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

9700/41 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.

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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)** 1. similar, morphological / physiological / biochemical / behavioural, features ;

2. interbreed / reproduce, to produce fertile offspring ;

3. occupy same niche ;

4. reproductively isolated ; [2 max]

(b) *isolating mechanism* – geographical / land barrier / AW **or** behavioural / AW ; [1]

(c) 1. no, breeding / gene flow, between <u>populations</u> ;

2. (gene) mutations occur ;

3. different selection pressures / different (environmental) conditions ;

4. genetic change ; e.g. different alleles selected for / change in allele frequency / change in gene pool **/** advantageous alleles passed **on** ;

5. different chromosome numbers ;

6. genetic drift ;

7. do not recognise song ;

8. therefore cannot interbreed ;

9. <u>allopatric</u> (speciation) ; [5 max]

[Total: 8]

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2 (a) (i) 1. ref. antigen presenting cells ;

2. (antigen) A recognised as, non-self / AW ;

3. by B lymphocytes;

4. with appropriate, receptor / antibody / immunoglobulin ;

5. ref. clonal selection ;

6. (B lymphocytes) clonal expansion / mitosis / cell division ;

7. T-helper cells to stimulate B-cell (response) ;

8. release cytokine;

9. (B lymphocytes) mature into plasma cells ;

10. (plasma cells) secrete (anti-A) antibody ; [4 max]

(ii) plasma cell fused with, myeloma / cancerous / malignant, cell ; [1]

(iii) 1. B cells / plasma cells, will not grow in culture / cannot divide (AW) / short-lived ;

2. cancerous / malignant / myeloma, cells divide, indefinitely / continuously
or
hybridoma divides (AW) indefinitely ;

3. AVP ; e.g. to obtain, genetic material / genes / genomes, from both cells [2 max]

(iv) use of marker described (attached to, antigen A / specific mAB against mouse antibody); [1]

(b) (i) 1. all infliximab treatments reduce percentage with increased joint damage ;

2. (general trend) high dosage / more infliximab, percentage with increased joint damage lower
or
low dosage / less infliximab, percentage with increased joint damage higher ;

3. both increasing dosage & decreasing time intervals have an effect;

4. at high dosage increasing time interval shows, percentage with increased joint damage is similar / AW ;

5. at low dosage increasing time interval shows, the percentage with increased joint damage is less / AW;

6. 30.5% with no infliximab to 0.5 – 1.0% with most infliximab / 30% decrease ;

7. other comparative data ; [3 max]

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(ii) because small numbers involved / AW ; [1]

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

1. quick diagnosis;
2. than having to culture pathogen ;
3. (quicker diagnosis) so quicker treatment ;
4. less labour intensive (than culturing) ;
5. not all pathogens can be cultured ;
6. microscopic identification difficult ;
7. viruses difficult to identify ;
8. AVP ; e.g. ref. specificity **/** ref. non-pathogenic diseases [3 max]

[Total: 15]

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3 **(a)** 1. VNTRs with more repeats are, longer / greater mass ; **ora**

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

3. fragments / DNA, attracted to, anode / positive electrode ;

4. Shorter / lower mass / fewer repeat, pieces move, faster / further in unit time; **ora**

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

(b) *N.B. answer on Fig 3.2*
one band in exactly same place as given band ; *may be drawn thinner*

second band above the first ; [2]

(c) *to identify*
1. a carrier / heterozygote, before marriage ;

2. a carrier / heterozygote, before conceiving child ;

3. HbS HbS child *in utero* re: termination ;

4. HbS HbS child at birth re: treatment ;

5. ref. genetic counselling ; [3 max]

[Total: 8]

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4 **(a)** 1. anthers, outside flower / exposed, to allow wind to carry pollen away ;

2. long / flexible, filaments to allow wind to dislodge pollen ; **A** versatile anthers

3. no / small, petals to allow, anthers/ pollen, to be exposed to the wind ;

4. anthers large to produce large quantities of pollen ; [2 max]

(b) 1. (genetic) mutation / random changes (in corn borer) ;

2. caterpillars / corn borers, with mutation, more likely to survive / have selective advantage ;

3. (adults with this mutation) likely to breed ;

4. mutated gene / resistance <u>alleles</u>, passed on to next generation ;

5. increase in frequency of <u>allele</u> for resistance ; [3 max]

(c) <u>rr</u> ; [1]

(d) 1. when (non resistant) borers from outside breed with resistant borers, many offspring will not be resistant ;

2. because (many) offspring will be, Rr / heterozygous ;

3. detail, e.g. results of rr x RR **and** rr x Rr ; [2 max]

(e) **(i)** 1. much mixing ;

2. more marked females recaptured than marked males, showing more mixing of males ; **ora**

3. high percentage of recaptured borers were unmarked ;

4. unmarked borers come from different fields ;

5. ref. considerable variation between results for different trials ;

6. use of data from shaded columns ; [3 max]

(ii) 1. (HDR strategy needs) mating between borers from *Bt* fields with borers from outside ;

2. (results show) marked females had mated with marked males / only some marked females had mated with unmarked males ;

3. use of figures relating to above point ;

4. (this means that) many females mated with males from the same field ;

5. (so) many females from a *Bt* field would mate with males from *Bt* field;

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6. their offspring would all be, resistant / rr ;

7. ref. this reduces the effectiveness of the HDR strategy / fewer heterozygotes ;

[4 max]

[Total: 15]

5 **(a)** 1. (mostly) secreted, during the second half of the cycle / from day 14 onwards ;

2. maintains, lining of the uterus / endometrium ;

3. in preparation for implantation ;

4. inhibits, GnRH / development of new follicle ; **A** FSH / LH [3 max]

(b) **(i)** 32.6 - 32.8 <u>days</u> ; [1]

(ii) 1. high fat diet causes decrease in age of puberty ;

2. change in either mother or her offspring has an effect ;

3. (from 40% +) greater effect by changing mother's diet;

4. use of comparative figures ;

5. cannot assume that effect on humans would be the same as on rats ;

6. no data provided on change in diet in European girls ;

7. does not take into account other possible changes ;

8. AVP ; e.g. for mp 7 [4 max]

[Total: 8]

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6 **(a)** 1 large, so easy to detect ;

2 taken by collectors ;

3 destroyed due to smell ;

4 habitat destruction / named example ; e.g. effect of grazing / building / agriculture

5 AVP ; e.g. not easily pollinated / detail of *Rafflesia* / flowers infrequently [3 max]

(b) **(i)** diversity of ecosystems in a region ;

the number of different species in each ecosystem ;

the genetic diversity within populations of each species ; [1 max]

(ii) 1. (some, species / plants / animals may have) uses in the future ;

2. medical uses / example ;

3. resource material ; e.g. wood for building / fibres for clothes / food (for humans) / agriculture ;

4. ecotourism ;

5. maintain, gene pool / genetic diversity ;

6. prevention of natural disasters ;

7. aesthetic reasons ;

8. to maintain stability in, ecosystems / food chains ; [4 max]

[Total: 8]

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7 **(a)** correct symbols ; e.g. $\mathbf{X^A}$ = (allele for) red-eye
$\mathbf{X^a}$ = (allele for) white-eye

parental genotypes $\mathbf{X^A\ X^a}$ and $\mathbf{X^aY}$;

gametes $\mathbf{X^A}$ $\mathbf{X^a}$ $\mathbf{X^a}$ $\mathbf{Y}$;

offspring genotypes $\mathbf{X^A\ X^a}$ $\mathbf{X^A\ Y}$ $\mathbf{X^a\ X^a}$ $\mathbf{X^aY}$;

offspring phenotypes red-eyed female, red-eyed male, white-eyed female, white-eyed male ; [5]

(b) **(i)** passes **Y** chromosome onto son / passes **X** chromosome onto daughter ; [1]

(ii) heterozygous ; [1]

(iii) gene / allele, mutation ; [1]

[Total: 8]

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8 (a) (i) 1. 26 °C optimum temperature for, rubisco / enzyme of Calvin cycle ;

2. (at just over 40 °C) enzymes / rubisco, denatured ;

3. so less carbon dioxide fixed ;

4. reduction in Calvin cycle / AW ;

5. increased rate of transpiration / AW ;

6. so stomata close ;

7. less carbon dioxide uptake ;

8. oxygen more likely to combine with rubisco ;

9. so increased photorespiration ; [5 max]

(ii) curve of C4 drawn with optimum to the right of existing curve ; *1 mark*

1. C4 / sorghum, enzymes, have higher optimum temperature (than C3) ;

2. has leaf structural features to avoid photorespiration ;

3. adapted to hot climate ; *2 max* [3 max]

(b) (i)

light intensity /lux	total CO_2 uptake / µmol	rate of photosynthesis /µmol s^{-1}
5	36	1.8
10	84	**4.2**
13	104	**5.2**
15	120	**6.0**

all 3 correct = 1 mark [1]

(ii) axes correct ;
units ;
correct plotting ;
suitable curve ; *between 5 and 15 lux*

accept ecf from table [3 max]

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(iii) when a process is affected by more than one factor / AW ;

the rate of photosynthesis is, restricted by / AW, the factor that is nearest its lowest value ; [2]

(iv) light intensity ; [1]

[Total: 15]

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9 **(a)** 1. reduced, NAD / FAD ;

2. passed to ETC ;

3. inner membrane / cristae ;

4. hydrogen released (from reduced, NAD / FAD) ; **R** H_2

5. split into electrons and protons ;

6. electrons pass along, carriers / cytochromes ;

7. ref. energy gradient ;

8. energy released pumps protons into intermembrane space ;

9. proton gradient ;

10. protons pass through (protein) channels ;

11. ATP synthase / stalked particles ;

12. (ATP produced from) ADP and inorganic phosphate ;

13. electron transferred to oxygen ;

14. addition of proton (to oxygen) to form water / (oxygen) reduced to water ; [8 max]

(b) 15. organisms need energy, to stay alive / for metabolism / AW ;

16. ATP as, (universal) energy currency / described ;

17. light energy for photosynthesis ; **A** light dependent stage

18. light-dependent stage detail ;

19. light-independent stage detail ;

20. chemical energy ;

21. for anabolic reactions ;

22. named reaction; e.g. protein synthesis / starch formation

23. activation of glucose in glycolysis / described ;

24. active transport ;

25. detail; e.g. sodium - potassium pump /movement against a concentration gradient

26. mechanical energy / movement ;

27. detail ; e.g. muscle contraction / spindle

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28. temperature regulation ;

29. AVP ; e.g. bioluminescence / electrical discharge [7 max]

[Total: 15]

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10 (a) *many of these mps can be given from a labelled diagram*

1. (outer) cortex ;
2. medulla ;
3. pelvis ;
4. renal artery ;
5. renal vein ;
6. nephron / (kidney) tubule ;
7. renal capsule / proximal convoluted tubule (pct) / distal convoluted tubule (dct), in cortex ;
8. loop of Henle / collecting duct (cd), in medulla ;
9. glomerulus ;
10. afferent & efferent arterioles;
11. capillary network, surrounds tubule / in medulla ; [6 max]

(b) *mechanisms*

12. active transport ; **A** actively pumped / uses ATP
13. Na^+ , out of pct cells / into blood ;
14. (sets up) Na^+ ion gradient ;
15. facilitated diffusion ;
16. using protein carrier ; **A** transport protein
17. <u>cotransport</u> (from lumen to pct cell);
18. of, glucose / amino acids / ions;
19. osmosis ;
20. down water potential gradient ;
21. diffusion (in correct context) ;
22. down a concentration gradient ; *max 7*

adaptations

23. microvilli ; **A** brush border
24. many mitochondria ;

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25. tight junctions ;

26. folded, basal membrane / described ;

27. many, transport proteins / cotransporters / pumps;

28. AVP ; e.g. many aquaporins [9 max]

[Total: 15]

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