UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the June 2005 question paper

9700 BIOLOGY

9700/06 **Paper 6 (Options), maximum raw mark 40**

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Grade thresholds for Syllabus 9700 (Biology) in the June 2005 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 6	40	28	24	15

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

June 2005

GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9700/06

BIOLOGY
(Options)

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OPTION 1 – MAMMALIAN PHYSIOLOGY

1 (a) (i) produces (digestive) enzymes/enzymes held in membrane;
maltase/lactase/sucrase/exopeptidases;

adsorbs, enzymes from pancreas/amylase;
in glycocalyx;

ref. enterokinase; **max 2**

(ii) microvilli;
provide large surface area;
for more, rapid/efficient, absorption;

many mitochondria;
provide ATP;
for active transport; **max 2**

(b) (i) uptake is higher without phlorrhizin;
without rises steeply during first 30 seconds, with rises slightly;
without phlorrhizin peaks at, 0.5 minutes/with phlorrhizin does not reach peak/plateaus at 2 minutes;
without phlorrhizin highest value is 3.3 a.u. but with phlorrhizin highest value is 0.4 a.u; **max 2**

(ii) without phlorrhizin active transport can take place/with phlorrhizin uptake is by diffusion;
without phlorrhizin glucose can be moved up a concentration gradient/with phlorrhizin can only move down a concentration gradient;
phlorrhizin may bind to, carrier/transport protein; ref. shape of curves (e.g. related to high glucose conc. without phlorrhizin); **max 2**

(c) *at neuromuscular junction*
calcium floods in through presynaptic membrane (of motor neurone) when action potential arrives;
causes release of, transmitter substance/ACh;
into synaptic cleft;
allowing action potential to be passed (into muscle);

in muscle/sarcomere
calcium stored in (cisternae of) endoplasmic reticulum (in muscle);
released/calcium channels open, when action potential arrives;
calcium binds with troponin;
causing tropomyosin to move;
allowing myosin and actin to bind; **max 4**

(d) (i) [control is 3.15 and 1.0 mg cm^{-3} is 1.20 so difference is 1.95
so percentage difference is 1.95 ÷ 3.15 x 100 which is 61.9]
difference correctly calculated;
correct percentage calculated (ignore signs); **A** 62% **2**

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(ii) dissolves in lipid (bi)layer/disrupts/alters arrangement of lipids in, lipid (bi)layer/membrane;
proteins/carriers/transporters, no longer in correct, position/shape *or* cannot work normally; **1**

Total 15

2 **(a)** A cochlea
B Eustachian tube
C incus/anvil
D eardrum/tympanic membrane

half mark each, round up;; **2**

(b) equalising pressure on both sides of, eardrum, tympanic membrane/part D; **1**

(c) (semicircular canals) filled with fluid;
hair cells in, ampulla;
cupula/gelatinous structure, moves as head moves;
ref. to inertia of fluid/AW;
hair cells/receptors, respond to position of cupula;
three, ampullae/semicircular canals, lie in different directions;
impulses pass to cerebellum/brain; **max 3**

(d) (middle ear) normally filled with air;
ossicles cannot vibrate (when in viscous fluid)/less movement of tympanic membrane;
sound/vibrations, not passed to, oval window/cochlea/inner ear; **max 2**

Total 8

3 **(a)** A peripheral;
B autonomic; **2**

(b) **(i)** heart rate increases;
increase (in heart rate) begins to level off at higher frequencies;
use of figures; (*need change plus frequency*) **max 2**

(ii) stimulation (of parasympathetic nerve) decreases heart rate;
doubling the frequency of stimulation approx halves the heart rate;
(*4Hz v 8Hz*)
use of figures; **max 2**

it is valid to compare all three levels of parasympathetic stimulation i.e. 0, 4 Hz and 8Hz. Allow up to 2 figure marks if two correct comparisons are made

(iii) the two nerves release different transmitter substances;
sympathetic, noradrenaline/epinephrine, and parasympathetic acetylcholine;
affect post-synaptic membrane differently; **max 2**

Total 8

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4 **(a)** **(i)** P – label to large vessel on left; **1**

(ii) Q – label to central vein; **1**

(iii) bile; **1**

(b) **(i)** (albumin) does not leave blood (in tissues);
decreases, solute potential/water potential, of blood (plasma);
below that of tissue fluid;
so water, does not leave blood/enters blood (from tissue fluid);
down water potential gradient;
max 3

(ii) converted to fibrin;
by thrombin;
fibrin is insoluble;
produces mesh in which, red cells/platelets, are trapped; **max 3**

Total 9

OPTION 2 – MICROBIOLOGY AND BIOTECHNOLOGY

1 **(a)** **(i)** no nuclear envelope;
single/not paired;
circular DNA;
ref. operons/not introns/not exons;
not a chromosome/not linear/no histones;
plasmid;
ref. loops/coils/super coils/relaxed coils/topoisomerase; **max 3**

(ii) sample grown on agar plate/nutrient broth;
incubated;
temperature/environmental feature;
pick off colony/remove known volume;
using sterile needle/loop/pipette;
streak on agar plate;
selective media;
detail mark e.g. plates sealed/upside down;
sterilise loop between streaks;
isolate colony;
all equipment used must be sterile; **max 4**

(b) **(i)** anaerobic;
reference to whale body temperature/37 ºC;
acidic/pH requirement;
nutrient requirement/krill protein; **max 2**

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(ii) bacteria natural gut inhabitants;
whales ingest oil;
spontaneous mutations occur;
bacteria able to breakdown anthracene/naphthalene;
these bacteria favoured by natural selection;
these bacteria survive and reproduce/increase in numbers; **max 3**

(c) oil spills thick/barrier to oxygen;
bacteria work in anaerobic conditions;
work lower in slick;
work on specific hydrocarbons;
different enzymes;
different chemical pathways used; **max 3**

Total 15

2 (a) phage DNA integrates into host chromosome;
replicates with the host chromosome;
no viral particles produced;
exists as provirus/in state of dormancy;
no lysis/cell not destroyed; **max 2**

(b) (i) work near a Bunsen;
ref. serial dilution;
dilute stock NFLX with isotonic saline/sterile water;
1 cm^3 + 9 cm^3 saline/water (10 x dilution);
repeat for each dilution; **max 3**

(ii) cloudiness in tubes where bacteria not killed/inhibited/clear in tubes where bacteria killed/inhibited;
as concentration of NFLX increases, more bacteria killed (making solution less cloudy);
reference to correct set of figures;
not zero because of bacterial debris;
minimum inhibitory concentration between 100 and 1000 µg cm^{-3}; **max 3**

Total 8

3 (a) **A** – conidiospore; Accept conidia
B – conidiophore; Accept fruiting hypha/AW
C – metula; Accept rami
D – phialides/sterigma/conidiogerous cells;

half marks, rounded up **2**

(b) (i) fermentation with constant volume of medium;
all nutrients added at the start;
harvest of product at end of fermentation;
organisms display a normal growth curve;
process is halted when sufficient product has formed;
AVP; **max 3**

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(ii) pH;
temperature;
aeration;
sugar concentration;
nitrogen source;
foaming; **max 3**

(c) *Penicillium* normal growth curve shape with all parts (lag phase, log phase, deceleration phase, plateau);
Penicillin – produced **after** end of log phase/as it enters stationary phase; **2**

Total 10

4 (a) (i) general trend is greater the alcohol content the greater the sugar content;
exception being **B**;
with a higher sugar level than expected;
correct use of figures; **max 2**

(ii) alcohol is toxic to yeast at such high levels;
inhibits respiration/fermentation;
ref. membrane permeability;
ref. denaturation of proteins; **max 2**

(b) 0.2 x 0.2 x 0.1 = 0.004;
7/0.004 = 1750;
1750 x 1000 = 1.75×10^6/1 750 000; **3**

Total 7

OPTION 3 – GROWTH, DEVELOPMENT AND REPRODUCTION

1 (a) unspecialised/undifferentiated, cells;
able to undergo mitotic division;
totipotent/pluripotent/AW;
able to differentiate into, different tissues/named tissues; **max 3**

(b) (i) dry mass better measure of growth;
shows plant/cell material present;
fresh mass includes water content/water content fluctuates;
varies with conditions;
allows more valid comparison; **max 3**

(ii) placed in oven/other suitable drying method;
at suitable temperature/70 – 100°C;
cooled in desiccator;
repeated to constant mass;
replicates/mean; **max 3**

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(iii) **A** causes increase in mass from 1 x 10^{-10} mol dm^{-3} v. **B** from 1 x 10^{-9};
A causes peak at 1 x 10^{-8} mol dm^{-3};
B maximum effect at 1 x 10^{-7} mol dm^{-3};
no difference at extreme concentrations/1 x 10^{-10} mol dm^{-3} and 1 x 10^{-7} mol dm^{-3} ;
A has less effect at 1 x 10^{-7} mol dm^{-3} cf. 1 x 10^{-8} mol $dm^{-3;}$
ref. comparative figures; (*must include ref. to mean fresh mass*) **max 3**

(c) apical dominance;
terminal bud source of auxin;
diffusion;
ref. interaction of plant growth regulators/AW;

tropism;
apex source of auxin;
differential distribution;

promotes cell elongation;
ref. stem/shoots; **max 3**
(*ora : inhibits cell elongation in roots*)
detail of action; [e.g. effect on cell wall or water uptake]

Total 15

2 **(a)** **(i)** prefer daisies with crab-spiders;
(with or) without scent/scent of little significance;
ref. comparative figures; **max 2**

(ii) attracted by (reflected) UV;
provided by spider;
honeybees not attracted by scent/UV more significant than scent;
idea of attraction to, contrast/pattern/honeyguides; **max 3**

(iii) *Note : MUST be benefit to crab-spiders NOT the daisies*
camouflage (allows them to avoid predators);
(UV reflection) attracts more prey;
reduces incidence of mutation; **2**

(b) self-pollination results in inbreeding (cross-pollination results in outbreeding);
self-pollination gives less genetic diversity (than cross-pollination); [R no genetic diversity]
self-pollination, increases homozygosity/decreases heterozygosity;
self-pollination increases expression of deleterious recessive alleles;
self-pollination gives greater chance of loss of alleles; **max 3**

A reverse arguments for cross-pollination

Total 10

3 **(a)** causes ovulation;
stimulates development of corpus luteum;
stimulates secretion of progesterone; **max 2**

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(b) (i) stimulates secretion of LH (in both);
more rapid secretion in women;
more in women than men;
15-30 minutes, secretion peaks/remains constant in women;
falls after 30 minutes;
falls at same rate after 60 minutes;
ref. comparative figures; **max 3**

(ii) correct working 15/2 = 7.5 (arbitrary units);
105 minutes; **2**

(iii) (of reproductive) age/not prepuberty/not after menopause;
(at same point of) menstrual cycle;
AVP; **max 1**

Total 8

4 (a) **A** endometrium/lining of uterus
B fetal capillaries/capillary tuft/chorionic villus
C umbilical vein
D umbilical cord ;; [*half marks rounded up*] **2**

(b) (i) diffusion of, oxygen/carbon dioxide/urea/(some) ions;
osmosis of water;
active transport of, (some) ions/amino acids/vitamins/antibodies;
facilitated diffusion of glucose;
pino/phago /exo/endo, cytosis of antibodies/other large molecules; **max 3**

(ii) large surface area;
ref. chorionic villi/tufts of capillaries;
ref. microvilli;
ref. maternal blood spaces;
close association of (maternal and fetal) circulations; **max 2**

Total 7

OPTION 4 – APPLICATIONS OF GENETICS

1 (a) (i) *gene mutation* – change in DNA code/nucleotide sequence/amount of DNA;
chromosome mutation – change in, structure/number, of chromosomes; **2**

(ii) discontinuous;
single gene;
different alleles have large effect/resistant v non-resistant; **max 2**

(iii) natural selection;
chloroquine much used;
chloroquine = selective agent;
susceptible die/resistant survive/ref. selective advantage;
resistants more likely to reproduce;
pass their *pfcrt* to their offspring;
allele frequency increases over generations; **max 4**

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(b) (i) $\frac{6 + 7 + 7 + 6}{4} / \frac{26}{4}$;
= 6.5; **2**

(ii) gives good resistance;
spread because selective advantage;
one ancestral to other/have common ancestors;
selected for after appearing independently; **max 2**

(c) triplet code/3 bases for each amino acid;
codes for some amino acids have 2 bases in common/degenerate;
change of first/second base changes amino acid;
different tRNA binds;
to changed mRNA;
in translation at ribosome; **max 3**

Total 15

2 (a) decreased (genetic) diversity;
loss of alleles/reduction in gene pool;
increased homozygosity/decreased heterozygosity;
accumulation/increased expression, of deleterious recessive alleles; **max 3**

(b) compare pattern with other individuals;
different, alleles/markers, give bands in different places;
because different, length/size/mass;
common bands indicate related individuals;
inbred reduced number of bands; [ora]
inbred bands from each, homologue/chromosome of pair, the same; [ora]
the more inbred the more similarities; [ora] **max 3**

(c) (i) inbreeding increases susceptibility to infection;
(increases susceptibility) to all three types;
most inbred susceptible to herpes/slightly inbred susceptible to bacteria; **max 2**

(ii) less ability to produce immune response;
because alleles lost;
less fit;
because of deleterious recessives;
AVP; *e.g. lost alleles might help to give resistance* **max 2**

Total 10

3 (a) (i) error in meiosis;
extra chromosome 21/trisomy 21;
problem of, spindle/synapsis/centromere; **max 2**

(ii) breakage of chromosome;
translocation;
detail e.g. Robertsonian/long arm 21 to another autosome/13/14/15; **max 2**

(b) (i) yes, differ significantly/not due to chance;
both less than, usual benchmark/0.05/1 in 20; **2**

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(ii) more cases than expected of second disease in both groups of families;
p = 0.00001 (highly) significant;
p = 0.001 significant; **max 2**

Total 8

4 (a) *Parents*: AaBb x aabb;
Gametes: AB Ab aB ab x ab;
Offspring: genotypes and phenotypes;

gametes	AB	Ab	aB	ab
ab	AaBb tall green	Aabb tall mottled	aaBb dwarf green	aabb dwarf mottled

3

(b) two genes are, linked/on the same chromosome;
inherited together/alleles do not assort independently;
<u>recombinant</u> (named) classes result from crossing over;
in meiosis;
prophase 1;
diagram of crossing over;
12 units apart; **max 4**

Total 7

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