

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

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9700	42

- 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 β 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]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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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 CO₂ uptake at higher light intensity ; **ora**
- 2 comparative figures ; *using columns 1 and 2*
- 3 CO₂ 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]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
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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⁺ from lowering pH ; [4 max]

Page 8	Mark Scheme: Teachers' version	Syllabus	Paper
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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^+ ; **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]

Page 10	Mark Scheme: Teachers' version	Syllabus	Paper
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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^+ channels open ; **A** sodium channels
 - 13 Na^+ enter cell ; **R** enter membrane
 - 14 inside becomes, less negative/positive/+40mV **or** membrane depolarised ;
 - 15 Na^+ channels close ; **A** sodium channels
 - 16 K^+ channels open ; **A** potassium channels
 - 17 K^+ 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]