CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the March 2016 series

9700 BIOLOGY

9700/42 Paper 4 (A Level Structured Questions), maximum raw mark 100

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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) light intensity ; [1]

(ii) (when) a process is affected by more than one factor ;
the factor that prevents any further increase in the rate of the process ;
[2]

(iii) some other factor becomes limiting ;
named example of appropriate limiting factor ;
e.g. carbon dioxide concentration
temperature
[2]

(b) 1 rubisco / enzymes, denatured / AW ;
2 less, photolysis / ATP produced / light-dependent stage / Calvin cycle ;
3 less carbon dioxide fixed ;

4 increase in transpiration ;

5 photorespiration / AW ;

6 stomata close ;
7 reduction in carbon dioxide uptake ;

8 loss of turgor / wilting ;
[max 4]

[Total: 9]

2 (a) 1 ferrets feed on, prairie dogs / one type of prey
or
badgers feed on prairie dogs and range of other animals ;
2 reduction in prairie dog population decreases number of ferrets (more than badgers) ;
3 ferrets have many predators
or
badgers have no predators ;
4 predators decrease number of ferrets more than badgers ;
[max 2]

(b) 1 (local government) authorities, education / pass protection laws / create protected zones ;

2 (universities) carry out research ;

3 example of relevant research ;
e.g. improve success of breeding programme
do IVF
monitor genetic variability
coordinate stud records
determine suitable habitat requirements for release sites
monitor wild populations

4 (zoos) run captive breeding (programmes) / description ;

5 native Americans / reservations / tribes, provide suitable habitat ;

[max 3]

(c) (i) 1 South Dakota increased, continuously / steeply ;
2 Wyoming constant initially then decreased (to 10) before increasing ;
3 Arizona population (very low level then), recovering / increasing ;
4 comparative figs ;
e.g. same site in 2 years or 2 sites in 1 year

[max 3]

(ii) 1 Wyoming ferret bone lengths smaller ;
2 Wyoming has lost, alleles / genetic variability / polymorphism
or
gene pool decreased ;
3 Arizona has gained, alleles / genetic variability / polymorphism
or
gene pool increased ;

[max 2]

(iii) 1 (Wyoming reduced size may be due to) less food available / inbreeding ;
2 (Wyoming smaller gene pool due to) very small population size ;
3 (Arizona extra allele due to, chance / random) mutation ;

[3]

(d) 1 increases number of, breeding stock / potential mates ;
2 larger gene pool / increase in genetic variation ;
3 sperm transported to other, zoos / breeding facilities ;
4 (frozen / stored), sperm acts as gene bank ;
5 alleles available from animals no longer alive ;

[max 3]

[Total: 16]

3 **(a)** 1 (Ca^{2+}) released from sarcoplasmic reticulum **;**
2 binds to troponin **;**
3 (troponin) changes shape **;**
4 tropomyosin is, displaced / AW **;**
5 (myosin) binding sites exposed **;**
6 myosin head now, binds / attaches / joins, to actin **;**
7 AVP **;** e.g. ref. myosin pulls actin

[max 4]

(b) 1 reduces release of, ACh / neurotransmitter, (by presynaptic neurone) **;**

2 prevents binding / less binding, of ACh (on postsynaptic membrane / sarcolemma) **;**

3 therefore no depolarisation (of postsynaptic membrane / sarcolemma) **;**

4 binds to receptors on, postsynaptic membrane / sarcolemma **;**
5 ref. competes with, ACh / neurotransmitter
or
prevents Ach from binding **;**
6 inhibits depolarisation of, postsynaptic membrane / sarcolemma **;**

7 inhibits (acetyl)cholinesterase / AW **;**
8 ACh not broken down **;**
9 permanent depolarisation of, postsynaptic membrane / sarcolemma **;**
accept mp9 with either mp8 or mp4

[max 4]

[Total: 8]

4 **(a)** 1 female gametogenesis begins before birth **and** male begins at puberty **;**
2 female 1 ovum **and** male 4 spermatids / spermatozoa **;**
3 female, meiosis is interrupted / delay occurs
and male, meiosis continuous process / not interrupted **;**
4 female fertilisation needed to complete meiosis **;**
5 greater number of gametes produced in males / AW **;**
6 males can produce gametes to a greater age / AW **;**

[max 3]

(b) **(i)** locus **R ;**
mutation **;**

[2]

(ii) 1 (all) parents / **A B C ;**

2 *supporting data:*
A at, loci **P**, **Q** and **R / 3** loci
B at, loci **P** and **S / 2** loci
C at, loci **P**, **Q** and **R / 3** loci **;**

3 offspring **5** at, loci **P** and **R / 2** loci **;**

[3]

(iii) 1 *(not clones because):*
offspring **1** and **2** differ at loci **P**, **Q** and **R**
or
offspring **3** and **4** differ at loci **P** and **S ;**

2 *(not asexual and mitosis because):*
offspring **1** and **2** different to **A** at loci **P**, **Q** and **R**
or
offspring **3** and **4** different to **B** at loci **P** and **S ;**

[2]

(c) *advantages (max 3):*
1 (small island population therefore) mates may be scarce **;**
2 female can still reproduce (without male) to continue, population / species **;**
3 offspring all male so female could then mate with sons **;**
4 retains adaptations for that environment / AW **;**

disadvantages (max 3):
5 reduction in genetic variation / small gene pool **;**
6 decreased heterozygosity **;**
7 harmful recessive alleles may come together **;**
8 lack of hybrid vigour / inbreeding depression **;**
9 cannot adapt to changing environment **;**

[max 4]

[Total: 14]

5 (a) (i) negative feedback **;** [1]

(ii) glucagon **;** [1]

(b) 1 (blood) glucose concentration, rises / high **;**
2 insulin released **;**
3 more glucose enters liver cells **;**
4 (leads to) increased activity of glycogen synthetase **;**
5 glycogenesis / AW **;**
6 decrease in activity of glycogen phosphorylase **;**
7 reduced glycogenolysis / AW **;**

[max 5]

[Total: 7]

6 (a) (i) 1 calcium ion channels open / membrane more permeable to Ca^{2+} **;**
2 calcium ions, diffuse in / move in down a concentration gradient **;**
3 cilia beat in opposite direction **;**

[max 2]

(ii) 1 active transport / pump **;**
2 (Ca^{2+}) against concentration gradient **;**
3 using ATP **;**

[max 2]

(b) (i) osmosis **;** [1]

(ii) the higher the water potential, outside / in the surrounding water, the faster the rate of contraction / AW **;** [1]

(c) 1 linear **;**
2 associated with, protein / histones **;**
3 contained in nucleus / surrounded by nuclear envelope **;**
4 AVP **;** e.g. present in mitochondria

[max 2]

[Total: 8]

7 (a) (i) **S** **;**
R **;**
S **;**

[3]

(ii) *has genes that code for:*
mitochondrial proteins **;**
mitochondrial enzymes **;**
mitochondrial replication **;**
rRNA **;** **A** ribosomes **A** tRNA **R** mRNA

[max 1]

(b)

substance that **enters** the mitochondria	substance that **leaves** the mitochondria
oxygen	carbon dioxide
pyruvate	ATP
ADP	water
phosphate / Pi	
fatty acids	

mark first answer in each box **;** **;** **;**
6 boxes correct = 3 marks
4 / 5 boxes correct = 2 marks
2 / 3 boxes correct = 1 mark

[max 3]

(c) *max 3 from mp1–mp5*
1 ETC / electron transport chain, stops **;**
2 Krebs cycle / link reaction, stops **;**
3 no proton gradient set up **;**
4 no proton flow through ATP synthase **;**
5 less / no, ATP produced **;**

6 named muscle fails to contract **;** e.g. heart / intercostals

[max 4]

(d) (i) 0.70 **; ;**
allow one mark for working 102 ÷ 145

[2]

(ii) 1 respire aerobically **;**
2 mixture of substrates / named mixture **;**
3 different tissues respire different substrates **;**

[max 2]

[Total: 15]

8 (a) *dominant:*
an allele that is expressed in (homozygotes and) heterozygotes / AW **;**

allele:
one of two or more alternative nucleotide sequences at a single gene locus / variant forms of a gene **;**

[2]

(b) (i) *brown, non-banded:*
C^BC^YNn ;

pink, non-banded:
C^PC^YNn ;

[2]

(ii) *brown, non-banded:*
C^BN C^Bn C^YN C^Yn ;

pink, non-banded:
C^PN C^Pn C^YN C^Yn ;

[2]

(iii) **C^YC^Ynn ;** [1]

(iv) 1 / 16 **or** 0.0625 **or** 6.25% **or** 1:15 **;** [1]

[Total: 8]

9 (a) 1 emits bright light ;
2 when exposed to UV light ;
3 visible colour change ;
4 add marker gene to the, vector / plasmid ;
5 easy to identify transformed bacteria ;
6 gene of interest inserted, into / close to, marker gene ;
7 easy to identify recombinant, DNA / plasmid ;
8 easy to identify transgenic organisms ;
9 examples ; e.g. GFP / β galactosidase / GUS
10 idea of no known risk ;

[max 6]

(b) 1 increase, food production / crop yields ;
2 improve food, quality / taste / keeping properties ;
3 add nutrients to crop (to improve human health) ;
4 crops may be more tolerant to climate change ;
5 crops, can be grown in poor quality land / do not need as much fertiliser ;
6 pest / insect / fungal disease, resistance (increases crop growth) ;
7 less pesticide used ;
8 benefit to farmer ; e.g. cost effective / health benefit
9 benefit to environment ; e.g. less effect on food chains, pollinators
10 herbicide resistance reduces competition from weeds ;
11 could engineer nitrogen-fixing ability in non-leguminous crops ;
12 specific examples (crop variety and enhancement described) ; ;
+ e.g. Golden Rice™ for extra vitamin A
13 Bt maize / Bt cotton, kill (named) leaf-eating insects
Flavr Savr tomato, stores better / can ripen on vine

[max 9]

[Total: 15]

10 (a) 1 normal, gene / allele ;
2 (insert into) vector ;
3 liposomes (as vectors) ;
4 liposomes in, aerosol / inhaler ;
5 liposome fuses with host cell ;
6 virus (as vector) ;
7 virus vector harmless ;
8 short term effect ;
9 repeat treatments needed ;
10 side effects ;

[max 7]

(b) 1 information about the increased risk of person having genetic conditions ;
2 ref. breast cancer / named example ;
3 allows people to prepare for late onset genetic conditions ;
4 ref. Huntington's disease / Alzheimer's disease / named example ;
5 identify whether fetuses are going to develop a genetic condition ;
6 so can give early treatment when born ;
7 allows parents to prepare for the birth of a child who will need treatment for a considerable time or even throughout life / AW ;
8 identifies carriers of genetic conditions ;
9 helps to provide early diagnosis ;
10 allows couples who are both carriers of a genetic condition to make decisions about starting a family / having more children / seeking IVF ;
11 AVP ; e.g. termination

[max 8]

[Total: 15]