CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 series

9700 BIOLOGY

9700/41 Paper 4 (A2 Structured Questions), maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	Alternative valid point (examples given as guidance)

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1 (a)

correct order	letter of stage
1	E
2	**H**
3	**A**
4	**J**
5	**C**
6	F
7	**B**
8	**G**
9	**D**
10	**I**

H A J C all above **F ;**
H A J C in correct order **;**

B G D I all below **F ;**
B G D I in correct order **;** [4]

(b) (i) vesicles found **only** in presynaptic neurone /
ACh released **only** from presynaptic neurone or membrane **;**

receptor (proteins) found **only** on postsynaptic membrane **;** [2]

(ii) 1. allows more interconnection of nerve pathways / AW **;**
2. for, memory / AW **;** *ignore learning*
3. allows wider range of responses **;**
4. AVP **;** e.g. summation [2 max]

[Total: 8]

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2 **(a)** 1. 6 penicillin inhibits, enzyme / peptidase ;
2. blocks / alters shape of, active site ;
3. peptidoglycan chains cannot link up / stops cross-links forming ;
4. (so) cell wall weak(er) ;
5. turgor of cell not resisted (by cell wall) /
idea of inability to withstand increased internal pressure ;
6. cell / wall / bacterium, bursts **;** *ignore 'dies' as in question* [4 max]

(b) 1. mRNA produced by transcription ;
2. idea of triplet code ;
3. translated (at ribosome) ;
4. correct ref. to function of tRNA **;** e.g. anticodon / carries amino acid
5. formation of polypeptide ;
6. AVP **;** e.g. ref. tertiary structure / 3D shape / ref. bonds [3 max]

(c) **(i)** *mutant strain 1*
1. very low resistance **or** affected by low concentration of antibiotic ; **A** less resistant
2. gene (for efflux pump) not properly, expressed / switched on ;
3. (so) few pumps (produced) **or** pumps out less antibiotic ;
A pumps not working well [2 max]

mutant strain 2
4. more / x4, resistant **or** tolerates high concentration of antibiotic ;
5. gene (for efflux pump fully), expressed / switched on ;
6. (so) many pumps available **or** pumps out more antibiotic ; [2 max]

(ii) 1. natural selection **;**
2. antibiotic provides selection pressure ;
3. mutant **2** has selective advantage ;
4. in presence of >64 **and** <256 $\mu g\,cm^{-3}$ antibiotic ;
5. **R** dies / mutant strain **2** survives ;
6. mutant **2**, reproduces / increases in number ;
7. (so) passes, resistance / mutation, (to offspring) ; *ignore allele / gene* [4 max]

[Total: 15]

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3 (a) (i) 1. gene isolated ;
2. inserted into plasmid / AW ;
3. correct ref. sticky ends ;
4. plasmid taken up by, *E. coli* / bacterium ; **R** plasmid inserted into bacterium
5. detail **;** e.g. use of restriction enzyme / cDNA produced [3 max]

(ii) 1. marker gene linked to gene for wanted protein ;
2. with promoter ;
3. GFP gene is, transcribed / expressed ;
4. producing GFP which fluoresces ; [3 max]

(b) *disadvantage*
1. may not fluoresce very brightly / may be difficult to detect ;

explanation
2. only a few molecules of GFP produced ;
3. each enzyme molecule produces more fluorescent substance / *idea of* enzymes can be re-used ; [2 max]

[Total: 8]

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4 (a) (i) A ; [1]

(ii) W - spermatogonium ;
X - primary spermatocyte ;
Y - secondary spermatocyte ; [3]

(b) 3 marks for correct labels ;;; [3]

(c) (i) fertility / number of offspring, decreases ;

at 20°C the number of offspring is 280 while at 25°C the number of offspring is 150 / accept difference between figures ; [2]

(ii) smaller reduction in, fertility / number of offspring, in *alg–3* mutants than in *alg–4* mutants ; **ora**

manipulated data quote
either by 24% in *alg–3* **and** 61% in *alg–4*
or by 30 in *alg–3* **and** 135 in *alg–4* ; [2]

(iii) D ; [1]

(iv) *at 20°C*
difference due (only) to lack of (development of) motility (in mutants) / AW ;
R ref to numbers of sperm

at 25°C
difference due to fewer sperm(atids) **and** less (development of) motility ; [2]

[Total: 14]

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5 **(a)** transfer of pollen from anther to stigma ;
on the same, flower / plant ; [2]

(b) 1. *idea of* genetic variation ;
2. increased heterozygosity ; **ora**
3. hybrid vigour / decreased inbreeding depression ;
4. able to adapt to changing conditions ;
5. *idea of* some individuals surviving ;
6. AVP ; e.g. reduced risk of expression of harmful recessive alleles [3 max]

(c) **(i)** 1. initially / first 24 mins, exposure time increases, number of seeds produced / (chance of) fertilisation ;
2. then / after 24 or 44 mins, steep decrease in, number of seeds produced / (chance of) fertilisation ;
3. from 120 mins, no seeds produced / no fertilisation ; [2 max]

(ii) 1. plant GM maize some distance away from places that teosinte grows ;
2. estimate how far pollen can travel in 120 minutes ;
3. need more results between 60–120 minutes ; [2 max]

[Total:9]

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6 (a) *allele*
different / alternative, form of a gene ; **A** variety of a gene

one of two or more alternative nucleotide sequences at a single gene locus ; [1 max]

dominant
(allele) that (always) expresses itself in the phenotype when present /
(allele) which influences the phenotype even in the presence of an alternative allele ; [2]

(b) parental genotypes ;
gametes ;
offspring genotypes (in Punnett square) ;;
offspring phenotypes linked to genotypes ;
ratio 9:3:3:1 linked to phenotypes ; [6]

[Total: 8]

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7 (a) *corals*

1. (cells) have no chloroplasts ;
2. (cells) have no, cell walls / large vacuoles ;
3. are heterotrophic / not autotrophic / not photosynthetic ; [2 max]

(b) biotic and abiotic components **or** living and non-living components ;
correct ref. to interaction **;** [2]

(c) (i) Indian Ocean = 22(%)
Pacific Ocean = 9(%) ;
both correct for 1 mark [1]

(ii) any three from

1. named marine pollutant ; e.g. oil / sewage
2. example of climate change ; e.g. sea level rising / change in sea temperature / decrease in oxygen concentration of sea
3. (increasing carbon dioxide) decrease in pH of sea ;
4. intensive fishing ;
5. tourism qualified ;
6. removal of parts of reef ;
7. reclaiming land ; [3 max]

[Total: 8]

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8 **(a)** **X** = crista(e) / inner membrane ;
Y = matrix ; [2]

(b) **(i)** raise chemical PE of glucose / provide activation energy / AW ; [1]

(ii) removes hydrogen / hydrogen carrier / coenzyme ; [1]

(iii) 4 ; **A** net 2 [1]

(iv) dehydrogenation ; **A** oxidation
decarboxylation ;
accept 'oxidative decarboxylation' for two marks [2]

(v) matrix ; [1]

(vi) 1. accepted by NAD ;
2. passed to ETC ;
3. for oxidative phosphorylation ;
4. ref. proton pump / chemiosmosis ; [2 max]

(c) 1. found in all organisms ;
2. loss of phosphate / hydrolysis, leads to, energy release / release of 30.5 kJ (per mole) ;
3. ADP + Pi ⟷ ATP / reversible reaction ;
4. small packets of energy ;
5. small / water soluble, so can move around cell ;
6. (used by cells as) immediate energy donor ;
7. link between energy yielding and energy requiring reactions / AW ;
8. high turnover ;
9. example of use ; e.g. active transport / muscle contraction / Calvin cycle / protein synthesis [5 max]

[Total:15]

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9 (a) **1.** reduction division / (to) halve number of chromosomes / diploid to haploid / AW ;
2. homologous chromosomes pair up / bivalents form ;
3. ref. chiasmata / ref. crossing over ;
4. homologous chromosome pairs / bivalents, line up on equator ;
5. <u>independent</u> <u>assortment</u> ;
6. spindle / microtubules, attached to centromeres ;
7. chromosomes of each pair pulled to opposite poles ;
8. by shortening of, spindle / microtubules ;
9. nuclear envelopes re-form ;
10. cytokinesis / AW ; [6 max]

(b) *accept alternative symbols for alleles throughout*
11. frequency of sickle cell anaemia is highest in areas where malaria is common ;
12. sickle cell anaemia red blood cells cannot carry oxygen very well / AW ;
A sickling blocks capillaries
13. homozygous H^S / H^SH^S, have sickle cell anaemia / may die ;
14. homozygous H^N / H^NH^N, have normal, Hb / red blood cells ;
15. heterozygotes, have sickle cell trait
or
(sickle cell trait) red blood cells not (severely) affected ;
16. malaria parasite / *Plasmodium*, affects red blood cells ;
17. malaria lethal ;
18. sickle cell trait people / heterozygotes, less likely to suffer from (severe effects of) malaria ;
19. have selective advantage ;
20. pass on both H^N and H^S ;
21. malaria selects against, homozygous H^N / H^NH^N ;
22. sickle cell anaemia selects against, homozygous H^S / H^S H^S ;
23. *idea that* sickle cell <u>allele</u> is maintained within population
because of sickle cell trait individuals ; [9 max]

[Total: 15]

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10 (a) 1. chlorophyll a is primary pigment ;
2. carotenoids / chlorophyll b, is accessory pigment ;
3. arranged in, light harvesting clusters / photosystems ; **A** antenna complex
4. on, grana / thylakoids ;
5. ref. PI and PII ; **A** P700 and P680
6. primary pigment / chlorophyll a, in reaction centre ;
7. accessory pigments / carotenoids / chlorophyll b, surround primary pigment ;
8. light energy absorbed by, accessory pigments / carotenoids / chlorophyll b ;
9. (energy) passed on to, primary pigment / chlorophyll a / reaction centre ;
10. chlorophyll a and b absorb light in red and blue/violet region ;
11. carotenoids absorb light in blue/violet region ;
12. ref. absorption spectrum peaks ;
13. diagram of absorption spectrum ;
14. different combinations of pigments (in different plants) give different spectra ; [8 max]

(b) 15. IAA / plant growth regulator / plant growth substance / plant hormone ;
16. synthesised in, growing tips / apical buds / meristems ;
17. moves by, diffusion / active transport ;
18. from cell to cell ;
19. also, mass flow / in phloem ;
20. stimulates <u>cell</u> elongation ; **R** cell enlargement
21. inhibits, side / lateral, buds / growth ; **A** inhibits branching
22. plant grows, upwards / taller **or** allows stem to grow up to light (instead of sprouting) ; **A** stem elongates
23. auxin not solely responsible for apical dominance **or** there is interaction between auxin and other plant growth regulators ;
24. ref. *idea of* concentration gradient down shoot so effect of dominance decreases ;
25. AVP **;** e.g. role of ABA and lateral bud inhibition / cytokinins antagonistic to IAA / gibberellins enhance IAA *also mp 23* [7 max]

[Total: 15]

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