

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

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## MARK SCHEME for the November 2004 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.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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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

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MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9700/06

BIOLOGY  
Paper 6 (Options)

Page 1	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

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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**

<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>
	<b>A LEVEL – NOVEMBER 2004</b>	<b>9700</b>

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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

<b>Page 3</b>	<b>Mark Scheme</b>	<b>Syllabus</b>
	<b>A LEVEL – NOVEMBER 2004</b>	<b>9700</b>

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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**

Page 4	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

- (b) (i) cerebrum/cerebral cortex/hippocampus;
- (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 °C/body temperature;  
reference 25 °C as optimum temperature of the desired/non pathogenic bacterium/  
37 °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**

<b>Page 5</b>	<b>Mark Scheme</b>	<b>Syllabus</b>
	<b>A LEVEL – NOVEMBER 2004</b>	<b>9700</b>

(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**

Page 6	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

(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
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*½ marks rounded up*

3

Total 10

Page 7	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

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4 (a) batch only for 2° metabolites/continuous for 1° and 2°;

**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<sup>-3</sup> glucose compared to 2g dm<sup>-3</sup> glucose;

plateau mark;

**max 3**

**Total 8**

Page 8	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

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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  $\mu\text{m s}^{-1}$  v. 60  $\mu\text{m s}^{-1}$ /normal 3 times faster;

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

**max 2**

**Total 15**

Page 9	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

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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

Page 10	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

(b) does consist of 4 haploid cells;

nucleus F same DNA content as nucleus E; ④ 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; ④ 'moisture'

(presence of) oxygen;

suitable/optimum, temperature;

appropriate, light intensity/wavelength;

max 3

(ii) scarification/description;

prechilling/stratification/description; ④ vernalisation

exposure to fire;

leaching/washing away, inhibitor;

max 2

AVP;

(iii) gibberellin/gibberellic acid (GA); ④ 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

Page 11	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

**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  $\mu\text{m s}^{-1}$  v. 60  $\mu\text{m s}^{-1}$ /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**

Page 12	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

- 2 (a) interbreed sticky rice with, hybrid/resistant, rice;
- practical detail;
- produce/collect, seed and grow;
- select plants with both 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 alleles;
- for future use;
- in changed environment; **A** e.g. of change – biotic or abiotic
- in, selective breeding/genetic engineering; max 3

- (b) frozen/-20 °C;
- dried/5% water;
- reference storage conditions; e.g. low humidity/sealed/labelled containers/high CO<sub>2</sub> concentration (although not actually used); max 2

Page 13	Mark Scheme	Syllabus
	A LEVEL – NOVEMBER 2004	9700

(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)  $\frac{(323-152)}{323} \times 100$  or  $\frac{(32+36+42+61)}{323} \times 100$ ;

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