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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the November 2004 question paper

9700 BIOLOGY

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

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Grade thresholds taken for Syllabus 9700 (Biology) in the November 2004 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 6	40	30	26	17

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.

November 2004

GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9700/06

BIOLOGY
Paper 6 (Options)

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OPTION 1 MAMMALIAN PHYSIOLOGY

1 (a) (i) A sclera;

B rod (cell)/receptor cell;

C bipolar, cell/neurone;

D ganglion cell; *½ marks rounded up* **2**

(ii) absorbs light after it has passed through, retina/rods and cones;

prevents, reflections within the eye/distortion/unclear image;

contains melanin/pigmented;

(blood) to supply oxygen/glucose, to retina/AW; **max 2**

(iii) each cone cell connects to one ganglion cell (only);

so, impulses/information, from each (cone) cell kept separate;

several rod cells connect to the same ganglion cell;

so, impulses/information, from several rod cells are pooled;

so greater resolution/AW (from cones);

watch for ecf from (i) **max 3**

(b) (i) (red and blue light) stimulate, different cone cells;

brain interprets, action potentials/impulses, from each type of cell differently;

action potentials/impulses, from B cell seen as blue light *or* ditto for R cell;
max 2

(ii) only one type of rod cell;

rod cells contain (only), one pigment/rhodopsin;

rod cell pigment/rhodopsin, absorbs/sensitive to light, over wide range of wave-lengths/AW;

(signals from) rod cells cannot give information about colour/cannot distinguish between different colours; **max 2**

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(c) (i) sex linked;

colour blindness, (allele/trait), is recessive;

men have only one copy of this, allele/gene;

as they have only one X chromosome;

no possible masking effect from another allele; **max 3**

or v.v. for women

(ii) opsin is a protein/genes code for protein structure; **1**

Total 15

2 (a) Z lines closer together;

actin filaments, touching/almost touching/slightly overlapping;

all filaments approximately the same length as in figure 1.2; **3**

(b) (myosin) heads form, cross-bridges/links, with actin;

(myosin heads) tilt;

moving actin filaments along;

heads release and reset;

ATP binds to myosin head;

myosin head acts as ATPase;

ATP provides energy for release;

ATP hydrolysed (by ATPase on myosin heads); **max 4**

AVP;

(c) triceps contracts;

bones of lower arm move downward/arm extends, (pulling on the myofibril); **2**

Total 9

3 (a) any sensible working;

1.7 (%); **2**

(b) hepatic portal vein; **1**

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(c) from cholesterol;

(inside) hepatocytes;

secreted into bile canaliculi; **max 2**

AVP;

(d) presence of hydrophilic and hydrophobic groups;

allow dispersal of tiny fat droplets into, water/digestive juices *or* decrease surface tension;

emulsify, fats/lipids;

larger/increased, surface area, for action of/contact with, lipase;

increase (rate of), digestion/hydrolysis/fatty acids and glycerol production; **max 3**

AVP; (detail)

Total 8

4 (a) ***cerebellum***

coordination of movement;

control of, balance/posture;

control of precision of movements involving voluntary muscle;

learning complex motor tasks; **max 3**

medulla oblongata

controls/increases, breathing;

controls/increases, heart rate;

control of, blood pressure/vasodilation and vasoconstriction; **max 3**

max 4

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(b) (i) cerebrum/cerebral cortex/hippocampus; **1**

(ii) build-up of, plaques/tangles;

(containing), tau protein/amyloid;

destroys/damages, neurones;

less acetylcholine secreted;

cause probably part genetic;

also environmental factors/e.g. (ageing/severe blows to head/high levels of aluminium in diet); **max 3**

AVP;

Total 8

OPTION 2 MICROBIOLOGY AND BIOTECHNOLOGY

1 (a) growth/presence, of pathogenic microorganisms/pathogens/AW;

grow better at, (temperatures close to) 37 ºC/body temperature;

reference 25 ºC as optimum temperature of the desired/non pathogenic bacterium/ 37 ^{o}C inhibits desired;

suitable enzyme reference; **max 2**

(b) (i) (10^{-6}) too many to count accurately/plaques overlapping not possible to count accurately;

large variation in numbers counted;

uneven distribution of viral particles in sample;

(10^{-8}) pipetting errors/diluting errors;

small number result in greater statistical errors/AW; **max 3**

(ii) average 68 + 64 + 66/3 = 66;

$66 \times 10^{7}/5 = 1.32 \times 10^{8}$; **2**

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(c) no deaths until day 3/4/AW;

no more deaths after day 12;

fastest death rate between day 4 and 6/AW;

not many people die;

figures; **max 2**

(d) (i) definition; (pathogens transmitted, from person to person/animal to animal)

detail; **2**

(ii) use of, air flow hood/laminar flow cabinet;

air purified before release;

by a filter/air purifiers;

negative pressure labs;

air moves into labs;

smooth surfaces/crevice free;

autoclaves/sterilising equipment;

air lock systems;

showers; **max 4**

Total 15

2 (a)

DNA	chitin/glucans
viruses	absent
bacteria/prokaryotes	absent

½ marks rounded up **3**

(b) bacteria replicate independently/bacteriophage requires, host/cell, for replication;

bacteria possess own enzymes/protein synthesising machinery; ora;

bacteria divide by binary fission/bacteriophage do not produce by binary fission/idea of 2 v lots;

prophage phase for bacteriophage; **max 2**

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(c) gram negative thinner peptidoglycan;

with lipopolysaccharide/lipoprotein outer layer; **2**

Total 7

3 (a) 1 mouse injected with, specific/suitable, antigen;

2 mouse killed 2 - 3 weeks later;

3 spleen (removed);

4 lymphocytes extracted;

5 by centrifuge;

6 myeloma cells/AW;

7 use of, a fusogen/polyethylene glycol;

8 cultured on agar plates, to prevent unfused cell growth;

9 hybrid cells tested for antibody production;

10 antibody producing cells cloned;

11 large scale (fermentation); **max 4**

(b) fluorescent – aid in imaging target/makes target visible/way to find, target cell/ antigen;

attach to, target cell/cancer cells/antigen on cells;

radioactive – kill cells/does not kill normal cells; **3**

(c)

C	**F**		**G**		**H**	**E**	**D**

½ marks rounded up **3**

Total 10

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4 **(a)** batch only for 2^o metabolites/continuous for 1^o and 2^o;

batch fermentation

microorganisms grown in same medium/no more nutrients added;

until certain optical density reached/stationary phase reached/no more product formed/sufficient product formed (and then harvested);

three stages of growth curve;

continuous culture

fresh medium added;

to maintain log growth phase;

cells harvested throughout; **max 3**

(b) co-selection;

spontaneous/random/existing, mutation of gene;

increased use of penicillin;

gives selective advantage;

kills all except resistant types;

population of bacteria become mainly resistant;

increased horizontal transmission;

more opportunity to pass on plasmid; **max 2**

AVP;

(c) penicillin production very low when no sugar present;

penicillin production higher with lower sugar levels;

use of figures;

steeper rise after 6 days, with 1 g dm^{-3} glucose compared to 2g dm^{-3} glucose;

plateau mark; **max 3**

Total 8

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OPTION 3 GROWTH, DEVELOPMENT AND REPRODUCTION

1 (a) enzymes from acrosome digest path through follicle cells;

sperm attach to receptors in zona pellucida;

(another) enzyme from acrosome digests path through zona;

sperm and oocyte (cell surface/plasma) membranes fuse;

enzymes released from, lysosomes/cortical granules, thicken zona/make zona sperm-proof/prevent polyspermy;

male and female (pro)nuclei fuse; **max 4**

AVP;

(b) changes, gene/DNA, base sequence;

codes for protein with different amino acid/acids;

codes for protein with amino acid(s) missing;

protein has different, tertiary structure/3D shape;

protein has different, R groups/affinity;

wrong, shape/charge, for (ion channel) function; **max 3**

(c) (i) **(**fusion of egg and sperm) outside the organism;

in sterile/nutrient, medium;

'in glass'/in Petri dish/in test tube; **max 2**

(ii) sperm from mutant mice cannot fertilise intact eggs;

sperm from mutant mice can fertilise eggs with zona removed;

but less well than sperm from normal mice;

use of comparative figures; (81% v. 0%/76% v. 62%)

sperm from normal mice less successful when zona removed (than with intact eggs); **max 4**

(iii) affects rate of movement/high rate of movement needed for successful fertilisation;

180 μm s^{-1} v. 60 μm s^{-1}/normal 3 times faster;

ion (sensible suggestion of ion) needed, to trigger movement/for penetration of zona pellucida; **max 2**

Total 15

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2 (a) permanent/irreversible;

increase in dry mass; **2**

(b) (i) 33/718;

0.05/0.046; **2**

(ii) decreases (with age);

decrease slows (with age);

reference plateau;

reference figures; **max 3**

(iii) plot mean increase in volume per 5 year period;

against, age/years (in correct context); **2**

Total 9

3 (a) (i) A synergid;

B embryo sac;

C fusion nucleus/fused polar nuclei;

Ⓐ *diploid/endosperm, nucleus*

D antipodal cell; **2**

½ marks rounded up

(ii) *female gamete*

fuses with one male, gamete/nucleus;

to give diploid zygote;

(future) embryo; **max 2**

*structure **C***

fuses with one male, gamete/nucleus;

to give triploid nucleus;

(future) endosperm; **max 2**

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(b) does consist of 4 haploid cells;

nucleus **F** same DNA content as nucleus **E**; Ⓐ *figures*

reference diploid endosperm/endosperm not triploid, after fertilisation;

reference no information *re* other two nuclei; **max 2**

Total 8

4 (a) (i) (presence of) water; ® *'moisture'*

(presence of) oxygen;

suitable/optimum, temperature;

appropriate, light intensity/wavelength; **max 3**

(ii) scarification/description;

prechilling/stratification/description; ® *vernalisation*

exposure to fire;

leaching/washing away, inhibitor; **max 2**

AVP;

(iii) gibberellin/gibberellic acid (GA); Ⓐ *cytokinin* **1**

(GA) stimulates production of, hydrolytic enzymes/amylase;

detail enzyme action;

(GA) stimulates, protein synthesis/growth;

(GA) switches on genes;

reference other growth regulator/inhibitor; **max 2**

Total 8

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OPTION 4 APPLICATIONS OF GENETICS

1 (a) changes, gene/DNA, base sequence;

codes for protein with different amino acid/acids;

codes for protein with amino acid(s) missing;

protein has different, tertiary structure/3D shape;

protein has different, R groups/affinity;

wrong, shape/charge, for (ion channel) function; **max 3**

(b) (i) (fusion of egg and sperm) outside the organism;

in sterile/nutrient, medium;

'in glass'/in Petri dish/in test tube; **max 2**

(ii) sperm from mutant mice cannot fertilise intact eggs;

sperm from mutant mice can fertilise eggs with zona removed;

but less well than sperm from normal mice;

use of comparative figures; (81% v. 0%/76% v. 62%)

sperm from normal mice less successful when zona removed (than with intact eggs); **max 4**

(iii) affects rate of movement/high rate of movement needed for successful fertilisation;

180 μm s^{-1} v. 60 μm s^{-1}/normal 3 times faster;

ion (sensible suggestion of ion) needed, to trigger movement/for penetration of zona pellucida; **max 2**

(c) (i) DNA different, mass/lengths *or* A, lighter/shorter, than C (or *vice versa*);

lighter/shorter, lengths move faster/ora;

in electrophoresis;

across gel; **max 3**

(ii) heterozygote has both, alleles/lengths of DNA *or* (heterozygote) has half the amount of each; **1**

Total 15

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2 **(a)** interbreed sticky rice with, hybrid/resistant, rice;

practical detail;

produce/collect, seed and grow;

select plants with <u>both</u> sticky rice and resistance;

interbreed these and select best;

idea many generations;

back cross to parent for alleles of background genes; **max 4**

(b) **(i)** distance apart/spore filtration, in mixed planting;

(mono) much greater/20% v. 1.2%, for sticky rice, because not resistant;

(mono) double/2.3% v. 1%, for hybrid rice, even though more resistant;

(mono) whole crop genetically similar/ora; **max 2**

(ii) in monoculture plants genetically similar so any successful strain can attack all;

no such selective advantage in mixed planting;

reference strains produced by mutation; **max 2**

Total 8

3 **(a)** to prevent/high risk of, extinction;

to maintain genetic diversity;

to counteract inbreeding depression;

store of <u>alleles</u>;

for future use;

in changed environment; Ⓐ *e.g. of change – biotic or abiotic*

in, selective breeding/genetic engineering; **max 3**

(b) frozen/-20 ºC;

dried/5% water;

reference storage conditions; e.g. low humidity/sealed/labelled containers/high CO_2 concentration (although not actually used); **max 2**

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(c) to ensure/maintain/test for, viability;

test every 5 years;

new seed collected/grow, when germination falls below 85%;

AVP; e.g. reference selective pressures whilst growing; **max 2**

Total 7

4 **(a)** trisomy 21/three chromosomes 21;

as a result of non-disjunction;

translocation;

part of 21 onto another chromosome;

detail chromosome (13, 14 or 15/group D);

together with two chromosomes 21; **max 3**

(b) detection of, specific allele/genetic disease/haplotype ; **1**

(c) **(i)** $\frac{(323-152)}{323}$ x 100 or $\frac{(32+36+42+61}{323}$ x 100;

53(%)/52.9(%); **2**

(ii) A to D increasingly successful/D highest/D higher than A, B and C;

D almost twice as good as A;

none, very successful/100%;

correct percentage calculation for A/D;; **max 3**

(iii) use more than one test; **1**

Total 10

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