

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
GCE Advanced Subsidiary Level and GCE Advanced Level

## **MARK SCHEME for the May/June 2007 question paper**

### **9700 BIOLOGY**

**9700/04**

Paper 4 (A2 Structured Questions), maximum raw mark 100

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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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## Section A

- 1 (a) 1. killed / hunted, qualified ; e.g. for meat / for fur / blood sport / takes human food / thought to be dangerous    A poaching (unqualified)  
 2. war ;  
 3. sale of live young ;  
 4. habitat destruction / AW ;  
 5. loss of / competition for food ;  
 6. AVP ; e.g. disease [3 max]
- (b) (i) 1. fewer animals need to be caught (for zoos) ;  
 2. ref. becoming pregnant ; e.g. IVF / finding a mate  
 3. reintroduction into the wild ;  
 4. research easier with captive animals / AW ;  
 5. ref. increase in numbers ;  
 6. ante or postnatal care ; [3 max]
- (ii) 1. inbreeding / AW ;  
 2. gene pool too small ;  
 3. no fear of humans / difficulty in socialising with other gorillas ;  
 4. difficulty in, finding food / reproducing ;  
 5. ref. transfer of pathogens ;  
 6. ref. effects of captivity ; e.g. stress [2 max]

**[Total: 8]**

2

process	major products
glycolysis	ATP ; pyruvate ; reduced NAD ;
Krebs cycle	ATP ; reduced NAD / reduced FAD ; CO <sub>2</sub> ;
oxidative phosphorylation	ATP ; water ; NAD / FAD ;

[8 max]

R NADP throughout

**[Total: 8]**

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3 (a) (i)

bacterial strain	A	B	
diameter (d) / mm	24	16 ;	
area / mm <sup>2</sup>	452 - 453	201 – 201.2 ;	A ecf
ratio of area A : area B	2.25 : 1	A 9:4	A ecf

[3]

- (ii) 1. penicillin kills more of strain A than strain B or C / AW ;  
 2. ref. different active or binding sites ;  
 3. A produces less penicillinase than B or C ;  
 4. C is resistant (to penicillin) ;  
 5. C has mutation ;  
 6. penicillin cannot bind to enzymes ;  
 7. penicillin inactivated by C / C produces much penicillinase ;  
 8. AVP ; e.g. B is evolving into a more resistant strain / variation in carriers across membrane [4 max]

- (iii) 1. antibiotic, is selective agent / provides selective pressure ;  
 2. resistant survive / susceptible die ;  
 3. ref. reproduction ;  
 4. resistants pass on, mutation / allele ; R gene  
 5. ref. vertical transmission ;  
 6. increases frequency of allele in population ;  
 7. may pass advantageous mutation to other species / ref. plasmid transfer ;  
 8. ref. horizontal transmission ; [4 max]

*accept reference to strains A, B and C in correct context for points 2, 3 and 4*

- (b) 1. competitive inhibitors (of transpeptidase) ;  
 2. binds to enzyme ;  
 3. blocks active site ;  
 4. crosslinks in peptidoglycan wall cannot form ;  
 5. weakens cell wall ;  
 6. lysis / cell bursts ;  
 7. ref. high internal pressure of bacterial cell ; [4 max]

**[Total: 15]**

- 4 (a) 1. norm concentration of blood glucose is 80 - 120 mg 100cm<sup>-3</sup> ; (A within range)  
 2. β cells of, Islets of Langerhans / pancreas, detect increase ;  
 3. ref. K<sup>+</sup> channels close / role of Ca<sup>2+</sup> ;  
 4. secrete insulin ;  
 5. ref. glycogenesis ;  
 6. increased uptake of glucose (by cells) ;  
 7. increased use of glucose in respiration / glucose converted to fat ;  
 8. ref. negative feedback / described ; [4 max]

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- (b) *reverse transcriptase*  
 makes, cDNA / single strand of DNA ;  
 from (human) mRNA ;  
*DNA polymerase*  
 produces, second strand of DNA / double stranded DNA ;  
 ref. links nucleotides (in context of backbone formation) ;  
 ref. semiconservative replication / ref. complementary base pairing ; [max 2]  
*restriction enzymes*  
 cut DNA / cut plasmid ; **R** cuts gene **A** cuts out gene  
 at specific sites / at palindromic sites ;  
 to give sticky ends ; **A** blunt ends [max 2]  
*DNA ligase*  
 seals nicks in sugar-phosphate backbone ;  
 forms rDNA ;  
 by adding phosphate group ; [max 2] [6 max]

[Total: 10]

- 5 (a) (i) air spaces (between cells) / aerenchyma ;  
 in mesophyll / cortex ;  
 formed by cell death ; [2 max]
- (ii) provides oxygen ;  
 for aerobic respiration / because conditions are anaerobic ;  
 ref. diffusion ;  
 AVP ; e.g. allows escape of ethene / buoyancy / active transport [2 max]
- (b) (i) internode length increases as water depth increases ;  
 use of figures ; (2 days) 2 depths + 2 lengths ignore units [2]
- (ii) part of plant is (always) above water ;  
 access to light ;  
 access to, air / oxygen / carbon dioxide ;  
 ref. pollination / flowering ; [2 max]
- (iii) ethene concentration increases up to 30 or 40 cm water depth ;  
 fluctuation / plateau between 30 or 40 cm to 60 cm water depth ;  
 comparison between when water level is constant and when water level increases ; [2]
- (c) (i) substance that affects growth / development ; [1]
- (ii) 1. gibberellin causes increase in stem length ;  
 2. detail of mechanism ; e.g. cell elongation  
 3. gibberellin has greater effect with ethene present ;  
 4. more gibberellin could be secreted as water depth increases ;  
 5. gibberellin could remain constant but have greater effect because more ethene  
 secreted ;  
 6. more gibberellin could be transported through plant as water depth increases ;  
 7. AVP ; [3 max]

[Total: 14]

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- 6 (a) A – germinal epithelium ;  
B – Graafian follicle ; [2]
- (b) (i) primary oocyte ; [1]
- (ii) label to primary oocyte on Fig. 6.2 ; [1]
- (iii) P - mitosis  
Q - meiosis ; both required for mark [1]

- (c) *either*  
independent assortment ;  
homologous / maternal and paternal, chromosomes position themselves either way up / AW ;  
on equator (of spindle) ;  
so segregate randomly / any combination of maternal and paternal chromosomes can end up  
in daughter cells ;  
AVP ; e.g. occurs during metaphase 1  
*or*  
crossing over / chiasmata ;  
between, chromatids of homologous chromosomes / non-sister chromatids ;  
genetic material on maternal and paternal chromosomes swap places / AW ;  
leads to new combination of alleles ; **R** genes  
AVP ; e.g. breaking established linkage groups / occurs during prophase 1 [3 max]

**[Total: 8]**

- 7 (a) both alleles, influence phenotype / are expressed ;  
ref. more than 2 phenotypes possible ;  
phenotype of heterozygote different from either homozygote ; [3]
- (b) son receives Y chromosome from father ;  
Y chromosome does not carry haemophilia allele ;  
father will pass haemophilia allele to daughter(s) ;  
daughter will be, a carrier / heterozygous /  $X^H X^h$  ;  
daughter may pass allele to, her son / his grandson ; *accept on diagram* [3 max]

- (c) (i) (male)  $C^B C^B X^a X^a$  ; x (female)  $C^W C^W X^A Y$  ;  
(gametes)  $C^B X^a$   $C^W X^A$  or  $C^W Y$  ;  
 $C^B C^W X^A X^a$  ;  $C^B C^W X^a Y$  ;  
(male, blue, barred) (female, blue, non-barred)

*accept other symbols but only with key**if male XY and female XX then mark gametes and offspring genotypes to max 2**if other symbols used but no key then mark to max 2*

[5]

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- (ii) blue colour is heterozygous /  $C^B C^W$  ;  
test cross ;  
 with non-barred female ;  
 if all offspring barred, must be  $X^A X^A$  / homozygous ;  
 if some offspring non-barred, must be  $X^A X^a$  / heterozygous ;

[3 max]

**[Total: 14]**

- 8 (a) 1. human ;  
 2. applies selection pressure ;  
 3. for benefit of human ;  
 4. choose / breed, parents with suitable trait ;  
 5. named example (species and characteristic) ;  
 6. select offspring ;  
 7. repeat over several generations ;  
 8. increased allele frequency ;

[4 max]

- (b) (i) 140 (%) ;;  
 2 marks for correct answer  
 (14/10 x 100 = 1 mark)

[2]

- (ii) genetic variation ;  
 ref. polygenes ;  
 environmental variation ;  
 AVP ; e.g. sampling / experimental, error

[2 max]

**[Total: 8]****Section B**

- 9 (a) 1. action potential / depolarisation, reaches presynaptic membrane ;  
 2. calcium (ion) channels open / presynaptic membrane becomes more permeable to  $Ca^{2+}$  ;  
 3.  $Ca^{2+}$  flood into presynaptic neurone ; **R** membrane  
 4. this causes vesicles of (neuro)transmitter to move towards presynaptic membrane ;  
 5. ref. acetylcholine / ACh ;  
 6. vesicle fuses with presynaptic membrane / exocytosis ;  
 7. ACh released into synaptic cleft ;  
 8. ACh diffuses across (cleft) ;  
 9. ACh binds to receptor (proteins) / AW ;  
 10. on postsynaptic membrane ; **R** neurone  
 11. proteins change shape / channels open ;  
 12. sodium ions rush into postsynaptic neurone ; **R** membrane  
 13. postsynaptic membrane depolarised ;  
 14. action potential / nerve impulse ;  
 15. AVP ; e.g. action of acetylcholinesterase

[9 max]

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- (b) 16. ensure one-way transmission ;  
 17. receptor (proteins) only in postsynaptic, membrane / neurone ; *ora*  
 18. vesicles only in presynaptic neurone ; *ora*  
 19. ref. adaptation ;  
 20. increased range of actions ;  
 21. due to interconnection of many nerve pathways ;  
 22. ref. inhibitory synapses ;  
 23. involved in memory / learning ;  
 24. due to new synapses being formed ;  
 25. AVP; e.g. summation / discrimination

[6 max]

**[Total:15]**

- 10 (a) 1. biconvex disc ;  
 2. 3-10  $\mu\text{m}$  diameter ;  
 3. double, membrane / envelope ;  
 4. internal membrane system ;  
 5. flattened or fluid-filled sacs / thylakoids ;  
 6. arranged in stacks / grana ;  
 7. hold pigments / named pigment ;  
 8. ref. clusters of pigments / AW ;  
 9. (membrane of grana) hold ATP synthase ;  
 10. intergranal lamellae ;  
 11. stroma / ground substance ;  
 12. lipids / starch grains ;  
 13. contains enzymes of Calvin cycle ;  
 14. stroma contains ribosomes / DNA etc ;  
 15. AVP ; e.g. variation in shape between species

[9 max]

*accept on labelled diagram*

- (b) 16. closely packed -- to absorb more incident light / AW ;  
 17. palisade mesophyll near upper surface of leaf -- to maximize light interception ;  
 18. arranged at right angles to leaf surface -- to reduce number of light absorbing walls ;  
 19. cylindrical cells -- producing air spaces between cells ;  
 20. air spaces -- act as reservoir of carbon dioxide ;  
 21. large surface area -- for gas exchange ;  
 22. cell walls thin -- so short diffusion pathway ;  
 23. large vacuole -- pushes chloroplasts to edge of cell ;  
 24. chloroplasts on periphery -- to absorb light more efficiently ;  
 25. large number of chloroplasts -- to maximise light absorption ;  
 26. chloroplasts can move within cells -- towards light ;  
 27. chloroplasts can move away from high light intensity -- to avoid damage ;  
 28. AVP ;

[6 max]

*accept chlorophyll for chloroplast for 23, 24 and 25 only***[Total: 15]**