CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

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 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)

1 (a) (i) stroma ; [1]

(ii) lower CO_2 concentration ;

less, carbon fixation / CO_2 combining with RuBP / RuBP converted to GP ;

RuBP reformed from TP ; [max 2]

(iii) 0.01 ;;

A 0.012 **or** 1.8 ÷ 150 **or** $\frac{2.0 - 0.2}{150}$ **or** $\frac{2.0 - 0.2}{350 - 200}$ for 1 mark [2]

(b) less TP ;

(so less) conversion to, (other) carbohydrates / lipids / amino acids / proteins ;
A named examples, e.g. glucose / hexose / cellulose / starch

AVP ; e.g. 1 – (amino acids) used to make proteins for, growth / cell division
e.g. 2 – (carbohydrate / lipid) for respiration for, growth / cell division [max 2]

[Total: 7]

2 (a) *idea of* cross-pollination involves two (parents) / self-pollination one (parent) ;

ref. outbreeding / inbreeding ;

(two parents) have different, genotypes / sets of alleles ;

idea of new combinations of alleles in offspring ; [max 3]

(b) (total) DNA / genome, cut into fragments ;

by restriction enzymes ;

DNA, denatured / made single stranded ;

ref. primers / (modified) PCR ;

ref. dideoxynucleotides / chain termination ;

DNA / Taq, polymerase ;

copies of different lengths produced ;

electrophoresis ; **A** description

detection, of fluorescence / by laser scanner ;

sequence of, bases / nucleotides, read (by computer) ; [max 4]

(c) cross(-pollinate) them **;** **A** description

(if same species) offspring, are fertile / can themselves produce seeds**;** **ora** [2]

[Total: 9]

3 **(a)** **(i)** AABBCC **;** [1]

(ii) meiosis unsuccessful (in, sterile hybrid / AB) **;**

gametes not formed **;**

bivalents cannot form / chromosomes cannot pair up / chromosomes are not homologous **;**

polyploidy occurs / chromosomes double **;** **A** tetraploid

failure of cell division / all chromosomes in one daughter cell **;** **A** description

chromosomes can now form pairs / gametes can be formed / meiosis can be completed **;** [max 4]

(b) **(i)** in presence of Eβf large number aphids, stop feeding / move **;**

in absence of Eβf, few / no, aphids, stop feeding / move **;**

air in Experiment 1, has other chemicals / not pure Eβf **or** air in Experiment 2 has only Eβf **;**

Eβf concentration in Experiment 2 may be unnaturally high **or** Eβf concentration unknown in Experiment 1 **;**

different volumes of air in Experiment 1 and Experiment 2 **;**

comparative data quote **;**

e.g.

55% versus 84% **or** 54 out of 99 versus 111 out of 132

54.5% versus 0.9% **or** 54 out of 99 versus 1 out of 113

84% versus 0% **or** 111 out of 132 versus 0 out of 106 [max 4]

(ii) Eβf stops aphids settling **;**

Eβf attracts, predators of aphids / ladybirds **;**

attacked aphids secrete more Eβf **;**

aphids not, eating / taking nutrients from, wheat **;** [max 3]

(iii) gene / Eβf, already in, peppermint / various plant species **;**

Eβf not, toxic / harmful to human health **;**

no new chemical added to human diet **;**

does not kill insects (unlike Bt maize or cotton) **;**

aphids still available for, predators / food web **;** [max 3]

[Total: 15]

4 (a) (i) spermatagonium – 2n
primary spermatocyte – 2n
secondary spermatocyte – n
spermatids – n
spermatozoan – n **;;**

all five correct for two marks
three or four correct for one mark [2]

(ii) (spermatogonium to primary spermatocyte) growth / mitosis **;**

(spermatid to sperm) <u>maturation</u> **;** [2]

(iii) *any 1 from*

provide nutrients for sperm(atid) **;**

protect sperm from attack from immune system **;**

regulation of, sperm production / FSH **;**

AVP **;** e.g. removes excess cytoplasm during sperm maturation /
guides sperm to centre of tubule [max 1]

(b) FSH ;

(hormone) given to stimulate follicle development ;

GnRH agonists / GnRH receptor antagonists ;

to prevent, LH surge / ovulation ;

human chorionic gonadotrophin ;

(hormone) given to stimulate maturation of oocytes ;

(mature oocytes) collected from ovaries (just before ovulation) ;

ref. use of, fine tube / needle / ultrasound ; [max 4]

(c) (i) FSH (alone) / FSH + testosterone, increases development (of spermatids into, spermatozoa / elongated cells) ;

testosterone (alone) has very little effect ;

FSH + testosterone causes greatest increase of development ;

use of, comparative / manipulated, figures ; [4]

(ii) (reduction is very small so) may be, insignificant / random / due to chance ;

(some cells) may have died ; [max 1]

(iii) temperature, similar to testes / in range 30 °C to 35 °C / lower than core ;

spermatozoa production, will not proceed at 37 °C / at high temperature ; [2]

[Total: 16]

5 (a) random / spontaneous ;

mutation ;

base / nucleotide / triplet, change / substitution ; **R** addition / deletion [max 2]

(b) (i) as altitude increases frequency of $\mathbf{A^0}$ increases ; **ora** for $\mathbf{A^1}$

$\mathbf{A^0}$ more frequent at high altitudes / $\mathbf{A^1}$ more frequent at low altitudes / intermediate frequency of either allele at intermediate altitude ; [2]

(ii) *idea of* (pre-existing) genetic variation in deer mouse population **;**

at high altitude mice with, glycine / $\mathbf{A^0}$, more likely to survive / have selective advantage **; ora**

mice (with $\mathbf{A^0}$) reproduce (at high altitude) **; ora**

and pass on the $\mathbf{A^0}$ allele **; ora**

partial pressure / concentration, of O_2 acts as a selection pressure **;**

ref. to disadvantage of haemoglobin with very high affinity at low altitude **;**

as less able to unload oxygen (in respiring tissues) **;** [max 4]

[Total:8]

6 (a) channels **; I** voltage-gated

depolarised **; A** positive inside

receptor / generator **;**

threshold **;**

frequency **; A** number per second / rate **R** speed [5]

(b) action potential stimulates neighbouring area of membrane **; AW**

Na^+, moves sideways / attracted to areas at resting potential **; A** local circuit

causes, Na^+ ion channels to open / 2^{nd} depolarisation **;**

(transmission) in one direction due to, hyperpolarisation / refractory period **;**

myelin sheath / Schwann cell **;**

sheath insulates, axon / dendron / neurone **;**

depolarisation / action potential, only at nodes of Ranvier / unmyelinated part **; ora**

saltatory conduction / action potential 'jumps' from node to node **;** [max 5]

[Total:10]

7 **(a)** centromere **;** [1]

(b) *idea that* different genes, are present / missing **; R** alleles

different, proteins / poypeptides, produced / missing **;** [2]

(c) XY **;**

X X_1 X Y **;**

XX XX_1 **;**

normal Turner's **;** [4]

[Total:7]

8 **(a)** (DNA for) transcription / codes for mRNA **;**

(ribosomes for) translation **;**

synthesis of, respiratory enzymes / named enzyme / inner membrane proteins **;** [max 3]

(b)

correct order	letter of stage
1	**V**
2	**S**
3	**U**
4	**W**
5	**R**
6	**Q**
7	**X**
8	**T**

S U W all above **R ;**
S U W in correct order **;**

Q X T all below **R ;**
Q X T in correct order **;** [4]

(c) hydrolysis / dephosphorylation / exothermic / exergonic ; [1]

(d) anaerobic respiration ;

substrate level phosphorylation (in glycolysis);

at triose phosphate ⟶ pyruvate step ;

(net) gain of 2ATP (per glucose) ; **A** 2 used and 4 produced

pyruvate, reduced / gains hydrogens (from reduced NAD) ;

forming lactate ;

NAD regenerated / $NADH_2$ re-oxidised ;

this allows glycolysis to continue ;

I ethanol pathway [max 5]

[Total:13]

9 **(a)** *similarities*
eukaryotic (cells) ;

detail of eukaryotic cell ;; e.g. nucleus / linear DNA / chromosomes associated with histones / (named) membrane-bound organelles / 80S ribosomes

differences
single-celled **or** colonial / multicellular ;

autotrophic **or** heterotrophic ;

motile **or** unable to move ;

cell wall **or** no cell wall ;

vacuole **or** no vacuole ;

different life cycles ; [max 7]

(b) fall in numbers ;

danger of becoming extinct ;

ref. (IUCN / International Union for Conservation of Nature) / red list ;

one mark for idea, additional mark if qualified with point specific to named example
e.g.
habitat destruction ;
detail ;

climate change ;
detail ; e.g. rise in temperature

increase in disease ;
detail ;

increase in, predators / grazers ;
detail ;

decrease in food ;
detail ;

named pollutant and habitat affected ;
detail ;

hunting / killing / poaching / removal (plant) ;
detail ; e.g. trade in animal parts, selling rare plants

increased competition ;
detail ;

lack of human education ;
detail ;

disturbance to breeding sites ;
detail ; [max 8]

[Total:15]

10 (a) bacteria walls made of peptidoglycans **;**

bacteria secrete autolysins **;**

make holes in cell wall / **AW ;**

to allow wall to stretch during growth / **AW ;**

(glycoprotein) peptidases form cross-links (between peptidoglycans) **;**

(penicillin) inhibits (glycoprotein) peptidases **;**

cross-links (between peptidoglycans) do not form **;**

cell wall weakened **;**

bacteria take in water by osmosis **;**

increased turgor pressure causes cell to burst **; AW**

AVP **;** e.g. competitive inhibition [max 8]

(b) ref. bioleaching **;**

Acidithiobacillus / A. ferrooxidans **; A** *Thiobacillus / T. ferrooxidans*

low grade ores / (mine) waste **;**

two metals **;** e.g. copper, zinc, cobalt, uranium, lead, nickel, gold, silver **I** iron

insoluble ore turned into soluble products **;**

ore piled up **;**

acidic conditions created / pH low(ered) / pH 1.5 – 3 **;**

different bacteria at different temperatures **;**

chemoautotrophic **; A** description

oxidation (reactions) **;**

sulfide / S^{2-} to sulfate / SO_4^{2-} **;** (direct oxidation of ore)

Fe^{2+} / ferrous → Fe^{3+} / ferric **;**

Fe^{3+} oxidise other ores **;**

product, drains / leaches / is washed, into pool **;**

metal displaced by adding scrap iron **;** [max 7]

[Total:15]