CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9700 BIOLOGY

9700/21 Paper 2 (AS Structured Questions), maximum raw mark 60

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 excepted)
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

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1 (a) (i) prophase **;**
R prophase I [1]

(iii) two homologous chromosomes shaded **;** [1]

(iii) centriole **; A** centrosome / microtubule organising centre / MTOC

one from
produces spindle / produces spindle fibres **;**
produce / organises, microtubules **;**
disassembles / AW, spindle / spindle fibres / microtubules **;** [max 2]
A one e.g. of role of, spindle fibres / microtubules *if a link to centriole has been made allow if centriole incorrectly named or if not given*

(b) *max 2 if no attempt made at both **X** and **Y***

***X** / cell surface membrane*
1 forms a (cleavage) furrow **; A** 'pinches in' / constricts / AW
2 ref. fusion **;**
3 to divide cell into two **; A** *idea of* formation of two (separate) cells linked to behaviour of (cell surface) membrane**;**

4 ref. to cytokinesis / contractile ring **;**

Y / *nuclear envelope*
5 disassembles / breaks down / AW **;**

6 during prophase / by end of prophase / before metaphase **;**
A by the end of prometaphase

7 re-forms / AW, during telophase (from ER) **;** [max 3]

[Total: 7]

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2 (a) (i) G ; [1]

(ii) B / C ; [1]

(iii) A / F ; [1]

(iv) B ; [1]

(v) D ; [1]

(b) 1 nitrogen and hydrogen / substrates, bind to / AW, active site **;**
2 enzyme-substrate complex (forms) **;**

3 ref. lock and key / induced fit, mechanism **;**

4 activation energy of reaction is lowered **;**
5 example of how activation energy lowered **;**
e.g. strain on (triple) bond of, N_2 / (di)nitrogen
A bond broken between nitrogen (atoms)
nitrogen and hydrogen ions held close together for bond formation
transfer of electrons
alternative pathway

6 product / NH_4^+, leaves active site **;**

7 ATP, required / used / provided from respiration **;**
8 ref. anaerobic conditions for enzyme action **;**

9 suggestion as to use of, vanadium / molybdenum, in active site **;**
e.g. act as cofactor / coenzyme
transfer of, electrons / protons [max 4]

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(c) 1 concentration of all the ions is greater in the root tissue than in the solution **;** ora
A roots

2 comparative data quote **;**

according to these data

3 (so) ions will not diffuse into the root tissue **;**
A if (facilitated) diffusion only, initially / till equilibrium reached

4 (so) active transport **; A** active, uptake / pumping **I** facilitated diffusion

5 use ATP **; A** energy
R ATP energy

6 move ions, against concentration gradient / from low to high concentration**;**
A diffusion gradient

7 use, membrane / integral / intrinsic / transmembrane / transport / carrier, proteins **;**
R channel proteins

8 are specific / have specific binding sites **;**

9 involve, conformational / shape, change **;**

10 comparative data quote to suggest that some ions are pumped more than others **;**
e.g. steepest gradients for K^+ and SO_4^-

11 phospholipid bilayer / hydrophobic core (of cell surface membrane) is impermeable to ions **;**

12 so ions cannot diffuse out / (membrane) proteins only allow inward flow of ions **;**

13 AVP **;** e.g. suggestion of differing numbers of specific membrane proteins to explain observation of mp 10 [max 5]

[Total: 14]

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3 (a) *max 1 if no ref. to TB and COPD or if correct definitions given and ref. to TB/COPD incorrect (TB is an infectious disease, COPD non-infectious)*

TB caused by, a pathogen / *Mycobacterium* / *M. tuberculosis* / *M. Bovis* **;** ora *for* COPD
A microorganism / bacterium / bacteria **I** virus / fungus / protoctist
A infectious disease is caused by a pathogen ora

TB is / COPD is not, transmissible / communicable / can be passed from one organism to another **;** *allow detail of TB transmission e.g. droplet infection* / *in contaminated milk*
A infectious disease is transmissible ora

COPD caused by, damage to / irritation of, lung tissue **;** AW
accept relevant ref. to tobacco smoking [2]

(b) (i) 1 lining / epithelium / wall, is thin / one cell thick / squamous **;**
I thin interstitium
R cell walls of alveoli
R alveoli are one cell thick
R endothelium / membrane

2 (so) short <u>diffusion</u> distance / only <u>diffuse</u> through two cells **;**

3 (collectively / many, so) large surface area for diffusion **;**
R an alveolus has a large surface area
I high SA:V ratio / increase SA

4 surrounded by / many / network of, <u>capillaries</u> **;**
I good blood supply

5 red blood cells are very close to air (in alveoli) **;**

6 (so) maintain, diffusion / concentration / partial pressure, gradient(s) **;**

7 elastin / elastic fibres, allow(s) alveoli to, increase in volume / expand / stretch / stop bursting / recoil **;**
I alveoli are elastic
R contract [max 3]

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(ii) *allow microorganisms or named type of microorganism or infectious agent for pathogens*

1 recognise, non-self / foreign, antigens, (on pathogen) **;**

2 receptors (on macrophage) bind antigens (on pathogen) **;**

3 (or), pathogen / AW, adheres / 'sticks', to (cell surface) membrane **;**

4 infolding of (macrophage cell surface) membrane around / engulf / phagocytosis of, pathogen **; R** engulf antigen

5 vacuole / vesicle / phagosome, forms **;**

6 ref. to lysosomes **;**

7 hydrolytic / digestive / named, enzymes **;**
e.g. lysozyme / protease / nuclease
A pathogen broken down by enzymes

8 hydrolysis of named compound(s) **;**

9 ref. to destroying / killing, pathogen **;**

10 ref. to antigen presentation **;**
accept idea even though does not occur in alveoli [max 4]

(c) 1 emphysema **;**
2 (alveolar walls broken down so) less surface area for, gas exchange / diffusion **;**
A impaired / AW, gas exchange / diffusion
3 difficulty in breathing / restriction in air flow / shortness of breath wheezing / rapid breathing **;**

4 blood is less well oxygenated / less oxygen reaches, tissues / muscles **;**

5 any two other, signs / symptoms **;;**
6 e.g. lethargy / tiredness / fatigue **/** constraints on mobility or activity
wheezing
persistent / AW, coughing
chest tightness **; R** chest pain
more prone to / frequent, chest / respiratory, infections
A more frequent colds / influenza ('flu)
weight loss
swollen, ankles / feet
increase in thickness of, right ventricle / right side of heart
increase in blood pressure in pulmonary artery [max 3]

[Total: 12]

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4 (a) 1 mitochondrion **;** **A** mitochondria
A outer mitochondrial membrane

2 produces / synthesises / AW, ATP **;** **A** release / supply, ATP / energy
R produces energy
R ATP energy

or
for outer mitochondrial membrane allows exit of (synthesised) ATP to cell

3 example of use of ATP in liver cells **;**
e.g. for synthesis of, cholesterol / glycogen / protein / biological molecules / polymers / AW
intracellular movement of vesicles
exocytosis / endocytosis / bulk transport
active transport [3]

(b) (i) lipoproteins are soluble **;**
cholesterol is not water-soluble **;**
cholesterol surrounded by / lipoproteins have, phospholipid heads / proteins, that are hydrophilic **;** AW
allows transport in blood **;** [max 1]

(ii) *cholesterol needed for*
making / components of, membranes **;**
membrane stability **;**
regulating the fluidity of, membranes / phospholipid bilayer **;**
production of, steroid hormones / named steroid hormone **;**
AVP **;** e.g. helps prevent entry of, ions / polar molecules [max 2]

(c) vesicles travel to cell surface membrane **;** **A** travels through cytoplasm towards space between cells
exocytosis **;**
vesicle / membrane, fusion (with cell surface membrane) **;**
contents / cholesterol, released **;** [max 2]

(d) glycosylation / adding sugar molecules to proteins / making glycoproteins **;**
A modifying proteins
phosphorylating proteins **;**
cutting / folding, proteins **;**
assembly of polypeptides into proteins (with quaternary structure) **;**
AVP **;** e.g. lipid synthesis
ref. lysosome formation [max 1]

[Total: 9]

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5 (a) (i) GTG ;

ACU ;

leu ; [3]

(ii) primary structure ; [1]

(b) 1 mutation ;
2 base substitution / T→ A in template strand of DNA / AW ;

transcription
3 DNA has CAC as 6th triplet ;
4 (so) mRNA has GUG as (6th) codon ;
allow one mark for altered mRNA codon *if no marks gained for mps 3 and 4*

translation
5 different tRNA involved / tRNA specific to val and not glu ;
6 anticodon on tRNA has CAC (with valine) ;
7 tRNA brings, incorrect amino acid / val, to ribosome ;
8 further detail ; e.g. incorrect amino acid incorporated into growing polypeptide chain [max 5]

[Total: 9]

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6 (a) *niche*
functional role / function / role / AW, of a species within an ecosystem **;**
A population / organism, *for species*
accept description

community
all populations of all species / all organisms / AW, living in a (particular) area / AW, (at the same time) **;** [2]

(b) 1 changing / increasing / decreasing, numbers of sea otters has (large) effect on the rest of the ecosystem **;**

effect on kelp
2 prey on sea urchins, which, graze / feed on, kelp **;**
3 if, no / few, otters numbers of urchins increase, so kelp decreases **;** ora
4 sea urchins have no other predator **;**

role of kelp
5 kelp, is a producer / initial input of energy into ecosystem **;**
6 so less kelp means less energy available for the ecosystem **;**
7 kelp provides habitats for many other species **;**
8 loss of kelp (significantly), changes structure of ecosystem / ref. to 'deforestation' **;**

effect on other organisms
9 decrease in numbers (of sea otters) leads (initially) to increase in numbers of their prey / named organism from Fig. 6.1**;** ora
10 *for any one example* ref. to consequence / knock-on effect **;**
11 AVP **;** e.g. ref. to effect on, energy flow through ecosystem / regulation of populations within the ecosystem / community structure [max 4]

(c) 1 (determine) energy content of consumed kelp, absorbed / that can be used, by sea urchins **;** AW
2 (determine) energy content of kelp consumed by sea urchins **;**

allow other reasonable suggestions for mps 1 and 2

3 *idea of* comparing energy contents and expressing as a, percentage / proportion / ratio **;**
A equation *or* worded e.g. mp 1 divided by mp 2

4 (calculated as) per unit, area / volume, per unit time **;**
A example e.g.(J) m^{-3} $year^{-1}$ [max 3]

[Total: 9]

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