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

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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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 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)

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 – **ora** 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]

(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]

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]

(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]

(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. $\frac{14.76 - 2.40}{2.40}(\times 100)$ or $\frac{12.36}{2.40}(\times 100)$ [2]

(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) <u>energy</u> to, primary pigment / reaction centre / P680 / P700 ; [2]

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

2 rubisco / enzyme, <u>denatured</u> ;

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]

(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)* $\mathbf{X^wY}$	×	*(red female)* $\mathbf{X^RX^o}$ **;**	
gametes	$\mathbf{X^w}$	**Y**	$\mathbf{X^R}$	$\mathbf{X^o}$ **;**
offspring genotypes	$\mathbf{X^RX^w}$	$\mathbf{X^oX^w}$	$\mathbf{X^RY}$	$\mathbf{X^oY}$ **;**
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]

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]

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]

(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]