

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

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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]

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(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** autoimmune disease but **not** tissue or blood typing
- 3 pregnancy testing/drug testing ;
- 4 (passive) vaccine production ; [2 max]

[Total: 15]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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- 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 O₂ cannot reach bundle sheath cells ;
3 light independent stage/Calvin cycle **or** RuBP, in bundle sheath cells ;
4 ref. malate shunt ;
5 maintains high CO₂ concentration (in bundle sheath cells) ;
6 PEP carboxylase, has high optimum temperature/has higher affinity for CO₂/doesn't accept O₂ ;
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]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
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- (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]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
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- (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]

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
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- 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]

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- 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]**

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- 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 CO₂ ;
 - 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]

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- 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]