CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 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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Question **Expected Answers**

1 **(a)** **A** – palisade, mesophyll/cell/tissue/layer**;**

B – guard cell**;**

C – (sub-stomatal) air space**;**

[3]

(b) **(i)** 1. through the stoma(ta)**;**

2. by diffusion/description**;**

3. from the, atmosphere/air**;** [max 2]

(ii) ribulose bisphosphate**;**
I RuBP [1]

(iii) reduces/donates hydrogen **;** [2]
A H/hydrogen atoms/H^+ **AND** e^-
R H^+ / H_2

GP to TP **;**
A PGA to PGAL

[Total: 8]

2 **(a)** male mosquitoes do not, bite humans/feed on blood transmit disease
OR
only females, bite humans/feed on blood/transmit disease**;**

I GM male mosquitoes are not infected with the disease [1]

(b) 1. easier to, identify/screen**;**

2. more economical/time saving/labour saving**;**

3. resistance gene(s) can be passed to other bacteria**;**

4. idea of antibiotics no longer effective
OR requiring development of new, antibiotics/treatments**;** [max 2]

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(c) (i) production of tTA causes production of **more** tTA/AW**;** [1]

(ii) 1. promoter, initiates transcription/switches on gene**/**causes gene expression/AW**;**

2. ref. binding of, RNA polymerase/transcription factors**;**

3. otherwise gene has to be inserted near an existing promoter**;**

4. this is difficult to do/this may disrupt expression of existing gene**;**

5. in eukaryotes precise position of promoter important**;** [max 3]

(iii) 1. GM larvae do not die immediately**;**

2. so gives longer time for tTA, production/build up**;**

3. so tTA gets into environment (when GM larvae die) and kills non-GM larvae**;**

4. so (longer-lived larvae) compete with non-GM larvae (for, food/space)**;**

[max 2]

R ref. to larvae breeding

(d) (i) 1. chemical **A** has, similar shape to tTA/complementary shape to binding site**;**

2. so chemical **A** binds to, DNA/binding site, **AND** prevents tTA from binding**;**

3. chemical **A**, binds to/changes shape of, tTA
AND so prevents tTA binding to, DNA/binding site**;**

4. stops positive feedback/small quantity of tTA does not kill**;** [max 2]

5. chemical **A**, binds to/changes shape of/breaks down, tTA, so no longer toxic**;**

(ii) 1. GM males, mated/bred**;**
R with GM females

2. mosquitoes fed chemical **A;**

3. males, identified/separated**;**

4. ref. cloning**;** [max 2]

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(iii) 1. GM males die if they cannot get chemical **A;**

2. (if males mate), their offspring die**;**

3. only mate with, other *A. aegypti*/their own species**;** [max 2]

[Total: 15]

3 **(a)** 1. nutrients added **and** product removed at a steady rate/AW**;**

2. (so) volume kept constant**;**

3. organism kept at, exponential/log, phase of growth**;** [max 2]

(b) 1. (branched fungus tangles together in clumps so) too heavy for bubbles to, lift/stir
OR ref. to blocking**;**

2. difficult to, harvest/get desired texture**;**

3. mutant may be, harmful when eaten/toxic/allergenic**;**

4. mutant may produce, distasteful/coloured, substance**;**

5. mutant may be less productive**;**

6. mutant may have high concentration of RNA (which is difficult to lower)**;**

7. approval for sale only applies to original strain**;** [max 4]

(c) 864 kg**;** [1]

[Total: 7]

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4 (a) (i) 1. ATP is made, in the electron transport chain/by oxidative phosphorylation**;**

2. oxygen is the final electron acceptor**;**

3. in the, inner membrane of the mitochondrion/cristae**;**

4. transfer of electron (between electron carriers) provides energy**;**

5. energy used to pump hydrogen ions (into intermembrane space)**;**

6. creates proton gradient**;**

7. diffusion of hydrogen ions down their electrochemical gradient causes ATP to be synthesised**;**

8. ref. chemiosmosis/ATP synthase/stalked particles**;**

9. idea that if less oxygen (consumed/available) then fewer electrons transferred along the chain**;** [max 4]

(ii) 1. at high temperatures, reactions/enzyme activity/metabolism, faster**;**

2. because, molecules/enzymes/substrates, have more <u>kinetic</u> <u>energy</u>**;**

3. more frequent collisions**;**

4. therefore, respiration/Krebs cycle/electron transport chain/production of reduced NAD, take place at a faster rate**;**

5. idea of increase in rate of anabolic reactions (requiring more ATP)**;** [max 3]

(b) (i) 1. oxygen consumed = oxygen inhaled – oxygen exhaled**;**

2. measure oxygen consumption at rest (x) **and** after exercise stops (y)**;**

3. extra oxygen consumed/oxygen debt = y – x**;**

4. measure mass of lizard**;** [max 2]

(ii) 1. less (oxygen debt)(for *Varanus*)**; ora**

2. difference is greater at higher temperatures**;**

3. any two comparative figures at one temperature including units**;** [3]
A 102.0 cm^3 O_2 kg^{-1} at 30°C and 40°C

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(iii) 1. *Varanus* uses, less anaerobic/more aerobic, respiration (when running)**;**

2. more ATP produced per glucose molecule**;**

3. able to run for long time**;**

4. good chance of catching prey**;** [max 3]

(iv) *assume Varanus throughout*
1. larger surface area, in lungs/for gas exchange**;**

2. more oxygen absorbed into blood (per unit time)/faster rate of gas exchange**;**

3. more oxygen supplied to muscles (so oxygen debt lower)**;** [max 2]

[Total: 17]

5 (a) (indicates that they) have undergone meiosis I**;**

so are, haploid/n **;**
A 23 chromosomes [2]

(b) (i) water moved out of cells**;**

down water potential gradient/into a more concentrated solution/into a lower water potential**;**

(by) osmosis**;** [max 2]

(ii) (**B**) has, higher survival of oocytes after thawing/more successful fertilisations**;**

supporting figures**;**

*these should compare columns 1 or 2 with column 3 or 5 for both **A and B***
raw or manipulated data can be given [2]

(iii) idea of deferring, fertilisation/implantation**;**

idea of preserving oocytes from a woman who may lose her fertility due to medical treatment**;**

idea of fewer rounds of, hormone treatment/oocyte retrieval**;** [max 1]

[Total: 7]

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6 **(a)** **(i)** **A** – calcium ions ; **A** Ca^{2+} **R** calcium/Ca/Ca^{+}

B – sodium ions ; **A** Na^{+} **R** sodium/Na [2]

(ii) exocytosis; [1]

(iii) depolarisation (of post-synaptic membrane)/action potential ; [1]

(iv) 1. splits ACh;

2. into acetate and choline;

3. stops continuous depolarisation of postsynaptic membrane/AW;

4. choline recycled (into presynaptic neurone); [max 3]

(b) binds to/blocks, dopamine receptors (on postsynaptic membrane);

prevents depolarization (of postsynaptic membrane);

reduces **effect** of dopamine;

R reduces amount of dopamine [max 2]

(c) *ref 13 base deletion*
frame shift/alters reading frame (after mutation);

(so) all amino acids different **after** mutation;

3-D shape/tertiary structure, of protein changed;

(whereas) 21 base-pair deletion, loses 7 amino acids/no frame shift;

(whereas) substitution, may change only one amino acid/may be silent; [max 3]

(d) increased chances of, survival/breeding/mating;

provides a selective advantage;

allele passed on (to next generation);

allele increases in frequency over time;

natural selection; [max 3]

[Total: 15]

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7 (a) *sex-linked*
(gene) carried on, one sex chromosome/**X,** and not on, the other/**Y;**

gene
section of DNA/sequence of nucleotides/sequence of bases,
that codes for a (particular) polypeptide**;** [2]

(b)

parental phenotypes	*tortoiseshell female*		*black male*	
parental genotypes	X^BX^O		X^BY**;**	
gametes	X^B	X^O	X^B	**Y;**
offspring genotypes	X^BX^B	X^BY	X^BX^O	X^OY**;**
offspring phenotypes	**black female**	**black male**	**tortoiseshell female**	**orange male;**

[4]

(c) tortoiseshell is heterozygous**;**

males, heterogametic/only one **X** chromosome**;**

(therefore) only one copy of gene/only black or orange allele present**;** [max 2]

[Total: 8]

8 (a) 550(%)**;;**

allow one mark for $\frac{104 - 16}{16}$ *(x 100)* [2]

(b) 1. limiting/density dependent, factors or described**;**

2. reached carrying capacity/AW**;**

3. competition/AW**;**

4. for, food/nesting sites/resources**;**

5. large population attracts predators**;**

6. large population spreads disease more easily**;** [max 4]

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(c) 1. not many to begin with**;**

2. are carnivorous**;**

3. prey numbers fell**;**

4. slower reproductive rate**;**

5. more likely to migrate (to other areas)**;**

[max 2]

[Total: 8]

9 (a) 1. cultural/aesthetic / leisure, reasons**;**

2. moral/ethical, reasons **;** e.g. right to exist/prevent extinction**;**

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

4. (eco)tourism**;**

5. economic benefits**;**

6. ref. resource / species, <u>may have use in future</u>/AW**;**
e.g. medical use

7. maintains, food webs **/** food chains**;**
A description

8. nutrient cycling**;**

9. protection against erosion**;**

10. climate stability**;**

11. maintains, (large) gene pool**/**genetic variation**;**

12. scientific research**;** [max 7]

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(b) *advantages* (max 5)

13. can monitor health of mother;
14. can monitor development of foetus;
15. storage of, sperm/eggs/gametes;
16. artificial insemination;
17. IVF;
18. ref. surrogate mothers;
19. international cooperation;
20. genetic records kept;
21. can prevent extinction/extend range of a species/used in restoring ecosystem;

disadvantages (max 5)

22. unnatural environment;
23. stress in captivity;
24. behavioural changes;
25. reproductive cycles disrupted;
26. may reject selected mate;
27. examples of problems with release ;;
28. difficulty in finding food
    may not integrate into groups
    more susceptible to disease
    very little natural habitat left to release animals into [max 8]

[Total: 15]

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10 (a) 1. *in C3 plants at high temperature*
rubisco combines with oxygen**;**

2. less rubisco to combine with CO_2**;**

3. *in C4 plant such as maize*
idea of spatial separation of light-dependent stage from carbon fixation**;**

4. rubisco/RuBP, in bundle sheath cells**;**

5. kept away from, oxygen/air**;**

6. mesophyll cells, absorb CO_2**;**

7. CO_2 released to combine with RuBP**;**

8. avoid/reduce, photorespiration**;**

9. high optimum temperatures of enzymes involved**;**

10. Calvin cycle can continue**;**

11. AVP **;** e.g. CO_2 reacts with PEP
PEP carboxylase

[max 7]

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(b) 12. light energy absorbed by chlorophyll**;**
A photosystems/pigments

13. electron, excited/raised to higher energy level**;**

14. (electron) emitted by chlorophyll**;**
A photosystems/pigments

15. passes to electron, acceptor/carrier**;**

16. passes along, chain of electron carriers/ETC/Electron Transfer Chain**;**

17. energy released used to pump protons**;**
I ATP production here

18. into thylakoid space**;**

19. thylakoid membrane impermeable to protons**;**

20. proton gradient forms**;**

21. protons move down gradient**;**

22. through/using, ATP synthase/ATP synthetase**;**
R ATPase

23. enzyme rotates**;**

24. ATP produced from ADP and Pi**;**

[max 8]

[Total: 15]

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