CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9700 BIOLOGY

9700/43 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.

Cambridge will not enter into discussions about these mark schemes.

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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)

1 (a) X^RY and X^rX^r ;

X^R Y X^r (X^r) ; *allow ecf from incorrect parental genotypes*

X^RX^r and X^rY ; [3]

(b) (i)

phenotype of fly	O	E	O–E	$(O–E)^2$	$\frac{(O–E)^2}{E}$
red-eyed female	54	50	(+)4	16	0.32 ;
white-eyed male	46	50	(-)4	16	0.32 ;

0.64 ;
allow ecf [3]

(ii) probability is greater than 0.05 ; **A** chi squared smaller than 3.84

no significant difference ;

due to chance ; [max 2]

[Total: 8]

2 (a) (i) 1. coelacanth α chain has higher percentage of matches ;

2. with both adult and larval amphibians ;

3. coelacanth β chain has higher percentage of matches with larval amphibians (rather than adults) ;

4. figures to support mp1 or mp3 or mp6 (comparing coelacanth with lungfish);

5. supports closer relationship of coelacanth and amphibia ;

6. (but) lungfish β chain has higher percentage of matches with adult amphibian (than coelacanths) ;

7. does not support suggestion / supports closer relationship lungfish and amphibia ;
[max 4]

(ii) 1. larvae aquatic **and** adults (partly) terrestrial / AW ;

2. different oxygen concentration available ;

3. need haemoglobins with different oxygen affinities ; [max 2]

(b) (i) 1. idea of, unchanging / constant, environment ;

2. oxygen concentration acts as a selective agent ;

3. organisms best adapted to these conditions survive ; ora

4. extreme (phenotypes) selected against ;

5. ref. narrow range of genetic variation / allele frequency maintained ;

6. sketch graph ;

7. ref. mutation ; [max 3]

(ii) 1. ref. change in oxygen concentration ;

2. (low) oxygen concentration acts as selective agent ;

3. some individuals (in population) are better adapted ;

4. these are more likely to survive ; ora

5. <u>directional selection</u> ;

6. sketch graph ;

7. populations develop in different concentrations of oxygen ;

8. <u>disruptive selection</u> ;

9. sketch graph ;

allow either mp6 or mp9 but not both [max 3]

(c) 1. (same) species separated into separate populations ;

2. (by) geographical isolation / named example ;

3. prevents interbreeding between populations / no gene flow ;

4. ref. to different selection pressures ;

5. change in allele frequencies ;

6. eventually do not successfully interbreed ;

7. <u>allopatric speciation</u> ;

8. ref. to genetic drift / founder effect / different mutations / (different) new alleles ; [max 3]

[Total: 15]

3 **(a)** 1. <u>oxidative phosphorylation</u> ;

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

3. reduced to water / accepts hydrogen ion to form water ; **A** equation

4. so electron transport chain can continue ; ora

5. increases ATP production ; ora

6. in absence of oxygen only glycolysis continues ; [max 3]

(b) (i) 1. lipid releases most energy ;

2. because it has more, hydrogens / C-H bonds ;

3. per unit mass ;

4. hydrogens needed for, ATP production / chemiosmosis ; [max 3]

(ii) many more hydrogens available to, reduce / convert, oxygen to water ; [1]

[Total: 7]

4 (a) idea that sperm can survive for several days ;

so fertilisation can occur, at / after, ovulation ; [2]

(b) (i) low until around day 13 then one peak returning to low at around day 28 ;

peak around day 22 ; [2]

(ii) began: day 1 *and* ended: day 14 ; [1]

(c) (i) 1. ref. to irregularity of cycle ;

2. example of factor affecting cycle ; e.g. illness / travel / stress / synchronicity [2]

(ii) 1. avoid sexual intercourse when LH level high ;

2. can predict next LH surge ; [2]

(iii) 1. change in basal temperature (at ovulation) is only small ;

2. *idea of* continuous monitoring **/** avoids, misreading values / inaccuracy / missing temperature change ; ora for thermometer [2]

(d) 1. there is a possibility of becoming pregnant on most days of the cycle ;

2. guidelines should include more days before and after ovulation ;

3. not possible to become pregnant on days 1–3 and days 27–29 ;

4. *idea of* days 10 to 17 are centred around the highest probability ;

5. ref. to day 18 having same probability as day 10 ;

6. comparative figures ; e.g. probability on two different days

7. idea of women with irregular cycles have more variation (in fertile window) ; [max 4]

[Total:15]

5 (a) (i) 1. greater in teosinte (than in maize) ;

2. greater at 9 loci / less at 1 locus / except at locus 7 ;

3. greatest difference at locus 10 ;

4. use of comparative figures ; [max 2]

(ii) 1. artificial selection / selective breeding ;

2. humans carry out selection ;

3. of plants with desirable traits ;

4. not all <u>alleles</u> selected (in cultivated varieties) ;

5. increased homozygosity ;

6. *idea that* greater variety of alleles are needed to survive in the wild environment ; [max 3]

(iii) 1. wild plants have greater variety of, alleles / base sequences ;

2. could be useful for future breeding ;

3. example of use ; e.g. to cope with climate change / drought [max 2]

(b) 1. to avoid inbreeding depression ;

2. hybrids have, higher yields / hybrid vigour ;

3. avoids expression of harmful recessive alleles ;

4. ref. to genetic uniformity ;

5. (which) results in easier, cultivation / harvest / etc ; [max 3]

[Total: 10]

6 (a) (i) **B** ;

(ii) **E** ;

(iii) **D** ;

(iv) **A + F** ; *both required* [4]

(b) (i) Protoctista ; [1]

(ii) 1. ref. to voltage-gated sodium ion channels / ref. ligand gated channels ;

2. channels change shape (when, pd / voltage, changes) ;

3. open when, membrane depolarises / action potential arrives / neurotransmitter binds to receptors ;

4. sodium ions flood in ;

5. diffuses / down concentration gradient ;

6. channels close when membrane, repolarises / potential reaches +30mV ;

7. ref. to sodium-potassium pump ; [max 3]

(iii) 1. no, depolarisation / action potentials ;

2. *idea of* life-threatening paralysis **/** named consequence ;
e.g. cannot breathe / heart stops [2]

[Total: 10]

7 **(a)** **A** – photosystem II / P680 / PS II ;

B – photosystem I / P700 / PS I ; [2]
if photosystem given for both but wrong way round give one mark

(b) **(i)** 1. carbon dioxide fixation ;

2. production of GP ;

3. ref. to rubisco ; [max 2]

(ii) 1. reduction (of GP) / donates hydrogen ;

2. GP to TP ; [2]

(iii) 1. supplies, energy / phosphate ;

2. (to convert) GP to TP ;

3. (to) regenerate of RuBP ; [max 2]

[Total: 8]

8 **(a)** 7 500 ;;

allow one mark for correct working
allow one mark for 7.5 tonnes [2]

(b) 1. stop / reduce, fishing ; **A** correct ref. to quotas / moratorium

2. ref. to size of nets ;

3. ref. to methods of fishing ;

4. control pollution ;

5. education ;

6. captive breeding and release / restocking from fish farms ;

7. ref. to marine reserves ; [max 3]

[Total: 5]

9 active transport **/** diffusion ;

mass ;

phloem ;

dominance ;

decrease / reduce / lower ;

division / mitosis / elongation ;

elongation / division / mitosis ; [7]

[Total: 7]

10 (a) 1. (CF caused by) mutation ;

2. of CFTR gene ;

3. (CFTR) protein defective ;

4. (so) insert, normal / dominant, (CFTR) allele ;

5. into DNA ; **A** chromosome

6. in cells of respiratory system ; **A** named part of airway **Ignore** alveoli

7. ref. to vector ;

8. taken as spray / inhaled ;

9. use liposomes ;

10. use harmless virus ;

11. not all cells take up virus ;

12. may have unpleasant side-effects ;

13. effects are short-lived / treatment needs repeating ; [max 8]

(b) *counsellor:*

1. ref. to pedigree analysis ;

2. ref. to genetic screening / DNA analysis ;

3. detail of genetic screening ; e.g. tissue samples from adults / IVF and test embryos/ amniocentesis

4. explains results of tests **/** estimates chances of having affected child ;

5. (may discuss) termination ;

6. (may discuss) alternative, therapies **/** treatments ;

7. (may discuss) financial implications (of having affected child) ;

8. (may discuss) the effect of having affected child on existing siblings ;

9. (may discuss) ethical issues ; *max 6*

couple referred if:

10. either has genetic disease (in family) or are carriers ;

11. history of recurrent miscarriages ;

12. older woman ; [max 7]

[Total: 15]

11 (a) 1. rise in blood glucose concentration detected by β cells ;

2. (β cells) in, islets of Langerhans / pancreas ;

3. insulin released into blood ;

4. binds to receptors in cell surface membrane ;

5. ref. to liver / muscle, cells ;

6. increase in uptake of glucose (by cells) /
(cell surface) membrane more permeable to glucose ;

7. increase in use of glucose in respiration ;

8. (increase in) conversion of glucose to glycogen ;

9. blood glucose concentration falls ;

10. inhibits, glycogen / lipid / amino acid, breakdown ; [max 6]

(b) 1. (stick / kit) dipped in (early morning) urine sample ;

2. hCG / urine, moves up strip ;

3. idea that hCG acts as antigen ;

4. (mobile) antibody also bound to, indicator / gold ;

5. (mobile) antibody in stick binds to hCG ;

6. ref. to variable region (of antibody) ;

7. ref. to specificity (of antibody) ;

8. ref. to monoclonal (antibody) ;

first window or region
9. second antibody is, immobilised / fixed ;

10. first antibody and hCG complex binds to second antibody ;

11. coloured band indicates pregnancy ;

second window or region
12. immobile antibody binds to mobile antibody-gold complex ;

13. second coloured band shows strip is working ; [max 9]

[Total: 15]