

**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**

**9700/42** 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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- 1 (a) 1 more nests in, areas of low salinity/less salty areas ; **ora**  
 2 comment about result for salinity 16-20 not following trend ;  
 3 2 paired figs with units ; *linked to 1* [3]

- (b) (i)  $\frac{(31-8)}{8} (\times 100)$   
 287.5/288 ;;  
*allow one mark for suitable working if incorrect answer* [2]

- (ii) *any two from*
- 1 (ensure) low salinity or more freshwater ;
  - 2 nest sites protected ;
  - 3 education/ecotourism ;
  - 4 assisted breeding ;
  - 5 ban on hunting ;
  - 6 preventing pollution ; [2 max]

**[Total: 7]**

- 2 (a) 1 receptor or binding site not, complementary/specific, to FSH ;  
 2 FSH has shorter  $\beta$  chain than LH ; **ora**  
 3 FSH has different, primary structure/sequence of amino acids ;  
 4 FSH has different, tertiary structure/3D shape ; [3 max]

- (b) (i) follicle (cells) ; **A** granulosa (cells) [1]  
 (ii) corpus luteal (cells) ; **A** granulosa (cells) [1]

- (c) 1 (binding to a receptor), acts as a signal to the cells/stimulates cells ;  
 2 to, start/increase, synthesis of hormone ; **A** cells start to divide  
 3 oestrogen secreted ; **A** mature follicle formed (oestrogen),  
 4 stimulates thickening of endometrium/inhibits FSH (production) ; [3 max]

**[Total: 8]**

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
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- 3 (a) 1 penicillin inhibits enzyme ; *ignore name of enzyme*
- 2 peptidoglycan chains cannot link up/stops cross-links forming ;
- 3 cell wall becomes weaker/AW ;
- 4 turgor of cell not resisted (by cell wall)/AW ;
- 5 cell/wall, bursts ; [3 max]
- (b) (i) **B** has, an outer membrane/channel proteins ;  
**B** has thinner (peptidoglycan) wall ; *accept ora for A* [2]
- (ii) 1 penicillin V can reach the, wall/(cell surface) membrane, of **A** ; **ora**
- 2 outer membrane of **B** stops penicillin V getting through ; **ora**
- 3 penicillin V cannot get through pores of outer membrane of **B** ; [2 max]
- (iii) can penetrate outer membrane ;  
through pores/directly through as non-polar ; [2]
- (c) *batch culture*
- 1 set up and allowed to proceed ;
- 2 nutrients not added or products removed, (during fermentation) ;
- 3 air allowed in/waste gas allowed out ;
- 4 at end of each process, product harvested/fermenter cleaned out ; *max 2*
- continuous culture*
- 5 nutrients added (all the time) ;
- 6 products removed (all the time) ;
- 7 no down time/AW ; *max 2* [3 max]
- (d) 1 (*Penicillium*/fungus), does not make penicillin all the time/penicillin is made in the later stages of growth ;
- 2 when beginning to run out of nutrients ;
- 3 (penicillin) is a secondary metabolite ;
- 4 continuous culture has no yield of penicillin ;
- 5 continuous culture, never reaches stationary phase of growth/always exponential growth ; [3 max]

[Total: 15]

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- 4 (a)**
- 1 can be grown in many different environments/AW ;
  - 2 (grains) contain variety of nutrients ; **A** list of 3+ nutrients
  - 3 detail of nutrient content ; e.g. high in calcium/vitamin B/protein
  - 4 (grains) have high, energy/fibre, content ;
  - 5 (grains) store well ; [3 max]
- (b) (i)** endosperm ; [1]
- (ii)**
- 1 both rise and then fall ;
  - 2 sorghum (enzyme) has higher activity (at all temperatures) ;
  - 3 sorghum (enzyme) has higher maximum activity ;
  - 4 sorghum (enzyme) has higher optimum temperature ; **A** 70° and 60°
  - 5 comparative figures to illustrate points 2 or 3 ; [3 max]
- (iii)**
- 1 (rice) tertiary structure/active site, of amylase is altered more by high temperature ;
  - 2 (therefore) fewer ES/enzyme-substrate complexes formed/AW ;
  - 3 high temperatures affect H bonds (more than other bonds) ;
  - 4 amylase in rice may have more H bonds ; **ora**
  - 5 correct ref. to other named bond ; [3 max]
- (c) (i)**
- 1 higher CO<sub>2</sub> uptake at higher light intensity ; **ora**
  - 2 comparative figures ; *using columns 1 and 2*
  - 3 CO<sub>2</sub> used in, Calvin cycle/light independent reaction ;
  - 4 photophosphorylation/light dependent stage provides, ATP/reduced NADP ;
  - 5 for use in, Calvin cycle/light independent reaction ;
  - 6 light is a limiting factor ; [3 max]
- (ii)**
- 1 survive better at low light intensities ;
  - 2 comparative figures ; *using columns 1 and 6* [2]
- [Total: 15]**

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- 5 (a) divergence values less for *persimilis* than for *pseudoobscura* (at all DNA regions) ; **ora** use of figures ; [2]
- (b) 1 some regions of DNA more prone to mutation than others ;  
 2 mutation in some regions likely to be fatal (so not seen in populations) ;  
 3 there tends to be less divergence if DNA is part of an important gene/**ora** ;  
 4 detail ; e.g. causes change in essential protein [2 max]
- (c) 1 allopatric speciation ;  
 2 geographical/physical, barrier ;  
 3 no, breeding/gene flow, between populations ;  
 4 mutations occur ;  
 5 different selection pressures/different (environmental) conditions ;  
 6 genetic change ; e.g. different alleles selected for/change in allele frequency/change in gene pool/advantageous alleles passed on ;  
 7 genetic drift ;  
 8 (ultimately) cannot interbreed/reproductively isolated ; [4 max]

**[Total: 8]**

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
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- 6 (a) 1 allele/gene, found on **X** chromosome ;  
 2 females have two copies of, allele/gene ;  
 3 males have only one copy of, allele/gene ; [2 max]

(b) *key to symbols*

*recessive allele*  $X^a$  (= allele for CI)

*dominant allele*  $X^A$  (= allele for normal iris) ;

*cross 1*

*parental phenotypes* male with CI/cleft iris **and** normal female ;

*gametes*  $X^a$  or Y **all**  $X^A$  ;

*offspring genotypes*  $X^A X^a$   $X^A Y$  ;

*offspring phenotypes* **normal female** **normal male** ;

.....  
 or  
 .....

*cross 2*

*parental phenotypes* male with CI/cleft iris **and** normal female ;

*gametes*  $X^a$  or Y  $X^A$  or  $X^a$  ;

*offspring genotypes*  $X^A X^a$   $X^A Y$   $X^a X^a$   $X^a Y$  ;

*offspring phenotypes* **normal female** **normal male** **cleft iris/CI female** **cleft iris/CI male** ; [5]

*offspring phenotypes must be linked to genotypes*

- (c) 1 in 4/25%/0.25 ; **R** ratios [1]

[Total: 8]

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
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- 7 (a) (i) removal of, carbon dioxide/carboxyl group ; [2]  
removal of hydrogen ;
- (ii) P and Q ; [1]
- (b) (i) 3 ; [1]
- (ii) 1 inner mitochondrial membrane/cristae ;  
2 dehydrogenase enzymes ;  
3 release hydrogen ;  
4 hydrogen splits into protons and electrons ;  
5 electrons flow down, ETC/Electron Transfer Chain/AW ;  
6 energy released ;  
7 protons pumped across (inner membrane) ;  
8 into intermembrane space ;  
9 proton gradient ;  
10 protons pass through, ATP synthase/stalked particles ;  
11 ATP formed ; *linked to 10*  
12 oxygen (final), hydrogen/proton and electron, acceptor ; *max 4* [5 max]
- (c) 1 pyruvate converted to ethanal ;  
2 ethanal reduced ;  
3 by reduced NAD ;  
4 NAD, oxidised/regenerated ;  
5 allows glycolysis to continue ;  
6 ethanal dehydrogenase ;  
7 ethanol formed ;  
8 prevents H<sup>+</sup> from lowering pH ; [4 max]

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- (d) 1 no, decarboxylation/carbon dioxide removed ; A ora  
 2 single step ;  
 3 lactate dehydrogenase ;  
 4 reversible ; [3 max]

[Total: 16]

- 8 (a) (i) 1 change in, genetic material/DNA, (in cell) ;  
 2 (therefore) change product of cell ;  
 3 during protein synthesis ; [2 max]

- (ii) 1 identification of transformed, cells/organisms ;  
 2 avoid use of antibiotics ;  
 3 easy to detect ;  
 4 no known ill effect on GM organism ; [2 max]

- (b) (i) 1 reduces deficiency disease/AW ;  
 2 better quality food ;  
 3 assistance to developing nations/AW ;  
 4 cheap seed ; e.g. for golden rice [2 max]

- (ii) 1 high cost of GM seed ;  
 2 too much power held by multinational companies ;  
 3 change to ecosystem ; e.g. hybridisation  
 4 GM crops may be difficult to sell ;  
 5 GM plant varieties may be genetically unstable ;  
 6 no long term studies done on effects on human health ;  
 7 reduction in biodiversity/outcompetes natural variety or species ; [2 max]

[Total: 8]



Page 9	Mark Scheme: Teachers' version	Syllabus	Paper
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- 9 (a) 1 arranged in light harvesting, clusters/system ;  
 2 primary pigments/chlorophyll a ;  
 3 at reaction centre ;  
 4 P700/P1, absorbs at 700(nm) ;  
 5 P680/P11, absorbs at 680(nm) ;  
 6 accessory pigments/chlorophyll b/carotenoids, surround, primary pigment/reaction centre/ chlorophyll a ;  
 7 pass energy to, primary pigment/reaction centre/chlorophyll a ;  
 8 P700 / P1, involved in cyclic photophosphorylation ;  
 9 (light absorbed results in) electron excited/AW ;  
 10 emitted from, chlorophyll/photosystem ;  
 11 flows along, chain of electron carriers/ETC ;  
 12 ATP synthesis ;  
 13 electron returns to, P700/P1 ; [8 max]
- (b) 14 photolysis (of water) ;  
 15 releases H<sup>+</sup> ; **R** H/hydrogen atoms  
 16 by, P680/P11 ;  
 17 e released ;  
 18 by, P700/P1 ;  
 19 both combine with NADP ;  
 (reduced NADP)  
 20 reduces, GP ; **A** PGA  
 21 to TP ; **A** PGAL / GALP  
 22 ATP used ;  
 23 NADP, regenerated/oxidised ; [7 max]

[Total: 15]

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- 10 (a)**
- 1 nucleus in cell body ;
  - 2 (long) dendron ; **R** plural
  - 3 (shorter) axon ;
  - 4 many mitochondria (in cell body) ;
  - 5 many RER/nissl's granules, (in cell body) ;
  - 6 synaptic knobs ;
  - 7 detail of synaptic knob ;
  - 8 (terminal) dendrites ;
  - 9 Schwann cells ;
  - 10 detail of myelin sheath ;
  - 11 nodes of Ranvier ;

*accept points on labelled diagram*

[7 max]

- (b)**
- 12 Na<sup>+</sup> channels open ;     **A** sodium channels
  - 13 Na<sup>+</sup> enter cell ;         **R** enter membrane
  - 14 inside becomes, less negative/positive/+40mV **or** membrane depolarised ;
  - 15 Na<sup>+</sup> channels close ;     **A** sodium channels
  - 16 K<sup>+</sup> channels open ;       **A** potassium channels
  - 17 K<sup>+</sup> move out (of cell) ;   **R** of membrane
  - 18 inside becomes negative **or** membrane repolarised ;   **A** negative figure  
max 5
  - 19 local circuits/description ;
  - 20 (myelin sheath/Schwann cells) insulate axon/does not allow movement of ions ;
  - 21 action potential/depolarisation, only at nodes (of Ranvier)/gaps ;
  - 22 saltatory conduction/AW ;
  - 23 one-way transmission ;
  - 24 AVP ; e.g. hyperpolarisation/refractory period

[8 max]

**[Total: 15]**