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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

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)

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

(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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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;

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

(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]

© University of Cambridge International Examinations 2012

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

© University of Cambridge International Examinations 2012

28. temperature regulation ;

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

[Total: 15]

© University of Cambridge International Examinations 2012

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. cotransport (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 ;

© University of Cambridge International Examinations 2012

25. tight junctions ;

26. folded, basal membrane / described ;

27. many, transport proteins / cotransporters / pumps;

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

[Total: 15]

© University of Cambridge International Examinations 2012

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

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)

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

(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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

(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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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 ;

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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

9700/43 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 must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

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)

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

(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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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;

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

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]

© University of Cambridge International Examinations 2012

(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]

© University of Cambridge International Examinations 2012

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

© University of Cambridge International Examinations 2012

28. temperature regulation ;

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

[Total: 15]

© University of Cambridge International Examinations 2012

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. cotransport (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 ;

© University of Cambridge International Examinations 2012

25. tight junctions ;

26. folded, basal membrane / described ;

27. many, transport proteins / cotransporters / pumps;

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

[Total: 15]

© University of Cambridge International Examinations 2012