CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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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 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)** transport proteins – **Y ;**

pigments – **X ;** [2]

(b) *DNA*
codes for, proteins / polypeptides / enzymes **;**

one example of protein or enzyme **;**
e.g. rubisco / electron acceptor / ATP synthase / transport

ref. transcription / mRNA **;** [max 2]

(c)

factor	stage	✓or ×
carbon dioxide concentration	Calvin cycle	✓
	photolysis	×
light intensity	Calvin cycle	×
	photolysis	✓
temperature	Calvin cycle	✓
	photolysis	×

;;;

all 6 correct = 3 marks
4 or 5 correct = 2 marks
2 or 3 correct = 1 mark [3]

[Total:7]

2 **(a)** presence of C base in DNA (code) changes amino acid (in myostatin) **;**

myostatin in CC horses, is inactive / not produced **; ora for TT**

in CC horses muscle, differentiation / growth, has not been slowed **; ora for TT** [max 2]

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(b) CC genotype does best in short races ;

data quote ; e.g. 75% winners at 1.0 km ;

TT genotype does better in longer races ;

data quote ; e.g. about 60% of winners at 2.6 km

CT genotype has some winners at all distances ;

CT does best at 1.8 km ; [max 4]

(c) (i) by humans ;

individuals with desired features chosen to breed / AW / named example ; [2]

(ii) can choose parents genotypes to breed ;

CC for racing short distances / TT for racing long distances / CT as all-rounders ;

ref. need to keep all three genotypes in population ; [max 2]

[Total:10]

3 (a) (i) idea of sugars unable to pass through phospholipid bilayer ;

hydrophilic / polar / not lipid-soluble / water soluble ;

large ; [max 2]

(ii) forms bonds with hydrophilic heads (of phospholipids) ;

hydrophobic parts of SWEET ;

bond with, fatty acid chains / hydrophobic tails, (of phospholipids) ;

ref. hydrogen bonding / ionic bonds / hydrophobic interactions ; [max 3]

(b) (i) (SWEET) gene cannot be switched on ;

no SWEET (protein) produced ;

no, glucose / sugar, secreted (into intercellular spaces) ;

(so) Xoo / bacteria, do not multiply / numbers remain low ;

(small numbers of Xoo / bacteria) so no disease ; [max 3]

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(ii) allele is recessive **;**

idea of not expressed when dominant allele present **;**

ref. promoter **;** e.g. normal promoter must be inactivated or removed / must transfer mutated promoter [max 2]

(iii) prevents <u>diffusion</u> of air (from leaves to roots) **;**

ref. aerenchyma **;**

roots respire anaerobically **;**

(so) less ATP produced (for growth) **;**

bacteria use of oxygen **;**

more ethanol produced may be beyond tolerance / **AW ;** [max 4]

[Total:14]

4 (a) details of electrophoresis **;;**

any 2 from
DNA cut by, restriction enzyme(s) / endonuclease(s)

loaded (into wells) at, negative end / cathode end, (of gel)

ref. buffer / electrolyte

(negatively charged) DNA attracted to, anode / positive electrode

separation due to, electric field / potential difference

short pieces / smaller mass, move further (in unit time) / move faster **ora**

fluorescent / radioactive, DNA probes

compare, DNA sequences / bands, (of male lizard and hatchling) **;** [3]

(b) (i) *body length*
no relationship (between body length and number of offspring) **;**

small / intermediate, body length produce more offspring **;**

sprint speed
lizards with greater sprint speed sire more offspring **;**

use of two paired figures from Fig. 4.3 to support relationship **;** [4]

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(ii) lizards with longer (hind) legs will tend to have more offspring ;

so will have a greater chance of passing on their alleles ;

(over time) the frequency of alleles (for long hind leg) will increase ;

so mean hind leg length will increase ;

directional selection ; [max 3]

(c) no, breeding / allele flow / gene flow, between (lizard) populations ;

different selection pressures / different (environmental) conditions ;

mutations occur ;

advantageous alleles, selected for / passed on ;

change in, allele frequency / gene pool ;

genetic drift ;

(eventually) unable to interbreed ;

allopatric speciation ; [max 5]

[Total:15]

5 (a) anterior pituitary ; [1]

(b) (i) early follicle development not dependent on FSH ;

with no FSH / no FSH receptors, follicle development stops ; **ora**

with no FSH / no FSH receptors, Graafian / ovarian, follicle does not develop ; **ora**

with no FSH / no FSH receptors, there is no ovulation ;

no corpora lutea because these form, from Graafian follicle / after ovulation ; [max 4]

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(ii) sperm development better when FSH present **;**

with FSH receptors
more sperm produced **; ora**

sperm more active **; ora**

males have increased fertility **; ora**

without FSH receptors
some sperm produced **;** [max 3]

[Total:8]

6 (a) (i) tendency of water molecules to move from one region to another **/** potential energy of water / ability of water to do work **;** [1]

(ii) (water potential) becomes, lower / more negative **;** [1]

(iii) posterior pituitary **;** [1]

(iv) for **one** mark **;**
any 2 from
urine
sweat
water vapour (from exhaled air)
faeces
bleeding
tears [max 1]

(b) affects collecting duct, (cells / wall) **;** **A** distal convoluted tubule cells

binds to receptors on cell surface membranes **;**

activates series of enzyme controlled reactions **;**

(phosphorylase causes), vesicles / aquaporins, to move to cell surface membrane (on lumen side) **;**

vesicles / aquaporins, fuse with cell surface membrane **;**

cells / wall, more permeable to water **;**

water moves out of lumen (of collecting duct) **;**

down water potential gradient **;** [max 5]

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(c) produce, a lot of urine / dilute urine **;**

dehydration / thirsty **;**

cramps / loss of salts **;** [max 2]

[Total:11]

7 **(a)** symbols and key **;** e.g. A = NF allele and a = normal allele

parental genotypes **and** gametes **;** e.g. parental genotypes Aa x aa
gametes A a x a a

offspring genotypes **and** phenotypes **linked ;** e.g. Aa has NF and aa is unaffected [3]

(b) spontaneous / random / chance **;**

mutation of, gene / allele **;**

AVP **;** e.g. named mutagen / detail of mutation / in oocyte / in sperm [max 2]

(c) compresses nerve **;**

damages, myelin sheaths / Schwann cells **;**

prevents, setting up of local circuits / saltatory conduction **;**

stops Na^+ / K^+ pumps from working **;**

blocks blood supply**;**

qualified **;** e.g. effect on, oxygen supply / glucose supply / ATP production

AVP **;** e.g. may stop ion channels opening [max 3]

[Total:8]

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8 (a) (i) receptors / hypothalamus, detect change in blood temperature **;**

brain **;**

(receptor / brain) sends impulses to effector **;**

effector carries out response / example of response **;**

blood temperature returns to normal **;**

negative feedback **;** [max 4]

(ii) larger SA : V ratio **;**

lose (relatively) more heat **;**

ref. more mitochondria to release heat energy **;**

cannot carry out behavioural actions to get warm **;**

infants cannot shiver **;** [max 2]

(b) (i) **A** – ATP synthase / ATP synthetase / stalked particles **; R** ATPase

B – inner membrane / crista **; I** phospholipid bilayer [2]

(ii) arrow going down from intermembrane space to matrix **;** [1]

(iii) 1 **and** 3 **;** [1]

(iv) water **;** [1]

(v) fatty acids **; A** lipid / fat / triglycerides [1]

[Total:12]

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9 (a) multicellular ;

differentiated cells ;

(most) have, vascular tissue / xylem and phloem ;

eukaryotic (cells) ;

ref. meristems ;

(most) are not motile ;

motile gametes **only** in mosses and ferns ;

autotrophic nutrition / photosynthesis ;

cells have:
chloroplasts ;

large / central, vacuole ;

walls made of cellulose ; [max 8]

(b) place in zoos ;

protected against, disease / predation ;

captive breeding programme ;

ref. assisted reproduction / cloning / sperm banks ;

released into wild ;

ref. national parks / reserves ;

rangers patrol parks ;

human access restricted ;

controlled agriculture ;

controlled industry ;

visitor centres / education ;

habitat / breeding sites, protected ;

banning sale of protected animals or their products ;

banning hunting ; [max 7]

[Total:15]

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10 (a) use *Penicillium* (in batch fermenter) ;

(main) nutrients added at start ;

penicillin only produced, after growth phase / when running out of nutrients ;

(penicillin) is a secondary metabolite ;

fermentation is stopped ;

penicillin is harvested ;

fermenter is cleaned out / ref. sterility ;

new culture of *Penicillium* is put in and started again ;

ref. fed batch culture ;

carbohydrate / named nutrient, added regularly ;

keeps fermentation going longer / produces more penicillin ;

detail of fermenter ;; e.g. paddle to mix nutrients / sterilising steam inlet / set at pH 6.5 / aeration / kept at 27 °C [max 8]

(b) *batch*
easy to set up culture ;

can continue with minimal attention / AW ;

environmental conditions easy to control ;

fermenter can be used for different process afterwards ;

only waste one batch if contaminated ;

less chance of blockage in fermenter ;

continuous
no / less, down time / AW ;

small vessels can be used ;

productivity high ;

cost effective ;

downstream processing easier ;

good for using immobilised enzymes ; [max 7]

[Total:15]

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