UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9700 BIOLOGY

9700/22 Paper 2 (Structured Questions AS), 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 must be read in conjunction with the question papers and the report on the examination.

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1 **(a)** **(i)** calcium ions are, water soluble / charged / not, fat / lipid, soluble / hydroph
ionic ; **A** not oil soluble
phospholipid bilayer / AW, is hydrophobic / AW ;

(ii) active transport / active uptake ; [1]

(calcium ions) moved against their concentration gradient ;
ref. to, carrier protein / transport protein / pump protein ; **ignore** ion pump
R channel protein
ref. to calcium ions combine with binding site ;
carrier protein, changes shape / conformational change ;
ref. to ATP ; [2 max]

(b) bacteria / antigen / epitope, combine(s) with / attach to/ recognition by, receptor ;
antibody on bacteria combines with receptor ;
opsonisation / opsonisation described ; e.g. facilitates phagocytosis
ref. to constant region ;

membrane infolds / invaginates / envelops / engulfs / enclose / AW ;
accept answers without 'membrane' where implied previously / later
membrane fuses ;
to form, vacuole / vesicle / phagosome (enclosing bacteria) ; [3 max]

(c) lysosomes fuse with, vacuole / vesicle / phagosome ;
A form secondary lysosomes
lysosomes contain, enzymes / named digestive enzyme ;
(catalyse) hydrolysis / digestion ; **A** breakdown
(digests / breaks down) protein / murein (or peptidoglycan) / carbohydrate / lipid / phospholipid / nucleic acid / DNA / RNA ;
named bond ; e.g. peptide, glycosidic, ester, phosphodiester [4 max]

[Total: 12]

2 **(a)** denature, sucrase / enzyme ; **A** deactivate
stop the reaction (in each tube at the same time) ;

idea that Benedict's test requires a high temperature ;
ref to reducing sugars ; [2 max]

(b) starts at, the origin / 5 g dm^{-3}, increases to 45–55 g dm^{-3} ;
constant from 80 to 100 g dm^{-3} ; [2]

(c)

description	*conc*	*rate**
	5	0.0036
	10	0.0069
	15	0.0105
	20	0.0133
	50	0.0213
	100	0.0222

penalise lack of units once only

1 increase in rate of hydrolysis to approx 50 g dm^{-3} ;
A decrease in time taken to approx 50 g dm^{-3} / correct rate calculations* to show an increase
2 remains constant / plateaus / levels out / AW, from approx 50 g dm^{-3} to 100 g dm^{-3} ;

explanation to max 4
3 (sucrase / enzyme) hydrolyses / breaks , glycosidic bonds ;
4 forming, reducing sugars / glucose / fructose ;

5 *idea that* concentration is the limiting factor, at low concentration of, sucrose / substrate ;

6 (at low concentrations) active sites, unoccupied / available ;
A as concentration increases, more active sites are occupied / more enzyme-substrate complexes formed / AW

7 at higher concentrations all active sites, occupied / saturated / AW ;
R enzymes for 'active sites'
8 substrate, in excess / AW ;
9 V_{max} reached / working at maximum rate ;

idea that
10 at higher concentrations, enzyme / sucrase, is the limiting factor ; [5 max]

[Total: 9]

3 **(a)** so they have the same number of chromosomes (as parent cell) ;

idea that cells would be rejected (if genetically different) ;
ref. to role of the immune system in removing genetically different cells ; [

(b) *reject 'smoking' or 'radioactive transmissions' unqualified*

(chemical) carcinogen(s) / named ;
any two named chemical carcinogens to max 2 if term carcinogen not used
e.g. benzpyrene / ethidium bromide / phenol / tar *check any others*

UV ;
X rays ;
ionising radiation ;
gamma rays ;
radon ;
virus(es) / correctly named virus ; **A** HIV / HPV / HTLV / HSV **R** named disease
genetic / hereditary, factors ; [2 max]

(c) **(i)** cytokinesis ; [1]

(ii) chromosomes, uncoil / become diffuse / decondense / AW ;
A chromosomes unwind / become long and thin
A chromosomes become chromatin
A cell enters interphase
spindle breaks down / microtubules disassemble / AW ; **R** disappears

nuclear envelope, reforms / forms / forming ; **A** nuclear membrane **R** (re)appears
nucleolus / nucleoli, reform(s) / forms / forming ; **R** (re)appears

cell membrane, drawn together / furrows / AW ;
idea of role of, microfilaments / AW, in 'drawstring' effect ;

division of cytoplasm / cell separation / cleavage / cleavage furrow develops ;
A cytokinesis *if not credited in* ***(i)***
cell membrane fuses ; [3 max]

(iii) divide / replicate, uncontrollably ; **ignore** quickly / fast
A uncontrolled mitosis **R** grow uncontrollably
do not, differentiate / become specialised ; **A** loss of function
form an (irregular) mass (of cells) / AW ; **A** (a) growth
promotes growth of blood vessels / AW ;
AVP ; e.g. ref to genes / no programmed cell death / loss of contact inhibition [2 max]

[Total: 10]

4 (a) (i) moist / AW, surface of mesophyll cells ;
water evaporates / evaporation ; *in correct context*
from spongy mesophyll cell walls ;
into (intercellular) air spaces ;
air within leaf is fully saturated ;
water vapour diffuses through stomata ; **A** 'water' if evaporated

down water potential gradient / from a high to a low water potential / from less negative to more negative water potential [3 max]

(ii) mass / water, loss increases from 0400 to 1600 and then decreases ;
0.3–4.4 g h^{-1} ; **A** other correct comparative data quote with units

mass / water, uptake increases from 0800 to 1900–1930 and then decreases ;
0.8–0.9 – 3.4 g h^{-1} ; **A** other correct comparative data quote with units

rate of, mass / water, loss peaks before rate of water uptake ;
A description related to light (mass loss) and dark (uptake)
data quote for times of peaks for both rates ; 1600 and approx 1900

0600 to 1600 rate of mass loss, ref. to steeper gradient ;

(rate of) mass / water, loss is higher than uptake, between 0700 and approx 1830 ;
A ora [4 max]

(b) cohesion-tension ;
cohesion / AW between water molecules ;
hydrogen bonds ; *accept here or for adhesion once only*
transpiration pull / water is pulled up the xylem / water in a continuous column ;

ignore negative / hydrostatic pressure

adhesion to (cell) walls ;
water molecules 'stick' to cellulose / cellulose is hydrophilic ;
A lignin (although it is hydrophobic!) [3 max]

[Total: 10]

5 (a) (i) **H** nucleolus ;
J Golgi (body / apparatus) ;
K cell wall ; **R** murein / peptidoglycan **ignore** cellulose or chitin
L vacuolar membrane / vacuole ; **A** tonoplast **R** cell sap [4 ma

(ii) no double membrane-bound organelles ;
no, nucleus / nuclear membrane / nuclear envelope / nucleolus ;
A DNA lies free in the cytoplasm
no mitochondrion ;
mesosomes ;
no (large) vacuole ;
no, ER / RER / SER ;
no Golgi (body / apparatus) ;
smaller / 70S / 18nm, ribosomes ;
cell wall made of, murein / peptidoglycan / different compounds (from eukaryote) ;
circular DNA / plasmid(s) / no linear DNA ;
no histones / not complexed with proteins ; **A** naked DNA / no chromosomes
AVP ; e.g. pili / no 9+2 microtubule pattern [2 max]

(b) nucleus, transcription / described as DNA to complementary RNA code / AW ;

nuclear pore, mRNA to, cytoplasm / ribosome / RER ;
RER / ribosome, assembly of amino acids / translation / polypeptide *or* protein synthesis ;
RER, transports protein to Golgi (apparatus / body) / modifies protein ;

Golgi adds, carbohydrates / sugars, to proteins ; **A** glycosylation
A post translational modification / other e.g.s
Golgi, packages protein / makes vesicle(s) ;

(Golgi) vesicle fuses with cell (surface) membrane ;

mitochondrion, provides / produces / synthesises, ATP *in correct context* ; [4 max]

[Total: 10]

6 (a) *community*

all populations / all organisms / all plants + animals (+ microorganisms) ;
R all the species

in same, place / ecosystem / area / (common) habitat, (at same time) ; [2 max]

(b) (i) *award two marks for the correct answer (4.5%)*

if no answer or incorrect answer or answer to too many decimal places, award one mark for working (2946/65 800 × 100)

2946 / 65 800 (× 100)

4.5 (%) ;; [2 max]

(ii) energy available (from secondary consumers) is too small ; **R** no energy
2 kJ m^{-2} (per week) ; [2]

(iii) decomposers are, saprophytes / saprotrophs / saprobionts / bacteria / fungi ;

plant matter provides little, protein / AW ; ora **A** high carbon / low nitrogen
plant matter / cellulose / lignin, not easy to decompose ;
ref. to organic matter / energy source, in plants not easy to obtain ;
supply of nitrogen is, limiting factor / limits growth of decomposers ;
(animal waste) protein / amino acids / urea, provides nitrogen ;
(animal wastes) provide materials for growth of, decomposers ;
further detail e.g. amino acids for proteins / membrane proteins / (hydrolytic) enzymes / other named protein(s) / nucleotides / nucleic acids ;

more decomposers leads to faster decomposition (hence more energy flow) ; [3 max]

[Total: 9]