

MARK SCHEME for the May/June 2008 question paper

9700 BIOLOGY

9700/04

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

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2008	9700	04

- 1 (a) higher population (growth), higher (rate of) deforestation / ora ;
 ref. 2 named countries (or letters) and paired figs ;
 ref. Vietnam (not fitting trend) ; [2 max]
- (b) (i) 1 ref. variety of, species / organisms / plants / animals ;
 2 variation **within** species / AW ;
 3 genetic diversity **between** species / AW ; [2 max]
- (ii) *economic*
- 1 (some, species / plants / animals may have) uses in the future ;
 2 medical uses / example ;
 3 resource material ; e.g. wood for building / fibres for clothes
 4 food (for humans) / agriculture ;
 5 tourism / example ;
 6 ref. maintain gene pool / genetic diversity ;
 7 prevention of natural disasters ;
 8 AVP ; e.g. ref. biological control (predators / parasites reduce pest populations) [4 max]
- [Total: 8]**
- 2 (a) **A** – (pancreatic) duct ; **A** capillary
B – islet of Langerhans / α and β cells ; [2]
- (b) α cells / β cells / islets / **B**, secrete, hormones / glucagon / insulin ;
 into the blood / not into a duct ; [2]
- (c) 1 increases permeability of membrane to glucose / increases glucose uptake ;
 2 increases respiration of glucose ;
 3 (increases), conversion of glucose to glycogen / glycogenesis ;
 4 (increases) protein / fat, synthesis ; [2 max]
- (d) 1 it is identical to human insulin / ora ;
 2 works better than non-human insulin / more rapid response ;
 3 no / fewer, rejection problems / side effects / allergic reactions ;
 4 ref. to ethical / moral / religious, issues ;
 5 cheaper to produce in large volume / unlimited availability ; **R** cheap to produce
 6 less risk of, transmitting disease / infection ;
 7 good for people who have developed intolerance / allergic reactions / immune responses
 to animal insulin ; [2 max]

[Total: 8]

Page 3	Mark Scheme	Syllabus	Paper
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- 3 (a) (i) 1 anthers, versatile / loosely attached / attached at one point (to filaments) ;
2 anthers / stamens / tassels / androecium, on long filaments / hang out (of flower) ;
3 anthers / stamens / tassels / androecium, above leaves ;
4 stigmas / silks, hang out (of flower) ;
5 stigmas, large surface area / hairy / feathery / branched, (to catch pollen) ; [3 max]
- (ii) *advantages*
1 genetic variation / more diverse gene pool / increased gene pool ;
2 increased heterozygosity ;
3 less likely that harmful recessive alleles will be expressed ;
4 hybrid vigour / decreased inbreeding depression ;
5 ability to respond to changing conditions / named example ;
e.g. different environments / pests / disease / increased survival of offspring [3 max]
- (b) (i) 1 cut DNA (into fragments) ;
2 by, restriction enzymes / named enzyme ;
3 place on (agarose) gel ;
4 apply, current / p.d. / electricity ;
5 fragments travel towards anode ;
6 short fragments travel, further / faster, than long ones ; **A** mass of fragments
7 visualise DNA with UV light / other means of visualisation ;
8 AVP ; e.g. Southern blotting / described [4 max]
- (ii) 1 change to, primary structure / secondary structure / tertiary structure / folding / 3D shape ;
2 protein / enzyme, cannot carry out its normal function ;
3 (could be an enzyme) that is essential for a metabolic pathway ;
4 (could) control the expression of another gene / series of genes ; [2 max]
- (iii) 1 (only) one base / base pair / triplet, needs to change (for teosinte to become maize) ;
2 idea that this could occur in a natural population of teosinte / mutation ;
3 variant, looks different / easy to spot ;
4 early farmers could have selected it to breed from ;
5 no need for complex breeding programme ; [3 max]

[Total: 15]

Page 4	Mark Scheme	Syllabus	Paper
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- 4 (a) 1 depolarisation / impulses / action potential, opens calcium ion channels ;
A increased permeability to calcium ions
2 in presynaptic membrane ;
3 calcium ions enter, synaptic knob / through presynaptic membrane ;
4 vesicles of, acetylcholine / neurotransmitter ;
5 fuse with presynaptic membrane ;
6 empty contents into synaptic cleft / exocytosis ; [3 max]
- (b) (i) 1 fluorescence, more / higher, in sperm from wild type mice / ora ;
2 comparative figures ; e.g. 170 v 10 **and** 400 v 10
3 mutant sperm do not have **P** / ora ;
4 so cannot take up calcium ions / ora ; [3 max]
- (ii) 1 fluorescence of flagella (of wild-type sperm) higher than heads ;
2 more **P** in flagellum than head ;
3 flagella take up more calcium ions ;
4 flagellum has larger surface area / ora ;
5 no difference in heads and flagella of mutant mice sperm since no **P** ; [3 max]
- (c) (i) fertilisation, in glass / in a dish ; **R** “test tube baby” unexplained
outside the reproductive tract / outside the body ; [2]
- (ii) *with ZP*
1 few / no, mutant sperm penetrate zona pellucida / ora ;
2 lack of calcium ions / ora ;
3 no / less, vigorous movement (of flagellum) / ora ;
- without ZP*
4 mutant sperm can penetrate oocytes (without ZP) ;
5 differences in penetration less significant between wild type and mutant ;
6 flagellum movement not needed for penetration (of oocyte membrane) / AW ;
7 AVP ; e.g. smaller % success of wild-type sperm with oocytes without ZP compared
with wild with ZP because, lack of binding site / damage to oocyte [4 max]

[Total: 15]

Page 5	Mark Scheme	Syllabus	Paper
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- 5 (a) 1 bacterium obtains energy ;
 2 for synthesis of materials ;
 3 for, growth / division ;
 4 does not need to use carbon compounds for energy ; **A** named carbon compound
 [2 max]

- (b) 1 takes up large area ;
 2 unsightly ;
 3 requires, lot of water / continuous water supply ;
 4 contamination of water / pollution due to acid ;
 5 Cu / Fe, toxic to plants ; [2 max]

- (c) *bioleaching (accept ora for mining)*
 1 low level technology / no sophisticated machinery / requires less maintenance ;
 2 low energy consumption / less fossil fuels used ;
 3 few safety hazards / safer ; **R** no hazards
 4 organism easy to, obtain / culture ;
 5 self replicating ;
 6 waste less hazardous ;
 7 disposal of waste, costs less / is easier ;
 8 ref. low grade ores / scrap iron ;
 9 less workers needed ;
 10 ref. use in situ ; [4 max]

[Total:8]

- 6 (a) *allele*
 (different) form of a gene ; **A** variety / version
ignore refs to locus / mutation [1]

recessive

allele which does **not** have its effect in heterozygote / allele which (only) has its effect in homozygote / affects phenotype if dominant allele is absent ; [1]

- (b) gene / allele, on X chromosome / sex linkage ;
 female, needs 2 RGC alleles / homozygous recessive / can be heterozygous ;
 male needs 1 RGC allele ; [2 max]

Page 6	Mark Scheme	Syllabus	Paper
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- (c) 1 – $X^R X^r / Rr$;
 4 – $X^R Y / R / R^o / R-$;
 6 – $X^r Y / r / r^o / r-$;
 7 – $X^R X^r / Rr$;

[4]

if X and Y not used then mark to max 3

[Total:8]

7 (a) (i) *ref. wavelength*

- 1 chlorophyll **a** peaks at 430nm **and** chlorophyll **b** peaks at 450nm ;
- 2 chlorophyll **a** peaks at 660nm **and** chlorophyll **b** peaks at 635–640nm ;
- 3 *ref. linking* 400–500nm with blue light / *ref. linking* 600–700nm with red light ;
- 4 (both have) little absorption, between 500–600nm / in green light ;
A little absorption, chlorophyll **a** 450–600 **and** chlorophyll **b** 500–600 ;

ref. light absorption

- 5 (both) peaks in blue light are higher than peaks in red light ;
- 6 chlorophyll **b** higher than chlorophyll **a** in the blue end / chlorophyll **a** higher than chlorophyll **b** in the red end / AW ; **A** converse
- 7 comparative figures for light absorption to illustrate points 5 or 6 ;

[3 max]

ignore units

- (ii) 1 absorbed light used for photosynthesis ;
 2 higher rate of photosynthesis in red and blue light ;
 3 action peak(s) / high rate of photosynthesis, correspond to absorption peak(s) ;
 4 blue / shorter wavelength, light has more energy / ora ;
 5 not an exact match between absorption and action spectra (in middle region) ;
 6 role of carotenoids / accessory pigments, (in middle region) ;

[3 max]

(iii) they contain chlorophyll ;

green / blue green / yellow green, light reflected ;

[2]

(b) **W** – label line to stroma ;

Y – label line to, granum / intergranal membranes ;

[2]

Page 7	Mark Scheme	Syllabus	Paper
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- (c)
- 1 light not limiting ;
 - 2 much, ATP / reduced NADP, available ;
 - 3 CO₂ is the limiting factor ;
 - 4 because low concentration CO₂ (in atmosphere) ;
 - 5 more CO₂ combines with RuBP ;
 - 6 ref. rubisco ;
 - 7 Calvin cycle / light independent stage ;
 - 8 GP to TP ;
 - 9 more hexose produced ;
 - 10 ref. fate of hexose ;

[5 max]

[Total:15]

- 8 (a) (i) same, mean / mode ;
narrower (5–35) ; *ignore height, curve should be symmetrical* [2]
- (ii) stabilising ; [1]
- (b) (i) mean / mode, to left of 20cm ;
narrower (0–35) ; *ignore height, curve should be symmetrical* [2]
- (ii) directional / evolutionary ; [1]
- (iii) fishing ;
predation ;
AVP ; [2 max]

[Total: 8]

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- 9 (a)**
- 1 reduced, NAD / FAD ;
 - 2 passed to ETC ;
 - 3 inner membrane / cristae ;
 - 4 hydrogen released (from reduced, NAD / FAD) ; **R H₂**
 - 5 split into electrons and protons ;
 - 6 protons in matrix ;
 - 7 electrons pass along, carriers / cytochromes ;
 - 8 ref. redox reactions ;
 - 9 ref. energy gradient ;
 - 10 energy released ; **R** produced
 - 11 protons (pumped) into intermembrane space ;
 - 12 proton gradient ;
 - 13 protons pass through (protein) channels ;
 - 14 ATP synthase / stalked particles ;
 - 15 ATP produced ;
 - 16 chemiosmosis ;
 - 17 electron transferred to oxygen ;
 - 18 addition of proton (to oxygen) to form water / (oxygen) reduced to water ; [9 max]

if candidate mistakenly writes about photosynthesis only allow marking points 7, 8, 9, 10 and 15 to 5 max

(b) in cytoplasm

- 19 NAD, becomes reduced / accepts H ;
- 20 during glycolysis ;

in plants

- 21 pyruvate converted to ethanal ;
- 22 ethanal reduced ;
- 23 by reduced NAD ;
- 24 ethanol formed ;

in animals

- 25 pyruvate converted to lactate ;
- 26 by reduced NAD ;
- 27 in, liver / muscles ;
- 28 allows glycolysis to continue ; [6 max]

allow either 23 or 26

[Total: 15]

Page 9	Mark Scheme	Syllabus	Paper
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10 (a) *endocrine*

- 1 hormones ;
- 2 chemical messengers ; **A** chemicals that transfer information
- 3 ductless glands / (released) into blood ;
- 4 target, organs / cells ;
- 5 ref. receptors on cell membranes ;
- 6 example of named hormone and effect ;

nervous

- 7 impulses / action potentials ; **R** electrical, signals / current
- 8 along, neurones / nerve fibres ; **R** nerves
- 9 synapse (with target) / neuromuscular junction ;
- 10 ref. receptor / effector / sensory / motor, neurones ;

differences – endocrine

- 11 slow effect / ora ;
- 12 long lasting effect / ora ;
- 13 widespread effect / ora ;
- 14 AVP ; e.g. extra detail of synapse

[8 max]

(b) 15 IAA / plant growth regulator ;

- 16 synthesised in, growing tips / apical buds / meristems ;
- 17 moves by diffusion ;
- 18 from cell to cell ;
- 19 also, mass flow / in phloem ;
- 20 stimulates cell elongation ; **R** cell enlargement
- 21 inhibits, side / lateral, buds / growth ; **A** inhibits branching
- 22 plant grows, upwards / taller ; **A** stem elongates
- 23 IAA / auxin, not solely responsible ;
- 24 interaction between IAA and other plant growth regulators ;
- 25 AVP ; e.g. role of ABA and lateral bud inhibition
- 26 AVP ; e.g. cytokinins antagonistic to IAA / gibberellins enhance IAA

[7 max]

[Total: 15]