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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2006 question paper

9700 BIOLOGY

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

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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

OPTION 1 – MAMMALIAN PHYSIOLOGY

1 (a) (i) **A** mitochondrion ;
B myofibril ;
C Z line ;
D sarcomere ;

½ marks rounded up [2]

(ii) it/**D**, would be longer/Z lines further apart ;
light area on each side of Z line/I band, longer ;
H band longer/wider ; [max 2]

(b) correct use of X with superscript *and* allele symbols stated ;
parents' genotypes X^FX^f and X^FY ;
correct gamete genotypes ;
possible offspring genotypes X^FX^F, X^FX^f, X^FY, X^fY ;
boy with muscular dystrophy identified ; [max 4]

(c) myosin (heads) pulls on actin ;
no pull on/not transmitted to, muscle membranes/rest of muscle fibre ;
no force generated/no pull overall ;
muscle will not contract; [max 3]

(d) tropomyosin lies along the actin ;
troponin found at intervals along actin ;

calcium binds with troponin (when action potential arrives) ;
troponin changes shape ;
tropomyosin moves ;
(myosin) binding sites uncovered ;
allows myosin to bind with actin/formation of cross-bridges ; [max 4]

[Total: 15]

2 (a) change in level of blood cholesterol/stimulation of a receptor, (causes) ;
action/effector, to bring level back to, normal/set point ; [2]

(b) (i) as a control/to compare with the statin group ; [1]

(ii) 1500 – 1300 = 200 ;
(200 ÷ 1500) × 100 = 13% ; (13.3%) [2]

(iii) they do (just about) support it/they do not support it/no significant difference ;
but no direct link is shown between cholesterol levels and statins ;
the link is only shown to be between statins and deaths ;
ref. assumption of link between reduced no. of heart attacks and reduced conc. of cholesterol in blood ;
further, tests/evidence, required ; [max 2]

(c) ref. to negative feedback effect ;
if less cholesterol in diet then liver will make more ;

statins inhibit the enzyme responsible for synthesising cholesterol ;
(statins) not affected by cholesterol level in blood/inhibition still takes place (even if blood cholesterol is low) ; [max 3]

[Total: 10]

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3 **(a)** mechanical digestion breaks large pieces of food to small ones ;
by teeth/mastication/churning of stomach ;
chemical digestion breaks (large) molecules ;
ref. to solubility ;
ref to hydrolysis ;
by enzymes ;
ref. emulsification of lipids ; [max 3]

(b) **(i)** allows up and down movement/not sideways movement ;
great force to/canines can, pierce prey/grip prey (to prevent escape) ;
allows wide opening (of mouth to catch prey) ; [max 2]

(ii) sharp edges/many points/jagged ;
act like scissor blades/slice past each other ;
molars, slice flesh/cut meat into pieces/crush bones ; [max 2]

[Total: 7]

4 **(a)** **(i)** semicircular canals/membranous labyrinth/ampulla/utriculus/macula ; [1]

(ii) cerebellum ; [1]

(b) **(i)** *beginning rotation*
number of impulses per second increases ;
from 200 to 800/4 times greater;

stopping rotation
number of impulses per second, decreases/stops ;
from below base level/from 190, to 0 ;
returns to base level within 20 (22) seconds of stopping ; max 2 [max 3]

(ii) (surrounded by), fluid/endolymph ;
changing rate of movement/acceleration ;
inertia of fluid/relative difference in movement, of fluid or hair cell (c.f. to head) ;
hair cells/cupula, bends/moves ;
alters permeability of cell membrane ;
depolarisation/generates an action potential ;
ref. to explanation of drop of impulses sec^{-1} to zero when rotation stops ; [max 3]

[Total: 8]

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OPTION 2 – MICROBIOLOGY AND BIOTECHNOLOGY

1 (a) (i) increases (throughout);
(mostly) 30 tonnes per year every 5 years ;
increase less between years, 15 and 25/30 and 40 ;
comparative figs. ; (2 quantities + 2 years) [max 3]

(ii) (originate by) mutation ;
pre existing/random/spontaneous (mutation) ;
increased use of antibiotics increases selection ;
reference to antibiotics as the selective agent ;
ref. natural selection ;
susceptible bacteria die/resistant bacteria survive ;
resistant bacteria pass resistance to offspring ; [max 4]

(iii) meat/eggs, contain bacteria that cause diseases in humans ;
these bacteria may become resistant to antibiotics used in medicine ;
disease treatment using the same antibiotic as used in animal feed will not be effective ; [max 1]

(b) (i) ampicillin (B) more effective than tetracycline (C) ; ORA
fewer bacteria are resistant to ampicillin ; ORA
comparative figs. ; [max 2]

(ii) $\frac{150}{250} \times 100$;

= 60% ; [2]

(c) inhibits enzyme ;
prevents bonds forming, between peptidoglycan molecules/in bacterial cell wall ;
cell wall, weakens/breaks down ;
bursts cells ; [max 3]

[Total: 15]

2 (a) A protein coat/capsid
B nucleic acid/DNA
C (tail) sheath
D (tail) fibres/pins

half marks rounded up [2]

(b) phage has only one type of nucleic acid/DNA, bacteria has both DNA and RNA ;
phage has protein outer covering/AW, bacteria has cell wall/murein outer surface ;
phage has no, organelle/cytoplasm/membranes;
bacteria have, ribosomes/organelles/cytoplasm/cell (surface) membrane ;
ref. mesosomes in bacteria ; [max 1]

(c) binary fission ;
(circular) DNA replicates ;
ref. attachment to mesosomes ;
cell membrane/septum/invagination, separates the, chromosomes/DNA strands ;
new cell wall material laid down between the cells ; [max 3]

(d) 1 to 2:
phage attaches to, a binding site/receptors, on the bacterial cell ;
injects, nucleic acid/DNA ;

2 to 3:
phage, nucleic acid/DNA joins host DNA ;

3 to 4:
(host cell divides) copying phage DNA along with host DNA / phage DNA passed on to daughter cells ; [max 3]

[Total: 9]

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3 **(a)** **(i)** to sterilise/kill any microorganisms present ; [1]

(ii) to double the chromosome number/to make the embryoids diploid ; [1]

(b) cells from callus of two different anther cultures ;
fused by, osmotic shock/heat treatment ;
colchicine not added, cells are diploid following cell fusion ; [max 2]

(c) *max 2 for 2 named nutrients*

carbon source/named C source ;
used for, respiration/production of ATP/release of energy ;
to build, organic/named, molecules ;

nitrogen source/named N source;
synthesis of, amino acids/proteins/enzymes ;
synthesis of, nucleotides/nucleic acids ;

mineral salts/named mineral salt ;
used as cofactors for enzymes/component of cell
structures/example, related to a named salt ; [max 4]

[Total: 8]

4 **(a)** **(i)** reaction with/damage to, skin proteins less likely;
allergies less likely ; ORA
inhaled less easily ;
enzymes are more thermostable ; [max 2]

(ii) rate of reaction slowed down/AW ; [1]

(b) **(i)** reactants/nutrients, are supplied throughout the process ;
products are removed throughout the process ;
maintained in, log/exponential/rapid growth, phase ; [max 2]

(ii) (stirring) might physically damage the immobilising system/AW ; [1]

(c) enzymes can be re-used ;
enzyme does not have to be separated from the products ;
cost of emptying and sterilising is less as fermenter runs for a long time ; [max 2]

[Total: 8]

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OPTION 3 – GROWTH, DEVELOPMENT AND REPRODUCTION

1 (a)

Kingdom	Method of asexual reproduction	Named example
Prokaryotae	**Binary fission**	**E.coli/suitable e.g. ;**
Protoctista	**Binary fission**	**Amoeba/suitable e.g. ;**
Animalia	**Budding Fragmentation**	**Hydra/suitable e.g. ribbon worms ;**

R parthenogenesis/accidental fragmentation of starfish/flatworms etc. [3]

(b) (i) **A** lag (phase) ;
B log / exponential, (phase) ; [2]

(ii) reached carrying capacity ;
death rate = reproduction rate ;

(rate of) mitosis/division, limited ;

nutrients, in short supply/used up ;
oxygen, in short supply/used up ;
waste products, build up/toxic/change pH ;

AVP ;
e.g. shading ; [max 4]

(c) respiration/metabolism, increases ;
releases more heat;

enzyme activity increases ;
enzymes denature;
unicell, activity falls/dies ; [max 3]

(d) method ;
details ;; R haemocytometer [3]

e.g. turbimetry/dry mass sampling/measure product of metabolism such as CO_2 or acid

[Total: 15]

2 (a) (i) $\frac{70}{10} \times 12$ or $\frac{70}{1} \times 1.2$;
84(μm) ; [2]

(ii) corpus luteum/yellow body ;
secretes progesterone; *ignore ref. to oestrogen* [2]

(b) (i) mitosis ; R. miosis [1]

(ii) 46/23 pairs/2n ; [1]

(iii) (primary oocyte divides by)
meiosis (I);
products, haploid/secondary oocyte and polar body ;
meiosis II ;
forms, ovum/egg, and polar body ;
AVP;
e.g. time delays (meiosis I or II) [max 3]

[Total: 9]

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3 **(a)** **(i)** delays germination in 'freak' conditions ; (short favourable spell in prolonged unfavourable spell)
allows, dispersal/maturation;
germination linked to time of rainfall/survives when no, rainfall/water ;
prevents germination when seeds, not buried in soil/too deep in soil ;
prevents germination until after fire/survives fire ;
prevents germination when seed still in fruit ;
AVP ;
e.g. stops germination when inhibition from parent present/
germination linked to suitable season [max 2]

(ii) growth inhibitors in, seed coat/testa/embryo ;
named inhibitor ; e.g. ABA/abscisic acid;
in high concentration ;
low concentration of, GA/gibberellin/gibberellic acid, allows action of inhibitor ; [max 2]

(iii) (availability of), water/rainfall ;
fire; [2]

(b) switching on genes/AW ;
GA, stimulates synthesis of, enzymes/named enzyme/protein ;
hydrolytic/hydrolysis ;
named enzyme breaks down named food reserve ;
AVP ;
e.g. detail of use of product [max 3]

[Total: 9]

4 **(a)** **(i)** **A** anther/stamen
B style
C ovule *half marks rounded up*
D stigma [2]

(ii) protandry/anther releases pollen before stigma receptive ;
R if ref made to relative positions of stigma and, anther/pollen [1]

(b) **(i)** insect visits not necessary/percentages not significantly different ;
if no/few, visits then self-pollination occurs ;
stigma bends back to touch pollen on style ; [max 2]

(ii) many visits likely to result in greater variation; ora
cross pollination/AW, more likely ; ora
OR
little/no, difference in variation ;
if insects transfer pollen within the same plant ;

detail of, source/lack of, genetic variation ; [max 2]

[Total: 7]

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OPTION 4 – APPLICATIONS OF GENETICS

1 (a) (i) explant/meristematic (AW) tissue ;
surface sterilised ;
sterile nutrient medium ;
named nutrient ; e.g. sucrose/amino acid/inorganic ion/minerals/vitamins
pgs to stimulate, mitosis/cell division ;
callus formed ;
pgs/cytokinin/auxin, to stimulate differentiation ;
then subdivided;
plantlets hardened off ;
plantlets transferred to sterile soil ; [max 4]

(ii) 3 sets chromosomes/3n ;
meiosis fails ;
cannot form (homologous) pairs/synapsis fails ;
in prophase 1 ; [max 2]

(iii) all genetically identical ;
so all susceptible to same, pathogen/edaphic factor/climatic factor ; [2]

(b) *sinensis x sinensis* ;

offspring selected ;
for harvestable dry mass and ability to withstand winter ;
need to be fertile ;
need to flower early ;

idea, time/several generations, needed for selection ;
idea backcrossing to parent species ;
to increase contribution re trait ;
ref. background genes ;
detail ; e.g. viable way of starting with hybrid/
emasculation/bagging before and after pollination [max 4]

(c) artificial selection/selective breeding ;
man selective agent ;
mutations (give different traits) ;
(different) people have selected for different traits ;
different plants, suited to different conditions/seen to be attractive/in fashion ; [max 3]

[Total: 15]

2 (a) (i) 100 000, base pairs/bases long/nucleotides long ; [1]

(ii) horizontal transmission ;
conjugation ;
detail of conjugation ; e.g. c. tube/single strand DNA transferred/made double stranded in recipient /ref. to plasmid DNA
'transformation ;
DNA released from one bacterium is picked up by another;

transduction ;
transfer DNA by, bacteriophage/'phage/virus ; [max 3]

(b) (i) $10^{-2} – 10^{-4}$;
$\times$ $100/10^2$; [2]

(ii) antibiotic increases transfer in both donors ;
both antibiotics have same effect on both donors ;
greater effect on *E. coli* than on *V. cholerae* ;
10 x greater/10^2v. 10^1/x 100 v. x 10 ; [max 3]

(iii) increase in, number of resistant bacteria/frequency of resistant alleles ; [1]

[Total: 10]

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3 **(a)**

CF		*HD*	
recessive (allele)	v.	dominant (allele) ;	
chromosome 7	v.	chromosome 4 ;	
sufferer homozygote recessive	v.	sufferer heterozygote ;	
heterozygote carrier	v.	heterozygote sufferer ;	
needs two carrier parents	v.	one parent with allele ;	
deletion/substitution,	v.	stutter / triplet repeat ;	
effect unchanged each generation	v.	effect increased each generation ;	[max 3]

(b) **(i)** the longer the fragment length the earlier the onset/inversely proportional;
ref. shorter fragments moving further/ora ; [2]

(ii) **C** has (two), normal/recessive, alleles ;
ref. homozygote ;

A, **B** and **D** have one normal and one mutant allele ;
ref. heterozygotes/dominance ;

stutter gets longer, from **A** to **B** to **D**/with each generation ; [max 3]

[Total: 8]

4 **(i)** low temperature/–20°C ;
seeds dehydrated/ref. 5% water content/stored in 5-10% humidity ;
periodic germination tests ;
when germination falls below 85% seeds grown and fresh seed stored ; [max 3]

(ii) maintain genetic diversity/store of alleles ;
to prevent extinction;
ref. future use ;
to use in selective breeding ;
in changed circumstances ; A e.g. of change

ref: endemic species unique ;
ref. unknown traits ;
ref. possible source of drug ;

argument re numbers ; [max 4]

[Total: 7]

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