

MARK SCHEME for the June 2005 question paper

9700 BIOLOGY

9700/06

Paper 6 (Options), maximum raw mark 40

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. This shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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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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)



UNIVERSITY of CAMBRIDGE
International Examinations

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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 °C;
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 cm³ + 9 cm³ 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/conidiogenous 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) $0.2 \times 0.2 \times 0.1 = 0.004$;
 $7/0.004 = 1750$;
 $1750 \times 1000 = 1.75 \times 10^6/1\ 750\ 000$; 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 $1 \times 10^{-10} \text{ mol dm}^{-3}$ v. **B** from 1×10^{-9} ;
A causes peak at $1 \times 10^{-8} \text{ mol dm}^{-3}$;
B maximum effect at $1 \times 10^{-7} \text{ mol dm}^{-3}$;
no difference at extreme concentrations/ $1 \times 10^{-10} \text{ mol dm}^{-3}$ and
 $1 \times 10^{-7} \text{ mol dm}^{-3}$;
A has less effect at $1 \times 10^{-7} \text{ mol dm}^{-3}$ cf. $1 \times 10^{-8} \text{ mol dm}^{-3}$;
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, cytolysis 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 *pfcr* 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;
recombinant (named) classes result from crossing over;
in meiosis;
prophase 1;
diagram of crossing over;
12 units apart;

max 4

Total 7