

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9700 BIOLOGY

9700/43

Paper 4 (A2 Structured Questions), maximum raw mark 100

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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) |
| <u>underline</u> | actual word given must be used by candidate (grammatical variants accepted) |
| 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) **W** = ethanal ; **A** acetaldehyde / C_2H_4O

X = carbon dioxide ; **A** CO_2

Y = reduced NAD ; **A** $NADH/NADH_2/NADH^+ + H^+$

[3]

(ii) *in yeast cells – or for muscle cells*

1 ethanol produced as opposed to, lactate / lactic acid ;

2 irreversible ;

3 different dehydrogenases involved / reduction of ethanal instead of pyruvate / AW ;

4 two steps / two enzymes involved / decarboxylation / ref. to (pyruvate) decarboxylase / CO_2 production ;

[max 2]

(b) *fewer ATP molecules produced*

no / fewer, protons / H^+ , move through, ATP synth(et)ase / stalked particles

or

less steep, proton / H^+ , gradient ; **I** chemiosmosis

more heat energy released

H^+ gradient / electron flow / ETC, energy converted to, heat / thermal energy ;

constant oxygen uptake

ETC still works / oxygen acts as final electron acceptor ;

I oxidative phosphorylation still works

[3]

[Total:8]

2 (a) 1 NicVAX / vaccine, recognised as, non-self / foreign ;

2 ref. to antigen presenting cells ;

3 (recognised / bound, by), specific / particular / certain, B-lymphocytes ;
I correct / right

4 clonal selection ;

5 clonal expansion / mitosis / cell division, of B-lymphocytes ;

6 T-helper cells stimulate B-lymphocytes ;

7 T-helper cells release cytokine ;

8 B-lymphocytes, become / mature into, plasma cells ;

9 plasma cells, secrete / produce, antibody ;

A *B-cell for B-lymphocyte throughout*

[max 5]

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(b) 1 plasma cells/B-lymphocytes, extracted from (mouse) spleen ; **I** blood
 2 fused with, myeloma/cancerous/tumour/malignant, cells ; **I** 'mixed with'
 3 use of, a fusogen/electrofusion ; **A** EFF–AFF/detergent
 4 formation of hybridoma cells ;
 5 identify hybridoma cells with, specific/anti-nicotine/relevant, antibody ;
 6 large-scale culture/grow in fermenter ;
 7 AVP ; e.g. detail of cell identification [max 4]

(c) (i) increase from 0 to 30 mins
or
 rapid/stEEP, increase from 0 to 15 mins ;
 (from 30 mins) decrease then, gradual/slow/gentle, increase ; **I** steady [2]

(ii) 1 (both) antibodies reduce nicotine (concentration in the fetal circulation) ;
 2 at specified time quote concentration for nicotine and **either** Nic-IgG **or** Nic311 plus units
or
 compare maximum concentrations for nicotine = 12.5 ng cm^{-3}
and Nic-IgG = 2.0 ng cm^{-3}
and Nic311 = 5.5 ng cm^{-3} ;
units need to be quoted once only
 3 lower nicotine (concentration) gives fewer adverse side-effects in the fetus ;
 4 Nic-IgG, is more effective/
 reduces the fetal nicotine (concentration) to a lower level, (than Nic311) ;
 5 AVP ; e.g. do not know concentration of nicotine that is harmful to fetus/
idea that nicotine still present in fetal circulation [max 3]

(d) pregnancy testing/diagnosis of disease/treatment of disease/delivery of drugs/
 blood or tissue typing ;
I monoclonal antibodies kill pathogens [1]

[Total:15]

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3 (a) (i) 1 expose salmon to, IPN/virus ;

2 (humans) select/choose/identify, unaffected/resistant, individuals ;
A survivors

3 breed them together ;

4 repeat for several generations ; [max 3]

(ii) 1 increase in homozygosity ;

2 harmful recessive alleles may be expressed ;

3 inbreeding depression/loss of hybrid vigour ;

4 limited gene pool/decrease in genetic variation ;

5 AVP ; e.g. loss of desirable traits [max 2]

(b) (i) accept **ora** throughout

1 comparative statement that group **A**, have lower percentage mortality ;

2 after 30 days no more in group **A** die
or
rise in deaths in group **B**, throughout/until 45 days ;

3 at specified time in days quote mortality for both **A** and **B** plus % unit ;
A 'percentage mortality' for unit

4 (more) resistance/less susceptibility, (to IPN) in group **A** ;

5 ref. to resistance allele(s) ; **A** resistance gene **R** immunity/tolerance

6 infection spreads throughout/reservoir of infection in, group **B** ; [max 4]

(ii) another, disease/pathogen, could be present ;
by chance/random event ; e.g. pollution/temperature variation [max 1]

[Total:10]

4 (a) 1 identify females, with the recessive allele/who are carriers ;

2 if embryo has allele can choose abortion ;

3 select unaffected IVF embryo (to implant) ; **A** pre-implantation genetic diagnosis

4 women can choose not to have children ; [max 2]

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(b) (i) 1 insert a, functional/normal/dominant/correct, allele ;
R remove/replace, faulty allele **I** gene

2 to obtain, functional/normal/correct, protein/polypeptide ;
A e.g. clotting factor

3 reduce the symptoms (of the disorder) ;

4 restore/modify/enhance, cellular functions ;
A e.g. enzyme reaction/clotting process/membrane transport

5 increase, quality of life/life expectancy/survival ; **A** live normal life

penalise germ-line therapy once only [max 2]

(ii) 1 caused by a recessive allele ;

2 serious/common, disorder ; [max 1]

(c) (i) 1 *F9* gene is shorter ;

2 easier to insert into, plasmid/vector/adenovirus ;

3 easier to enter nucleus ; **I** into cell

4 easier to integrate into genome ;

ora throughout for F8 gene [max 2]

(ii) *adenovirus advantage*
1 (double-stranded) DNA so no, reverse transcription/making cDNA;
I single-stranded to double-stranded step alone

2 high gene expression so produce more (therapeutic) protein ;

adenovirus disadvantage

3 high immune response so adenovirus may be removed before it reaches target cells ;

4 high immune response so, allergies/side effects ; [max 3]

[Total:10]

5 (a) (i) 1 diversity of, habitats/ecosystems ;

2 number of different species ;

3 genetic diversity within a species ; [max 2]

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(ii) 1 maintain, food chains/food webs
or
 maintain, stability/balance, in ecosystems ; **I** ecological

2 maintain, genetic diversity/genetic variation/gene pool ;

3 resources (for humans) ; e.g. biofuel/food/medicine/wood

4 aesthetic reasons/(eco)tourism ;

5 maintain, nutrient cycle/soil structure/climate stability ; [max 3]

(b) (i) between 1970 and 1990

1 in terrestrial, as protected areas increase, biodiversity decreases
A negative correlation/inversely proportional

2 in marine (general trend) as protected areas increase, biodiversity increases ;
A positive correlation

3 exceptions ; e.g. dip, from 1980/till 1985 (in marine)/
 rise, from 1970/till 1975 (in terrestrial) ;

between 1990 and 2005

4 **in both habitats** as total area protected increases, biodiversity decreases ; [max 3]

(ii) 1 marine environments are difficult to, patrol/monitor ;

2 lack of public, awareness/interest ;

3 international ownership issues ; **A** example

4 difficult to, set/mark/recognise, boundaries ;

5 AVP ; e.g. problem of mobile populations [max 2]

[Total:10]

6 (a) G ;

C ;

J ;

B ;

[4]

(b) (i) 515 (%) ;;

allow one mark for working

e.g.
$$\frac{14.76 - 2.40}{2.40} (\times 100) \text{ or } \frac{12.36}{2.40} (\times 100)$$

[2]

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(ii) *high protein diet*

- 1 hydrolysed/digested, to amino acids (in gut) ; **A** broken down
- 2 excess amino acids cannot be stored ;
- 3 deaminated (in liver)/ornithine cycle, to produce urea ;
- 4 more urea in blood filtered into nephron(s) ;

[max 2]

[Total:8]

7 (a) (i) 1 more light absorbed by chlorophyll ;

- 2 short/blue, wavelengths have more energy ; **ora**

A suitable figures for **X** (in range 400–500nm)
or for **Y** (in range 600–700nm)

- 3 (so) greater rate of photosynthesis ;

[max 2]

(ii) 1 contain chlorophyll ;

- 2 reflects/does not absorb, green light ; **A** reflects/does not absorb, 500–600 nm

[2]

(iii) 1 absorbs light, wavelengths/colours, not absorbed by, primary pigment/reaction centre/P680/P700 ;

- 2 passes (light) energy to, primary pigment/reaction centre/P680/P700 ;

[2]

(b) 1 decrease in rate of photosynthesis ; **A** photosynthesis stops

- 2 rubisco/enzyme, denatured ;

- 3 less/no, carbon dioxide, fixed/binds to RuBP ;

- 4 (initial) increase in transpiration ; **A** high transpiration

- 5 loss of turgor/wilting ;

- 6 ABA production ;

- 7 (eventually) stomata close ;

- 8 reduction in carbon dioxide uptake ;

- 9 photorespiration/rubisco binds to oxygen instead of carbon dioxide ;

[max 5]

| | | | |
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(c) rubisco / RuBP carboxylase-oxygenase ;
 thylakoids ; I membranes
 DNA ;
 ribosomes ; A 70S R 80S [4]

[Total:15]

8 (a) NNGG

NNGg

NnGG

NnGg ;;

4 correct = 2 marks

2/3 correct = 1 mark

[2]

(b) 1 test cross ;

2 cross fly with, vestigial wing and ebony body fly

or

double/homozygous, recessive fly / nngg fly ;

3 if some offspring have vestigial wing and/or ebony body genotype is heterozygous ; A if, some offspring have recessive trait/not all offspring have dominant trait, genotype is heterozygous

4 if offspring all have normal wing and/or grey body genotype is homozygous ;
 A if offspring all have dominant trait genotype is homozygous

A short for vestigial and black for ebony throughout

[max 3]

(c)

| | | | | |
|----------------------|-------------------------------|-------------------------------|---------------------------------|--------------------|
| parental genotypes | (white male) | | (red female) | |
| | X ^w Y | | X ^R X ^o ; | |
| gametes | X ^w | Y | X ^R | X ^o ; |
| offspring genotypes | X ^R X ^w | X ^o X ^w | X ^R Y | X ^o Y ; |
| offspring phenotypes | red-eyed female | orange-eyed female | red-eyed male | orange-eyed male ; |

wrong symbols = 0

superscript R on Y chromosome = 0

superscripts w/o on Y chromosome = 1 (for correct line 4)

no X and Y = max 2 (for correct lines 3 and 4)

ecf alleles written as subscripts not superscripts = max 3

ecf superscript R written as small r = max 3

[4]

[Total:9]

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9 (a) 1 germinal epithelial cells form oogonia ; **A** primordial germ cells form oogonia

2 by mitosis ; **A** mitosis increases number of oogonia

3 *ref. to* germinal epithelial cells/oogonia, are, diploid/2n ;

4 oogonia , grow/mature ;

5 (oogonia) start meiosis to form primary oocytes ;

6 meiosis stops at prophase 1 ;

7 stage, 1/2/3/4/5/6, occurs in, embryo/fetus ;

8 many primary oocytes in baby girl at birth ;

9 primary oocyte completes meiosis I ;

10 at/after, puberty ; **A** correct *ref. to* each menstrual cycle/before ovulation

11 produces secondary oocyte and (first) polar body ;

12 products (of meiosis I) are two haploid cells ;

13 secondary oocyte undergoes meiosis II at fertilisation ;

14 produces ovum and (second) polar body ;

15 AVP ; e.g. *ref. to* events occur in follicles

correct names required for all mp except mp6, mp7, mp10, mp12 and mp15

[max 9]

(b) 1 fall in concentration of progesterone ;

2 endometrium (uterine lining) breaks down ; **I** 'thins'

3 menstruation/period, occurs ;

4 follicular/granulose, cells secrete oestrogen ; **I** oestrogen produced

5 oestrogen concentration rises ;

6 (oestrogen) stimulates, proliferation/thickening/increase in blood vessels, of endometrium ;

7 corpus luteum secretes progesterone ; **I** progesterone produced

8 progesterone concentration increases ;

9 (progesterone) maintains endometrium ; **I** 'thickens'

[max 6]

[Total:15]

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10 (a) 1 hybrids/offspring from cross between two species, infertile/sterile ;
A AA × BB gives, sterile/infertile, AB

2 (normal) meiosis cannot occur ;

3 chromosomes do not pair up ;
A set A chromosomes, not homologous to/do not pair with, set B

4 (spontaneous) doubling of chromosome number/formation of, tetraploid/AABB (emmer wheat) ; **A** chromosome doubling
I doubling idea for mp 4 if context **not** chance occurrence but **ecf** for mp 6

5 non-disjunction (in mitosis) ; **A** in meiosis (unreduced gametes)

6 restores fertility/(AB) gametes can now form ; *must be linked to mp 4*

7 second hybridisation **and** polyploidy gives, hexaploid ;
A 4n (emmer wheat) × 2n (wild goat grass) **and** chromosome number doubling → 6n
A AABB × CC → ABC **and** doubling to AABBCC

benefits

8 hybrid vigour ;

9 large grains ;

10 high yield ;

11 beneficial characteristic/named example, introduced by parent of hybrid ;
A example e.g. shorter stems plus benefit/
 grain remains attached to ear more strongly plus benefit

[max 8]

| | | | |
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(b) environmental

- 1 GM/genetically modified, rape may itself be, a weed/invasive ;
- 2 pollen transfer to/hybridisation with, wild relatives ;
- 3 resistant gene transfer to, non-GM crops/wild relatives ; **I** other plants
- 4 (resulting) hybrid offspring invasive ;
- 5 (intensive) use of herbicide selects for herbicide-resistant weeds ;
- 6 (intensive use of herbicide) reduces biodiversity ;

economic

- 7 problem with competition between crops and herbicide-resistant weeds ;
- 8 *idea of*, contamination of organic farming/
accidental mixing of GM crops with non-GM, financial consequences ;
- 9 high cost of/poor farmers cannot afford, GM, seeds/plants ;
- 10 cost of herbicide ;
- 11 cost of problems with pollution ;
- 12 cost of human health problems ;

[max 7]

[Total:15]