UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

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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UNIVERSITY of CAMBRIDGE
International Examinations

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]

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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]

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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]

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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]

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(c) **1** – X^RX^r / **Rr** ;

4 – X^RY / **R** / R^o / **R-** ;

6 – X^rY / **r** / r^o / **r-** ;

7 – X^RX^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]

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(c) 1 light not limiting ;

2 much, ATP / reduced NADP, available ;

3 CO_2 is the limiting factor ;

4 because low concentration CO_2 (in atmosphere) ;

5 more CO_2 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]

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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]

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