malate shunt **;**

5 maintains high CO_2 concentration (in bundle sheath cells) **;**

6 PEP carboxylase, has high optimum temperature/has higher affinity for CO_2 /doesn't accept O_2 **;**

7 (PEP carboxylase) not denatured **;**

8 photorespiration is avoided **;** [4 max]

(b) 1 reduces water loss/AW **;**

2 wax does not melt **;**

3 shiny surface reflects radiation **;** [2 max]

(c) (i) greater reduction in sorghum than in soybean **;**
use of comparative figures **;** e.g. sorghum 5.5 to 1.2 **or** by 4.3
soybean 5.2 to 1.6 **or** by 3.6 [2]

(ii) *reject 'no' for all points*

1 less surface area **;**

2 less absorption of light **;**

3 less, photophosphorylation / light dependent reaction **;**

4 less chemiosmosis **;**

5 (due to) smaller thylakoid space **or** reduced proton gradient **;**

6 less ATP (produced) **;**

7 less reduced NADP (produced) **;**

8 light-independent reaction / Calvin cycle, slows down **;**

9 less carbon dioxide, fixed / combined with PEP **;** **R** uptake [4 max]

[Total: 15]

5 (a) *(A.) porcatus* **;** [1]

(b) 1 *A. brunneus, A. smaragdinus and A. carolinensis* have smaller differences with *A. porcatus* (than with others)/AW **;**

2 therefore more closely related to *A. porcatus* (than to each other) **;**

3 use of figures **;**

4 AVP **;** e.g. comment about figures for *A. brunneus* with *A. smaragdinus*/ ref. different times of separation [3 max]

(c) 1 allopatric speciation ;

2 (lizard populations) separated by water ;

3 geographical/physical, barrier ;

4 no, breeding/gene flow, between populations ;

5 mutations occur ;

6 different selection pressures/different (environmental) conditions ;

7 genetic change ; e.g. different alleles selected for/change in allele frequency/ change in gene pool/advantageous alleles passed **on** ;

8 (can result in) different chromosome numbers ;

9 genetic drift ;

10 ultimately, reproductively isolated/cannot interbreed ; [4 max]

[Total: 8]

6 **(a)** change in, DNA/base sequence ;
produces different allele ;
ref. different, protein/polypeptide, produced ; [2 max]

(b) 1 – X^rX^r ;
3 – X^rY ;
9 – X^RX^r ;
10 – X^RY ; [4]

(c) *answers must refer to phosphate ions*

1 altered shape/non-functional/no, carrier protein ;

2 less/no, reabsorption of phosphate ions (into blood) ;

3 from, glomerular filtrate/lumen of/proximal convoluted tubule ;

4 more/all, phosphate ions excreted ;

5 low phosphate ion concentration in, blood/bones ; **R** no phosphate ion conc [2 max]

[Total: 8]

7 (a) (i) glycolysis ; [1]

(ii) cytoplasm/cytosol ; [1]

(iii) 4 ; **A** 4 – 2 = 2 [1]

(b) (i) inner membrane/cristae/stalked particles ; [1]

(ii) 1 reduced, NAD/FAD ;

2 dehydrogenase enzymes ;

3 release hydrogen ; **A** H **R** H_2/H^+

4 hydrogen splits into proton and electron ;

5 electrons flow down, ETC/AW ;

6 energy released ;

7 protons pumped (across inner membrane/from matrix) ;

8 into intermembrane space ;

9 proton gradient ;

10 protons pass through, ATP synthase/stalked particle ;

11 oxygen final, hydrogen/proton, acceptor ; [5 max]

(c) (i) nuclei **and** ribosomes ; [1]

(ii) 1 glycolysis, does not occur in mitochondrion/only occurs in cytosol or cytoplasm ;

2 pyruvate produced in glycolysis ;

3 pyruvate can enter mitochondrion/glucose cannot enter mitochondrion ;

4 carbon dioxide produced/decarboxylation, in, Krebs/link reaction ; [3 max]

(iii) 1 cyanide, inhibits cytochrome oxidase is a non-competitive inhibitor ;

2 reduced NAD not oxidised/AW ;

3 Krebs cycle stops ;

4 alternative H acceptor needed/pyruvate is H acceptor/pyruvate is reduced ; **R** H^+

5 lactate produced in cytoplasm ;

6 by anaerobic respiration ; [3 max]

[Total: 16]

8 (a) (i) 1 parents, heterozygous/carriers ;

2 CF allele recessive ;

3 CF child homozygous recessive ; [2 max]

(ii) 1 thick/sticky/dehydrated, mucus produced ;

2 mucus not moved effectively by cilia/mucus accumulates ; **R** mucus blocks airway

3 reduced gaseous exchange/longer diffusion pathway ;

4 difficulty in breathing/AW ;

5 infections/(mucus) traps bacteria ;

6 lungs are scarred ; [2 max]

(b) (i) 1 alters genotype ;

2 insert, dominant/normal, allele ; **R** gene

3 into, affected/appropriate, cells ;

4 use of vector/named vector ;

5 ref. recombinant DNA ; [2 max]

(ii) *advantage*

1 treats cause not symptoms ;

2 no, physiotherapy/antibiotics/etc, needed ;

3 less time consuming than others treatments ; max 1

disadvantage

4 effects only last for a few days (at present)/low uptake by target cells ;

5 only target lung cells (at present) ;

6 side effects ; max 1 [2 max]

[Total: 8]

9 **(a)** 1 closely packed to absorb maximum light ;

2 vertical/at right angles to surface of leaf to reduce number of cross walls ;

3 large vacuole pushes chloroplasts to edge of cell ;

4 chloroplasts at edge short diffusion path for carbon dioxide ;

5 chloroplasts at edge to absorb maximum light ;

6 large number of chloroplasts to absorb maximum light ;

7 cylindrical cells **or** air spaces to circulate gases/provide a reservoir of CO_2 ;

8 large surface area for diffusion of gases ;

9 moist cell surfaces for diffusion of gases ;

10 cell walls thin for maximum light penetration/diffusion of gases ;

11 chloroplasts can move towards light ;

12 chloroplasts can move away from high light intensity to avoid damage ; [8 max]

(b) 13 Calvin cycle/stroma ;

14 carbon dioxide fixed by RuBP ;

15 rubisco ;

16 2 molecules of GP formed ; **A** PGA

17 (GP) forms TP ; **A** GALP/PGAL

18 use of ATP ;

19 use of, reduced NADP/NADPH ;

20 from light dependent stage ;

21 some TP forms, hexose/sucrose/starch/cellulose/glycerol ;

22 some TP converted to acetyl CoA ;

23 some TP used to regenerate RuBP ;

24 using ATP ;

allow either mp 18 or mp 24

marks can be awarded on a diagram [7 max]

[Total: 15]

10 (a) 1 renal/Bowman's, capsule ;

2 ref. podocytes ;

3 (proximal convoluted tubule/distal convoluted tubule/capsule) in cortex ;

4 proximal convoluted tubule ;

5 loop of Henle ;

6 (loop) in medulla ;

7 distal convoluted tubule ;

8 afferent arteriole ;

9 glomerulus ;

10 efferent arteriole ;

11 capillary network around/proximal convoluted tubule/loop/distal convoluted tubule ;

12 collecting duct ;

accept points on a labelled diagram [7 max]

(b) 13 endothelium of, blood capillaries/glomerulus ;

14 more/large, gaps between endothelial cells ;

15 podocytes ;

16 large gaps between podocytes/filtration slits ;

17 basement membrane, selective barrier/acts as a filter ;

18 prevents, large protein/RMM > 68 000, passing through ;

19 no cells pass through ;

20 named molecule which is filtered ; e.g. urea/water/glucose/uric acid/creatinine/ $Na^+/K^+/Cl^-$;

21 high, blood/hydrostatic, pressure in glomerulus ;

22 afferent arteriole wider than efferent arteriole ;

23 lower pressure in, renal/Bowman's, capsule ;

24 fluid forced into capsule/ultrafiltration ; [8 max]

[Total: 15]