UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced/Advanced Subsidiary Level

MARK SCHEME for the May/June 2006 question paper

9700 BIOLOGY

9700/06 Paper 6

Maximum raw mark 40

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It 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*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

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UNIVERSITY of CAMBRIDGE
International Examinations

OPTION 1: Mammalian Physiology:

1 (a) light sensed by, retina / cones / rods;
nerve impulses along optic nerve;
to brain;
nerve impulses to muscles in Iris;
radial muscles contract;
ref. automatic nervous system; **max 4**

(b) (i) as time increases number of correct positives decreases;
non-linear relationship / words to that effect;
use of correct manipulated figures **max 2**

(ii) blood alchohol concentration is going down;
as liver breaks down alchohol
so fewer people will be over the limit / have more than 0.08% blood alchohol concentration; **max 2**

(iii) many false negatives even at time 0;
when all subjects were expected to have more than 0.08% blood alchohol concentration;
some false positives at all times;
could lead to people being wrongly, convicted / words to that effect;
ref. figures. **max 2**

(c) (i) alchohol dehydrogenase;
converts (ethanol) to, ethanal / acetaldehyde;
aldehyde dehydrogenase;
converts, ethanal / acetaldehyde, to, ethanoate / acetate;
hydrogens picked up by NAD / NAD is coenzyme / NAD is reduced; **max 3**

(ii) fatty acids accumulate;
fats deposited (in liver) / fatty liver;
alchohol, toxic to / kills hepatocytes;
fibrous tissue, builds up/replaces hepatocytes;
blood supply reduced;
cirrhosis; **max 2**

Total: 15

2 (a) one mark for each correct label; **2**

(b) increases surface area;
faster absorbtion;
of water / ions; **max 2**

(c) (i) ref. osmosis;
water potential in lumen is lowered;
below that of the, cells / intestine wall;
water moves down water potential gradient; **max 3**

(ii) difference is 14.2 – 7.5 = 6.7 ;
so percentage change is (6.7 ÷ 14.2) x 100 = 47.2 % ;
or (6.7 ÷ 7.5) x 100 = 89.3% **2**

(iii) water has left the blood;

plasma proteins do not leave blood;
ref. more antibodies; **max 1**

Total: 10

3 (a) (i) lens cannot (easily) change shape;
therefore poor, accommodation / focussing at different distances;
lens does not take up rounded shape when tension relaxed / ciliary muscle contracted.
So difficult to focus on near objects; **max 3**

(ii) light cannot pass through lens;
vision is clouded; **2**

(b) Cloudy area of lens / whole lens, is removed;
can be replaced with artificial lens / patient wears glasses;
detail; **max 2**

Total: 7

4 (a) (i) A centrum and B neural spine; **1**

(ii) X plus reason
Position of neural spines, position of aorta, position of ribs **1**

(b) thoracic has longer neural spines than lumbar;
ref. to muscle attachment;

thoracic has extra articulating surfaces;
for ribs;

lumbar has, larger / thicker, centrum;
extra load-bearing / stronger muscles;

lumbar has heavier transverse processes;
for attachment of stronger muscles; **max 4**

(c) bone / vertebrae, loses calcium;
bone / vertebrae, loses, bulk / strength;
vertebrae become smaller; **max 2**

Total: 8

OPTION 2: Microorganisms and Biotechnology

1 (a) (i) 1cm³ of effluent added to 9cm³ sterile water (gives 10^{-1});

1cm³ of the first dilution removed and added to 9cm³ sterile water (gives 10^{-2});

repeat procedure with second and subsequent dilutions to obtain the range required; **3**

(ii) 10^{-4}; **1**
10^{-3} too many to count accurately as colonies overlap;
10^{-5} too few as sampling errors in dilutions are very great; **2**

(iii) 55 in 0.1cm³ = 550 per cm^3 = 5.5 x 10^2;

dilution is 10^4 = 5.5 x 10^6 per cm^3 **2**
allow ecf from **(ii)**

(b) activated sludge / trickling filter / description;
aerobic bacteria digest organic matter;
aerobic bacteria respire / metabolise / AW, organic matter;
insect larvae / protoctista, feed on bacteria
insect larvae / protoctista (protozoa), form a layer on surface of stones; **max 3**

(c) saprophytic / putrefying, bacteria digest protein to amino acids;

amino acids deaminated releasing ammonia;

ammonium compounds / urea, acted on by, nitrifying bacteria / named example;

ammonium converted to nitrite;

nitrite converted to nitrate; **max 4**

Total: 15

2 **(a)** **(i)** Cut with endonucleases;
separated by size using electrophoresis; **2**

(ii) Mass of, disorganised / undifferentiated / unspecialised, plant cells; **1**
cells containing DNA from two different sources **1**

(iii) To enable selection of the transgenic cells;
only the cells with the new DNA can grow in the presence of the antibiotic; **2**

(b) **(i)** may help to prevent night blindness;
enable local farmers to grow a cash crop;
enable the development of rice breeding to improve local crops; **max 1**

(ii) May help reduce the risk of cancer; **1**

Total: 8

3 **(a)** **(i)** Inject antigen into mouse;
Extract, blood / spleen, containing lymphocytes;
centrifuge to separate lymphocytes; **max 2**

(ii) It causes the lymphocytes to divide faster than normal;
It gives "immortality" / cells survive indefinitely **max 1**

(b) **(i)** Cancer changes the antigens on cells; **2**
Antibodies are specific so only cancer cells are affected;

(ii) The antibiotics are delivered directly to the infected cells; **1**

If present the HIV antibodies in serum bind to HIV antigens;

Anti – HIV antibody binds to the HIV antibodies;

Enzyme attached to the anti-HIV antibody catalyses reaction to give a coloured product; **3**

[Total 9]

4 **(a)** A membrane;
B cell wall;
C cytoplasm;
D DNA / nucleic acid; accept: chromosome **2**
1 mark for 2 correct, rounded up.

(b) (Gram positive)
walls are thicker;
have more, peptidoglycan / murein;
more rigid;
no outer membrane;
no lipid / no polysaccharide;
stain is taken up more easily;
Allow ora. **max 3**

(c) Up to 220 slow growth of population after air supplied the population increases rapidly; **1**

(d) **(i)** To prevent the entry of the other microorganisms / AW; **1**

(**ii**) The air rising to the top of the fermenter will carry materials from the bottom; **1**

Total: 8

OPTION 3 – Growth, Development and Reproduction

1 (a) (i) 0 to 4 days, decreases;
4-30 days increases;
30-35 days, no change;
after 35 days, decreases;
ref. figs.; **max 3**

(ii) *0 to 4 days*
uses up food store;
respiration may be more than photosynthesis;

after 35 days
seeds/fruits/leaves, fall off; **3**

(iii) to make results more reliable;
some seeds may, not continue to grow/die;
some seedlings grow at different rates so gives a better pattern; **max 2**

(b) (i) amount of water may vary in seedling;
evaporation of water from soil may vary, affecting results;
max 1

(ii) not enough seed/only 60 seeds, as only single plant;
destroys plants with each reading/AW;
AVP; **max 2**

(c) *'in terms of short day plant'*
plants flower when long, dark/night;
short day plant;
phytochrome;
long night converts P_{FR}/P730 to P_R/P660;
AVP; e.g. low P_{FR} allows flowering, P_R/P660 and P_{FR}/P730, during day is P_{FR}, P_{FR} is active form, Inhibits flowering in SDP **max 4**

Total: 15

2 **(a)** Anterior (lobe of) pituitary, produces growth hormone/GH;
regulates growth of all parts of the body;
increases rate of, cell growth/cell division/protein synthesis;
GH release controlled by hypothalamus/AW;
stimulated by growth hormone releasing factor/GHRF;
inhibited by growth hormone release-inhibiting hormone/GHRIH;
AVP; e.g. GH favours use of fat, so body less fat and more muscle;
no feedback inhibition; **max 3**

(b) **(i)** 0 to 2 years, Y more rapid increase in growth/height than Z;
Y reaches puberty/growth spurt at 10,Z at 12 yrs;
Y adult height taller/figs, than Z;
Y reaches final height sooner/ora;
ref. comparative figs.; **max 3**

(ii) deficient diet during pregnancy, lower birth weight, reduced growth;
breast milk deficiencies/AW;
lack of protein/adequate diet/named nutrient;
different genetic makeup/genotype;
different levels of growth hormone;
hormonal differences/named hormone level;
AVP; **max3**

Total: 9

3 **(a)** P urethra,
Q erectile tissue,
R prostate gland,
S epididymis; **2**

One mark for 2 correct, rounded up.

(b) **(i)** 92-52, 40
40/92 X 100;
43.(125)%; **2**

(ii) increase in oestrogen/female hormone in drinking water, reference sperm production/affects male hormones/testosterone; **1**

(c)

spermatogenesis	***oogenesis***
Continuous after puberty,	In cycles after puberty;
Millions produced,	One/few per cycle;
Occurs 12-65+,	9 –menopause/40;
4 sperm ,	1 ovum per meiosis;
No,	Polar bodies;
All mitotic products used	many mitotic products degenerate/less mitotic replication;
Complete meiosis on release,	Completes meiosis after ovulation/AW;
Primary spermatocyte smaller,	Than primary oocyte/primary oocyte greater growth phase;
Products need to differentiate	no differentiation of products;
Requires testosterone,	Requires oestrogen;

max 4

Total: 9

4 (a) (i) asexual; **1**

(ii) plantlets could be removed, grown to give large number;
parent plant can be used over and over, so cheaper;
plantlets could be transported easily as smaller than parent;
genetically identical/clone;
AVP; **max 2**

(b) (i) changes, gene/DNA, base sequence/described e.g. deletion/addition/substitution;
codes for protein/enzyme with different amino acid/acids;
codes for protein with amino acids missing;
enzyme/protein has different, tertiary/active site structure/3D shape;
AVP; detail of protein synthesis e.g. change to mRNA, changes t-RNA;
max 3

(ii) idea of less chlorophyll/less photosynthesis, less growth; ora **1**

Total: 7

OPTION 4 - Applications Of Genetics

1 (a) autosomal / chromosome 7;
recessive (allele);
homozygote sufferer;
heterozygote carrier;
correct statement re inheritance; [e.g. 1in 4 from two carrier parents]
max 4

(b) (i) move towards anode;
because negatively charged;
rate of movement inversely proportional to, mass/length;
smaller fragments move further / ora; **max 3**

(ii) one of two lower bands; **1**

(iii) C is heterozygote;
different allele on each homologue;
one normal (100 bp) fragment and mutant (97 bp) fragment; **max 2**

(c) (i) ΔF508 CFTR not inserted in membrane so no conductance possible;
R117H CFTR different, shape / 3' structure so poorer conductance;
does not fit ions correctly;
effect on Cl^- greater than HCO_3^- ;
does not bind ATP correctly; **max 3**

(ii) $\frac{(33 - 5)}{33} \times 100$;

84.8 (%) ; **2**

Total: 15

2 (a) (i) straight line showing unchanged activity ; **1**

(ii) inhibits VKOR;
non-competitive;
binds to VKOR and alters shape of active site;
too little vitamin K produced;
vitamin K involved in clotting; **max 2**

(b) (i) gene mutation;
substitution of base (pair) in DNA;
change of triplet code;
so encodes different amino acid; **max 3**

(ii) different, primary structure;
different shape / 3' structure;
ref. active site;
no longer binds warfarin;
enzyme not inhibited;
no problem with vitamin K metabolism; **max 4**

Total: 10

3 **(a)** **(i)** no chlorophyll;
no photosynthesis;
no, primary pigment / reaction centre / photosystem; **max 2**

(ii) AaBB yellow
AaBb yellow
aaBB green
aaBb green *half marks rounded up* **2**

(b) **(i)** *clear diagram showing:*
cross over in between two loci of non-sister chromatids giving Ab and aB;
other chromatids unchanged; **2**

(ii) large number of, parental types / AB and ab;
small number of, recombinant types / Ab and aB;
more recombinants further loci are apart / ora; **max 2**

Total: 8

4 **(a)** parents isolated;
seed parent, emasculated / AW;
flower bagged;
before and after pollination;
pollination by hand; **max 3**

(b) annual life cycle / AW;
idea several generations needed for selection;
for large, sweet and black;
backcross to commercial variety;
increase contribution of commercial variety / ora;
ref. alleles of background genes; **max 4**

Total: 7