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

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.

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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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]

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]

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]

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]

(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]

(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]

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]

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]