UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9700 BIOLOGY

9700/42 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.

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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) (i) two peaks ;

dip in middle connected ; **R** no intermediates shown [2]

(ii) mates selected by size ;

few intermediates mate ;

intermediates selected against / extremes selected for ;

<u>alleles</u> for extreme phenotypes (more likely to be) passed on ; **ora**

AVP ; e.g. habitat for intermediate size no longer available / difference in predation [3 max]

(iii) <u>stabilising</u> ; [1]

(b) sympatric / occurs in same location **or**
allopatric **/** physical separation ;
ref. different selection pressures ;

eventual reproductive isolation / no longer interbreed ; [2 max]

[Total: 8]

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2 **(a)** 1. *idea of* wait for / time needed for, immune response to occur ;

2. ref. B lymphocytes mature to, plasma cells / effector B cells ;

3. plasma / effector B, cells secrete antibodies ;

4. plasma / effector B, cells extracted from (mouse) spleen ;

5. fused with, myeloma / cancerous / malignant, cells ;

6. (hybridoma cells) cultured ; ***A*** *before or after mp7*

7. identify cells secreting antibody (specific / against *T. pallidum*); *ignore 'containing'*

8. AVP ; e.g. use of fusogen [4 max]

(b) 1. (solution of) H9-1 / antibody added ; *ignore injecting*

2. given time for binding (then washed off) ;

3. examined with microscope ;

4. using, UV light ; **A** laser

5. fluorescent / yellow, treponemes are *T. pallidum* ; [3 max]

(c) *dark-field microscopy*

1. not enough treponemes (*T.pallidum*) present ;

2. *(idea of*) not noticed among other treponemes ;

blood test

3. not enough antibodies present to measure (in plasma) ; *ignore absent*

4. in host cells but not in blood / takes time to reach blood stream from point of entry ;

5. ref. time for immune response to occur / immunocompromised people ; [2 max]

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(d) (i) 1. H9-1, more accurate than other tests / correct in all cases ;

2. small number of false results from other tests ;

3. blood test least accurate ;

4. comparative figures ; (dark-field microscopy v. blood test)

e.g. of acceptable figures:-
(dark-field microscopy) 1 false negative and 2 false positives / ~ 5% / 3 errors out of 61 / 3.33% false negatives
(blood test) 3 false negatives and 2 false positives / ~ 8% / 5 errors out of 61/ 10% false negatives

5. comment re: small numbers ; [3 max]

(ii) 1. had infection before / antibodies already present ;

2. (have antibodies to) other treponemes that share an antigen with *T. pallidum* ; [1 max]

(e) *N.B.* ***treatment*** *not diagnosis*

1. *idea of* (monoclonal) recognise, specific antigen / cancer cell ;

2. (monoclonal) carries, drug / radioactive molecule / coloured molecule ;
ignore magic bullet alone

3. how this leads to treatment ; e.g. *cytotoxicity / effect radiation / effect laser*

4. as passive vaccine ;

5. (monoclonal) injected directly into, blood / body, to attack a particular pathogen ; [2 max]

[Total: 15]

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3 **(a)** 1. sequence of, bases / nucleotides, in the original DNA strand(s) ;

2. complementary base-pairing ;

3. A with T and C with G ;

4. purine with pyrimidine ;

5. 2 H-bonds and 3 H-bonds ; *allow marks from annotated diagram* [2 max]

(b) chance / random ;
only present in low concentration ; [2]

(c) **(i)** ATCGAT / in order of size starting with shortest ; [1]

(ii) 1. fragments are separated according to, length / mass ;

2. phosphate groups (of DNA) give negative charge ;

3. fragments move to, anode / positive electrode ;

4. short / light, fragments move, faster / further in unit time / **ora** ;
must be comparative

5. ref. impedance of gel / AW ; [3 max]

[Total: 8]

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4 **(a)** 1. ref. to vitamin A deficiency in, developing countries / named part of the world ;

2. rice, is a staple food / forms a major part of diet (in those countries) ;

3. increases vitamin A (in diet) ;

4. ref. prevention of blindness or reduces susceptibility to, diarrhoea, respiratory infections, measles ; **ora** [2 max]

(b) (desaturases, are not limiting production because) phytoene does not accumulate ;

(so) desaturases are, functioning normally / converting phytoene to other compounds ;

or

GGDP, present in large amounts / accumulates / remains high ;

(so) phytoene synthase is, limiting / reducing conversion to phytoene ; [2]

(c) **(i)** restriction (enzymes) ; [1]

(ii) 1. (promoter required) to ensure expression of the (introduced) genes / AW ;

2. (suitable promoter) might not be present in the rice cells ;

3. (suitable promoter) might not be in the correct position relative to the introduced genes ; [2 max]

(iii) *yes (no mark)*

1. all rice cells contain the same *crtI* genes ;

2. only difference was the source of the *psy* genes ;

3. if *crtI* limiting there would be no difference in the carotene in each group ; [2 max]

(d) 1. different base sequences (in the *psy* genes from different sources) ;

2. so different amino acid sequences, in the enzyme / in phytoene synthase ;

3. so different tertiary structure ;

4. could affect interaction with other components, e.g. cofactors ;

5. AVP ; *e.g. refs to different protein synthesising machinery in the cells*

ignore refs to active site and ability to bind with GGDP – must be able to do that as it does it in daffodils [2 max]

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(e) 1. GM seed could be difficult for farmers in developing countries to obtain ;

2. high cost of buying (new) GM seed / cannot use own seed ;

3. may not grow well in all conditions (as other traits not selected for) ;

4. too expensive for, people to buy / farmers to sell ;

5. might reduce efforts to relieve poverty ; [3 max]

[Total: 14]

5 **(a)** contains oestrogen and progesterone ; **A** progesterone only

prevents, fertilisation / ovulation / implantation ;

negative feedback on / inhibition of, FSH / LH ;

AVP ; e.g. change in cervical mucus / thinning of uterine lining [2 max]

(b) **(i)** 24 813 ;;

allow one mark for working

e.g. 27 000 x (8.1 ÷ 100) = 2187 so, number born was 27 000 – 2187

or
27 000 x 91.9 % [2]

(ii) ARVs have no effect on, number of pregnancies / whether or not a woman gets pregnant ;
ARVs do not get rid of HIV (so cannot reduce number of pregnancies in HIV-infected women) ;

contraception reduces the number of pregnancies (in HIV infected women) ; [2 max]

(iii) 1. contraception reduces the number of (HIV-infected) pregnancies (but ARVs do not) ;

2. reference to advantage of this ; *e.g. fewer drugs needed if fewer HIV-infected pregnancies*

3. effect of (current and predicted use of) contraception greater than ARVs on births of HIV-infected children ;

4. comparative use of figures ;
ARV versus contraception for either pregnancies or births

5. ref. low cost of contraception compared with cost of ARVs ; **ora** [3 max]

[Total: 9]

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6 (a) (i) may be of use in the future ;

(may produce) medicines / AW ;

resources (for humans) ;
e.g. wood for building / fibres for clothes **/** fuel **/** food / agriculture

maintain, gene pool / genetic diversity ;

to maintain stability in ecosystems ;

aesthetic reasons ;

(eco)tourism ; [3 max]

(ii) dried / kept cool ; [1]

(b) (i) positive correlation / number of plant genera increases as rainfall increases ;

paired figs ; *genera number & rainfall in 2 countries showing the trend*

China does not fit the pattern ; [2 max]

(ii) temperature ;

light intensity ; *ignore sunlight / light / sun*

day length ;

humidity ;

carbon dioxide concentration ;

wind ; [2 max]

[Total: 8]

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7 (a) *heterozygous*
two different alleles of a gene / different allele pair for a gene / AW ;

produces gametes with different genotypes ; *max 1*

genotype
alleles present in an organism / particular alleles of a gene / genetic constitution / AW ; [2]

(b) *parental genotypes*
AaDd x AaDd ;

gametes
AD Ad aD ad x AD Ad aD ad ;

two marks for correct Punnett square ;; *deduct one mark for each mistake*

(all 4) phenotypes linked correctly to genotypes ;

(probability of yellow offspring) 3 out of 16 **or** 0.19 **or** 19% ; [6]

[Total: 8]

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8 **(a)** (guard cell) thicker inner / unevenly thickened, cell wall ; **ora**

ref. to differences in, size / shape ; [1 max]

(b) **(i)** (receptors) on plasma / cell surface, membrane (of guard cells) ; [1]

(ii) K^+ / potassium ; [1]

(iii) (guard cell has) higher water potential than epidermal cell ; **ora** [1]

(iv) decrease ; [1]

(c) **(i)** provides carbon dioxide ; [1]

(ii) 0.1 ;
% per minute ; *reject plural* [2]

(iii) 0 – 10 mins / initially, rate for **B** is faster than rate for **A** ;

10 – 20 mins / AW, rate decreases for **B** and not for **A** / rate decreases more for **B** ;

paired figs ; *A & B % at same time (minutes)* [2 max]

(iv) no, photosynthesis / light dependent reaction ;

oxygen used up in respiration ; [2]

(v) temperature ; [1]

(d) reduced NADP ;

ATP ; [2]

[Total: 15]

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9 (a) *Active transport or anabolic reactions*

1. ATP provides energy (linked to either) ; i*gnore ref. to energy currency alone*

active transport

2. movement against concentration gradient ;

3. carrier / transport, protein (in membrane) ; *ignore pump*

4. binds to (specific) ion ;

5. protein changes shape ;

anabolic reactions

6. synthesis of complex substances from simpler ones ;

7. starch / cellulose / glycogen, from, monosaccharides / named monosaccharides / named sugar ;

8. glycosidic bonds ;

9. lipid / triglyceride, from fatty acids and glycerol ;

10. ester bonds ;

11. polypeptides / proteins, from amino acids ;

12. peptide bonds ;

13. other named polymer from suitable monomer ;

14. appropriate named bond ; *5 max*

[7 max]

(b) *general*

15. reduced NAD produced in glycolysis ; ***A*** glycolysis described

16. small amount of ATP produced in glycolysis ;

in yeast cells

17. pyruvate converted to ethanal ;

18. carbon dioxide released / decarboxylation ;

19. ethanal, reduced / accepts H ;

20. by reduced NAD ;

21. ethanol formed ;

in mammalian cells

22. pyruvate converted to lactate ;

23. by reduced NAD ;

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24. in, liver / muscle, cells ;

25. AVP ;;

26. e.g. reversible in mammal / irreversible in yeast / single step in mammal / more than 1 in yeast / reoxidised NAD allows glycolysis to continue / named enzyme

*only award **either** mp19 **or** mp23* [8 max]

[Total: 15]

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10 (a) 1. (homeostasis is) maintenance of, constant / stable, internal environment ;

2. irrespective of changes in external environment ;

3. negative feedback ;

4. receptor /appropriate named cell, detects change in, parameter / blood glucose concentration ;

5. (receptors are) β / α , cells ;

6. in, Islets of Langerhans / pancreas ;

7. insulin / glucagon, released ;

8. action taken by effector / correct action described (liver / muscle, cell) ;

9. restoration of, norm / set point / AW ;

10. ref. fluctuation around the norm ; [6 max]

(b) *endocrine*

11. hormones ;

12. chemical messengers ; **A** chemicals that transfer information

13. ductless glands / (released) into blood ;

14. target, organs / cells ;

15. ref. receptors on cell membranes ;

16. example of named hormone and effect ;

nervous

17. impulses / action potentials ; **R** electrical, signals / current

18. along, neurones ; **R** nerves

19. synapse (with target) / neuromuscular junction ;

20. ref. receptor / effector **or** sensory / motor, neurones ;

differences – endocrine

21. slow effect / **ora** ;

22. long lasting effect / **ora** ;

23. widespread effect / **ora** ;

24. AVP ; e.g. extra detail of synapse [9 max]

[Total: 15]

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