

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2008 question paper**9700 BIOLOGY****9700/04**

Paper 4 (Theory 2), maximum raw mark 100

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Question Expected Answers Marks

1 (a)

eukaryotic		prokaryotic
1. linear / strands	or	circular ;
2. in nucleus	or	(free) in cytoplasm ;
3. associated with, proteins or histones	or	naked ;
4. in chromosomes	or	not in chromosomes ;

assume eukaryotic if not stated

[2 max]

- (b)**
- 1 habitat destruction / deforestation ;
 - 2 disease ;
 - 3 fall in prey numbers / difficulty in finding food ;
 - 4 increased competition (with other carnivores) ;
- 5/6 ref. named human activities ; ; e.g. killing / agriculture / logging
R pollution

[3 max]

- (c)**
- 1 national parks ;
 - 2 zoos ;
 - 3 captive breeding programmes ;
 - 4 AVP ; e.g. banning hunting / gamete banks / education qualified

[2 max]

[Total:7]

2 (a) (i) acts as chloride channel ; **A** Cl^- **R** chlorine

Cl^- moves out (of cell) ;

active transport / binding site for ATP ;

[2 max]

(ii) **E** on diagram / upper face, because this is where, oligosaccharides / glycolyx / carbohydrate chains, are present ;
A glycoprotein **R** glycolipid

[1]

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(b) (i) form / variety / version, of a gene ;
 only affects phenotype when dominant allele not present / AW ; [2]

- (ii) 1. thick / sticky / dehydrated, mucus produced ;
 2. mucus not moved effectively by cilia / mucus accumulates ;
 3. reduced gaseous exchange / longer diffusion pathway ;
 4. difficulty in breathing ;
 5. more infections / (mucus) traps bacteria ;
 6. lungs are scarred ; [3 max]

(c) viral DNA carries normal (CFTR), allele / gene ;
R RNA **A** recombinant DNA
 virus binds (with lung cells) ;
 viral DNA put into, (lung) cells / host DNA ; [2 max]

(d) (i) 1. translation will not occur normally ;
 2. no amino acid added to chain when stop codon reached ;
 3. protein chain not completed / protein only partially made ; [2 max]

(ii)

PTC124		gene therapy
1. can be taken orally	or	delivered (by vector) into respiratory tract ;
2. self administered	or	requires medical treatment ;
3. is readily taken up by cells	or	poor take up by cells ;
4. no vectors needed / fewer or no side effects	or	possibility of side effects (from vectors) / named side effect ;
5. only needs to enter cytoplasm	or	difficulty in inserting gene into host DNA ;
6. no need to switch on gene	or	difficulty in switching on gene ; [3 max]

[Total:15]

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- 3 (a) 1 very extensive root system / roots go very deep ;
- 2 small surface area of leaves ; **R** narrow leaves
- 3 leaves roll / presence of hinge cells ; **A** bulliform
- 4 leaves / stalks, have waxy covering / thick cuticle ;
- 5 high silica content ;
- 6 stomata, reduced in number / in sunken pits ;
- 7 idea of supporting tissue ; e.g. sclerenchyma [max 2]
- (b) (i) 1. (ABA concentration) increases from day 3 / 4 to day 7 then decreases (to day 8 / 9 /10) **or** peaks at day 7 ;
2. comparative figs (2 ABA concentrations at 2 days) ; *ignore units*
e.g.1 at day 4 and 10 at day 7
3. as water potential decreases concentration of ABA increases / ora ;
4. no response until water potential drops below -600 to -800 kPa ; [max 3]
- (ii) fall in water potential causes, stomatal resistance to increase / closure of stomata ; **A** ora
- increase in ABA concentration causes, stomatal resistance to increase / closure of stomata ; **A** ora
- detail of mechanism ; e.g. turgor of guard cells / proton pump / flow of K⁺ [max 2]
- (c) stomatal closure reduces water loss ; **R** stops / prevents
- by transpiration / (by diffusion of) water vapour from leaves ; [2]
- [Total: 9]
- 4 (a) 1 (mouse) injected with antigen ; **A** protein / red cells
- 2 spleen / plasma / B, cell ;
- 3 with ability to make antibody ; *linked to 2*
- 4 fused with, tumour / myeloma / cancerous, cell ;
- 5 cells cultured ;
- 6 cells checked for antibody production ;
- 7 cells cloned ; [4 max]

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- (b) (i) 1. Herceptin / X-ray, induces (slightly) more cell death than control ;
A more effective
2. X-rays induce more cell death than Herceptin ; **A** more effective
3. comparative figures supporting 1 or 2 ; e.g. 0.6 or 0.75 v 0.5
4. Herceptin and X-rays induce much more cell death (than either treatment alone) ;
A highest / most / greatest, effect
5. comparative figures supporting 4 ; e.g. 2.0 v 0.6 or 0.75 [3 max]
- (ii) $\frac{2.0 - 0.6}{0.6} \times 100 \%$
- = 233 % ;; *award 2 marks for correct answer ignore decimal places*
- allow 1 mark for valid working if answer incorrect* [2]
- (c) (i) 1. increase in dose of X-ray causes, decrease in % cells surviving / more cell death ;
2. increase in X-ray dose plus Herceptin causes greater, decrease in % cells surviving / cell death ;
3. difference greatest above 2 (J kg⁻¹) ; **R** ref to time or rate [3]
- (ii) identifies cancer cells ;
immune response triggered ;
- enters cancer cell ;
kills it ;
- Herceptin enhances effect of X-ray ; [2 max]

[Total: 14]

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- 5 (a) *FSH:*
- 1 anterior pituitary gland ;
 - 2 follicle ;
 - 3 stimulates, growth of follicle / follicle to secrete oestrogen ;
- progesterone:*
- 4 corpus luteum ; **A** some from follicle cells **A** yellow body
 - 5 endometrium (uterine epithelium) / anterior pituitary ; **A** lining **R** wall
 - 6 stimulates glandular activity in endometrium **or** maintains / increases, thickness of endometrium **or** inhibits FSH secretion **or** inhibits LH secretion ;
- [6]
- (b)
- 1 (effect on) hypothalamus / anterior pituitary ;
 - 2 (both) inhibit secretion of, FSH / LH ;
 - 3 (hence) no ovulation ; **R** ref. to eggs
 - 4 ref. negative feedback ;
 - 5 makes cervical mucus hostile to sperm / thickens mucus therefore stops sperm ;
 - 6 prevents implantation ;
- [3 max]
- [Total: 9]**
- 6 (a) (i) adenine ;
- (ii) ribose ; **R** pentose
- [2]
- (b)
- 1 energy is released when it is hydrolysed ; **A** equation **A** joules for energy
 - 2 easily hydrolysed ;
 - 3 (energy) used in, processes / reactions ; **A** named process
 - 4 rapid turnover ;
 - 5 links catabolic and anabolic reactions / AW ;
 - 6 found in, most cells / all organisms ;
 - 7 soluble so easily moved (within cell) ;
 - 8 ATP produced from variety of reactions ; **A** named reactions
- [4 max]

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- (c) 1 ETC / inner mitochondrial membrane / crista / stalked particles ;
 2 grana / thylakoids / inner chloroplast membrane ;
 3 cytoplasm / cytosol ;
 4 mitochondrial matrix ; [2 max]

[Total: 8]

- 7 (a) G to cells in centre ;
 R to surrounding white area ; [2]
- (b) ADH ; [1]
- (c) (i) (too) large / MM > 68 000 ;
 to pass through basement membrane ; R gaps / wall [2]
- (ii) reabsorbed ;
 in proximal convoluted tubule ; [2]
- (iii) 1. more urea in urine than in filtrate / ora ; A comparative figs
 2. water is reabsorbed ;
 3. in, distal convoluted tubule / collecting duct ;
 4. most urea stays in urine ; R all urea stays
 5. other substances are reabsorbed ; [2 max]

[Total:9]

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- 8 1 $CC^a Bb \times C^h C^a Bb$;
- 2 $CB Cb C^a B C^a b \times C^h B C^h b C^a B C^a b$;
- 3 offspring phenotypes:
full black : full red : himalayan black : himalayan red : albino black : albino red ;
- 4 phenotype ratio:
6 : 2 : 3 : 1 : 3 : 1 ;
- 5/6 offspring genotypes in Punnett square ;; [6]
- ecf*
if incorrect symbols penalise the parent genotypes (pt 1) and mark rest of cross up to max 4
- ecf*
if one gene only used then mark to max 2
- [Total: 6]**
- 9 (a) (i) ribulose ; [1]
- (ii) ribulose biphosphate carboxylase / rubisco ; [1]
- (iii) stroma ; R stoma [1]
- (iv) ATP / reduced NADP ; R reduced NAD [1]
- (b) 1 light independent reaction / Calvin cycle, continues ;
- 2 RuBP (still) converted to GP ;
- 3 until used up ; *link to 2*
- 4 light dependent reaction stops ;
- 5 no, ATP / reduced NADP, produced ;
- 6 RuBP not regenerated ;
- 7 GP, converted to TP / used to make hexose ; [4 max]
- [Total: 8]**

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- 10 (a) *most of these points can be taken from an annotated diagram*
- 1 nucleus in cell body ;
 - 2 (short), dendrites / dendrons ;
 - 3 axon ;
 - 4 (axon) much longer than, dendrite / dendrons ;
must be stated / not on diagram
 - 5 cell body contains, mitochondria / RER / golgi / groups of ribosomes ;
 - 6 many mitochondria at, synaptic knob / terminal branch ;
 - 7 synaptic vesicles ;
 - 8 neurotransmitter / named neurotransmitter ; *linked to 7*
 - 9 Schwann cells / myelin sheath ;
 - 10 nucleus in Schwann cell ; **R** nucleus in myelin sheath
 - 11 node of Ranvier ;
 - 12 AVP ; e.g. motor end plate / (dendrites) have receptors (for neurotransmitters) [7 max]
- (b)
- 13 Na⁺ channels open ; **A** sodium channels
 - 14 Na⁺ enter cell ; **R** enter membrane
 - 15 inside becomes, less negative / positive / +40mV / depolarised ;
 - 16 Na⁺ channels close ; **A** sodium channels
 - 17 K⁺ channels open ; **A** potassium channels
 - 18 K⁺ move out (of cell) ; **R** of membrane
 - 19 inside becomes, negative / repolarised ; **A** negative figure [5 max]
 - 20 local circuits / description ;
 - 21 (myelin sheath / Schwann cells) insulate axon / does not allow movement of ions ;
 - 22 action potential / depolarisation, only at nodes (of Ranvier) / gaps ;
 - 23 saltatory conduction / AW ;
 - 24 one-way transmission ;
 - 25 AVP ; e.g. hyperpolarisation / refractory period *related to 24* [3 max]

[Total: 15]

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- 11 (a)
- 1 allopatric speciation ;
 - 2 geographical isolation / spatial separation ;
 - 3 e.g. of barrier ;
 - 4 e.g. of organism ; *must relate to 3*
 - 5 sympatric speciation ;
 - 6 example ;
 - 7 meiosis problems ;
 - 8 polyploidy ;
 - 9 behavioural / temporal / ecological / structural, isolation ;
 - 10 (isolated) populations, prevented from interbreeding / can only breed amongst themselves ;
 - 11 no, gene flow / gene mixing, (between populations) ;
 - 12 different selection pressures operate ;
 - 13 natural selection ;
 - 14 change in allele frequencies ;
 - 15 different gene pool ;
 - 16 over time (differences prevent interbreeding) ;
 - 17 reproductively isolated ;

[8 max]

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- (b) 18 humans ; *must be linked to, choosing / selecting / mating etc*
- 19 parents with desirable feature ;
- 20 e.g. organism **and** feature ;
- 21 bred / crossed ;
- 22 select offspring with desirable feature ;
- 23 repeat over many generations ;
- 24 increase in frequency of desired allele(s) / decrease in frequency of undesired allele(s) ;
- 25 background genes ;
- 26 loss of hybrid vigour / increase in homozygosity / ref. inbreeding depression ;
- 27 AVP ; e.g. detail of breeding techniques [7 max]

[Total: 15]