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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

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.

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max	indicates the maximum number of marks that can be given
ora	or reverse argument

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1 **(a)** community **;**
niche **; A** role
second trophic level / first level consumers / primary consumer level **;**
A *other appropriate terms* [3]

(b) *loss (of energy-containing food in producers or in grazers) in*
indigestible parts / not being absorbed / faeces / egestion **;;**
one mark for producer, one mark for grazer

excretion (in, grazers / herbivores / primary consumers) **;**
respiration (in, grazers / herbivores / primary consumers) **;**
loss of energy in movement / AW (in, grazers / herbivores / primary consumers)**;**
AVP **;** e.g. heat energy [max 2]

[Total: 5]

2 **(a)**

structure	trachea	bronchus	bronchiole	alveolus
ciliated epithelium	✓	✓	✓	×
goblet cells	✓	✓	✓ / ×	×
cartilage	✓	✓	×	×
smooth muscle	✓	✓	✓	×

one mark each row [4]

(b) **(i)** athlete takes a deep breath and then breathes out as much air as possible / AW **;**
suitable method to record this, e.g. spirometer / breathing out into a bell jar of water **;** [2]

(ii) 0.5 dm^3 / 500 cm^3 **;** [1]

(c) reduced supply of blood to, heart / cardiac, <u>muscle</u> **;**
reduced supply of glucose (to cardiac muscle) **; R** no
reduced supply of oxygen (to cardiac muscle) **; R** no
less aerobic respiration / (more) anaerobic respiration (of cardiac muscle) **;**
build up of, lactate / carbon dioxide **;**
ref. limited cardiac output **;**
AVP **;** e.g. ref. to consequences to (muscles of) body with reduced blood supply, ref. to pain caused by angina **R** heart attack / AW [3]

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(d) damages, lining of arteries / endothelium **;** *accept once*
speeds up (atheromatous / fibrous) plaque development **;** *accept once*
increases chance of blood clotting / promotes thrombosis **;** *accept once*

nicotine
increases heart rate / AW **;**
increases blood pressure **;**
makes platelets 'sticky' **;**
decreases blood flow to, extremities / AW **;**
constriction of blood vessels **;** (max 2)

carbon monoxide
combines with haemoglobin / forms carboxyhaemoglobin / higher affinity for haemoglobin (than oxygen) **;**
reduces oxygen-carrying capacity / AW (in context of, haemoglobin / blood) **;**
promotes release of damaging free radicals / peroxides / superoxides / oxidising agents **;**
causes, platelets and neutrophils to stick together / platelets to stick to endothelium **;**
ref. hypoxia damage to cardiovascular system **;** (max 2) [max 3]

[Total: 13]

3 (a) *accept ora*
penalise once if refs. in context of rates e.g. faster
no cells remaining, correct concentration value given (accept up to 0.26%) **;**
100% / AW, cells remaining, ref. from 0.86%–0.9% / AW **;**
steep increase in percentage cells remaining between 0.5–0.8% **;** **A** to 0.7% *if next marking point included*
steepest increase between 0.7–0.8% **;**
comparative data quote to support ref. to increase **;** [max 3]

(b) *max 5 if no mention of water potential anywhere in the answer*
correct use of term osmosis linked to water potential (in context of high to low) **;**

0% and 0.7%
(net) water in (to red cells) **;**
0%, all cells burst / (haemo)lysis of all cells **;** } general ref. to bursting at either concentration **;**
0.7%, some cells burst **;** ora }
cell membrane cannot withstand pressure **;**
(0.7%) (remaining) cells swollen / cell volume increases **;**
0.7% water potential gradient not as steep as in, water / 0% **;**

1.5%
(net) loss of water from cells **;**
cells, shrink / AW *or* cell volume decreases **;** **A** descriptions relative to biconcave disc shape [max 6]

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(c) 4, oxygen molecules / O_2, per (molecule of) haemoglobin **;**
(forms) oxyhaemoglobin (in lungs) **; A** marking points 1 and 2 as equation
ref. oxygen remains bound until blood in area of low pO_2 / high pCO_2 / high(er) temperature **; A** in area of respiring tissues (max 3)
carbon dioxide combines with haemoglobin **;**
terminal, amine / amino, group of haemoglobin **; A** $–NH_2$
carbamino-haemoglobin **; R** carboxyhaemoglobin
ref. to hydrogen ions from carbonic acid **;**
ref. carbon dioxide remains bound until blood in area of low pCO_2 / high pO_2 **;** [max 4]

(d) (i) 19.7 / 20 (%) **;;**

allow 1 mark if incorrect answer but correct working shown
7.3 – 6.1 / 6.1 × 100 / 1.2 / 6.1 × 100 [2]

(ii) partial pressure / AW, of oxygen is, low / lower than at sea level **;**
haemoglobin less well saturated **;**
more red blood cells / more haemoglobin **;**
compensates for, smaller volume of oxygen absorbed (per red blood cell) / lower saturation of haemoglobin **;**
A ref. to tissues receiving sufficient oxygen
AVP **;** e.g. ref to erythropoietin (EPO) [max 3]

[Total: 18]

4 (a) (i) Vibrio cholerae **;** [1]

(ii) active transport / described as movement against concentration gradient **;**
A facilitated diffusion / described [1]

(iii) (bacteria) leave infected person in faeces / AW **;**
(bacteria) enter water supply / AW **; A** idea of contaminated, food / utensils
(bacteria) ingested by uninfected person **;** [3]

(b) *must be in context of B-lymphocytes / B-cells / plasma cells*
max 3 if T-cells

*secondary response **A** ora*
presence of memory cells / AW (giving larger numbers) **;**
ref. increased chance of, encountering antigen / antigen presentation / clonal selection **;**
ref. larger numbers cells following, clonal expansion / AW (cf primary response) **;**
(so) shorter duration for onset of antibody production **;**
(so) higher antibody concentration **;**

secondary response antibody production (by plasma cells) lasts longer **;**
AVP **;** e.g. faster rate, plasma cell / antibody, production, ref. longer-life of cells involved in secondary response [max 4]

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(c) **1** poor sanitation / no treatment of faecal waste / AW **;**
2 contamination of (drinking) water supply **;**
3 poverty, qualified / poor living conditions
4 poor hygiene **;**
5 poor / lack of, (health) education about transmission **;**
6 ref to natural disasters **;** e.g. assistance / aid / medical help / AW, cannot arrive in time
7 ref. refugees / displaced people **;**
8 lack of, water purification equipment / bottled water / AW **;**
9 no rehydration therapy available (at time when needed) **;**
10 no (effective) vaccine **;**
11 further detail **;** (bacteria live in gut, where immune system is not effective)
12 AVP **;** e.g. contamination of vegetable plots with faecal waste, ref. to different strains [max 4]

[Total: 13]

5 **(a)** **(i)** β glucose **;** [1]

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

(b) many hydrogen bonds within the molecule **;**
idea of parallel chains / AW **;**
hydrogen bonds between cellulose molecules **;**
to form microfibrils **;**
held together by more hydrogen bonds to form fibres **;** [2 max]

(c)

function	letter from Fig. 5.1
organelle that contains DNA	H
structure that transports cell wall material to the cell surface membrane	A
site of transcription	H
site of ribosome synthesis	J
site of photosynthesis	D

[4]

(d) polypeptide / protein, in (cisternae of) RER **;**
to Golgi (apparatus / AW) **;**
modification / glycosylation / packaging **;**
vesicle(s) formed / transport in vesicle **;** **A** vacuole
membrane of vesicle fuses with cell surface membrane **;**
exocytosis / described **;** [max 3]

[Total: 11]

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1 (a) (i) transcription <u>first</u> process and exocytosis <u>final</u> process **;**
correct order for remaining three processes (3, 4, 2) **;** [2]
accept words and mixture of words and letters

(ii)
F ;
A / **D**
A ;
C
D ;

events	order of events	cell location (letter)	
exocytosis	**5**	**F**	cell membrane **;**
protein modification	**3**	**A / D** **A+D**	Golgi and/or RER ,
secretory vesicle formation	**4**	**A**	Golgi **;**
transcription	**1**	**C**	nucleus ,
translation	**2**	**D**	RER **;**

[3]

(b) 1 vesicle / vacuole, moves towards, cell, surface / membrane **;**
A plasma membrane **R** if lysosome
2 fusion / described, of vesicle with membrane **; R** attach / bind / combine
3 ref. to (fluid nature of) phospholipids **;**
4 contents / AW, secreted / released / exported / removed / emptied / excreted **;**
A waste material / digested material
5 active process / energy-requiring / ATP used / AW **;**
R 'active transport' **R** endocytosis [max 3]

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

(ii) 1 secondary structure / α-helix / β-(pleated) sheet **;**
2 tertiary structure / description / folding / complex 3D shape **;**
3 formation of named bond(s) **; R** if peptide bond in list
4 quaternary structure / description (e.g. assembly of polypeptides) **;**
5 glycosylation / formation of glycoproteins / addition of carbohydrate(s) *or* sugar(s) **;**
R hydrocarbon chain
6 addition of, non-protein portion(s) / prosthetic group(s) / named example **;**
A haem / iron / Fe / copper / Cu / magnesium / Mg / AW
7 removal of some amino acids **; R** one amino acid
8 polypeptide(s) cut into two or more pieces **;**
9 AVP **;** e.g. ref. to exposure to water molecules and folding
R ref. to amino acids coded for by stop codons [max 2]

[Total: 11]

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2 (a) communicable / transmissible / contagious / transferable / AW **;**
A passed from one (infected), host / organism / one person, to another
A 'passed on'

caused by, a pathogen / microorganism / *at least* **two** named types of pathogen **;**
A virus, bacterium, fungus, protoctist, worm **;**
R parasite unqualified by two types [max 2]

(b) *Plasmodium, falciparum / ovale / vivax / malariae* **;**
A phonetic spellings for specific name, **A** plasmodium
R if specific name first, [1]

(c) (i) (only) female feeds on blood / male does not feed on blood **;**
female requires blood (protein) for (development of) eggs **;**
(only) female carries, pathogen / disease-causing organism / *Plasmodium* / parasite **;**
A (only) female transmits the disease
(only) female is vector **;** ***ora ignore*** female carries, the disease / malaria [max 1]

(ii) anti-coagulant (in saliva) is passed when mosquito, sucks blood / feeds / bites / takes a blood meal **;**
anti-coagulant prevents blood clotting when mosquito, sucks blood / feeds / bites / takes a blood meal **;** [max 1]

(iii) *in marking accept*
Plasmodium / pathogen / causative organism / malarial organism *where parasite is given below*

short time (in blood plasma)
for exposure to cells of the immune system / AW **;**

next stage(s) of life cycle inside cells **;**
A sporozoites into merozoites in liver /
merozoites into schizonts in red blood cells

parasite gains, food / energy, from cells **;**
parasite, reproduces / multiplies, inside (liver / red blood) cells **;**
damage to / bursting of / lysis of / impaired function of, cells **;**

(antimalarial) drugs cannot penetrate (liver / red blood) cells **;**
parasite, concealed / 'hides', from host immune system **;**
A antigen concealment **;**

no symptoms, until parasite leaves cells / while parasite is in cells **;**
idea that people incubating disease are symptomless **;**
A symptomless carriers
idea that treatment unlikely to prevent spread from infected person **;**

AVP **;** *examples*
different stages provide problems with drug / vaccine development
AVP **;** mode of action of potential drugs – block attachment sites on cells
parasite in blood cells allows testing by taking blood samples
further development of any idea given above [max 2]

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(d) *if virus / bacterium / disease used instead mark to max 3*
in marking accept
Plasmodium / pathogen / causative organism / malarial organism *where parasite is given below*

distribution described for one mark

either
(mainly in) tropics / between the tropics
or
any **two** named, areas and/or countries, affected **;**
e.g. *areas* (sub-Saharan) Africa, Central America, South America, South Asia, Central Asia, Middle East, Caribbean
e.g. *countries* India, Sri Lanka, China, Vietnam, Cambodia, Brazil, Kenya

discussion to max four

1 (areas where) both parasite, **and**, vector / mosquito / Anopheles, are present **;**
2 Anopheles / mosquito / vector, survives / breeds / lives, in, hot and humid areas / moist tropical areas **;** ***ora*** **A** standing / stagnant, water

3 parasite, needs to reproduce within the mosquito (at temperatures above 20°C) **;**

4 eradicated in some countries / any e.g. (USA, Italy) **;**

5 ref to LEDCs and, poor / non-existent, control programmes **;**
A poor health facilities / poor drug supplies / AW

6 mosquitoes resistant to, DDT / insecticides / pesticides **;**
7 parasite resistant to, chloroquine / drugs **;**

8 link between human population density and *Anopheles* **;**
e.g. human activity provides (lots of) breeding sites for *Anopheles*
9 occurs where named high risk group(s) exist **;**
e.g. refugees, HIV-positive pregnant women (more likely to pass HIV to unborn children), (young) children
10 (outside tropics) disease spread by, travellers / tourists / migrants / refugees **;**

11 AVP **;**
most cases / over 90% cases, in (sub-Saharan) Africa
not, at high altitude / in deserts
different species of *Plasmodium* differ in geographical distribution / AW
misdiagnosis (so not reported)
changing pattern linked to, global warming / changes in land use / deforestation / irrigation / other relevant named
R references to sickle cell [max 4]

[Total: 11]

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3 (a) spherical / ball-shaped / AW **;** **A** round(ed) / circular
has tertiary structure **;** **R** 3D
hydrophilic / polar, (R) group(s), on outside / face to watery exterior **;**
hydrophobic / non-polar, (R) group(s), in centre **;**
water soluble **;** [max 3]

(b) (i) *idea that plant cell walls and fungal cell walls have different components*
fungal cell walls made of, glucans / chitins / fungal cellulose / different components to plant cell walls **;** **A** peptidoglycan / murein
A plant cell walls contain cellulose, but fungi do not
idea of specificity in context of question
enzymes are specific **;**
A specificity explained e.g. both substrates not complementary / shape of active site specific to one substrate [2]

(ii) **1** (at optimum pH) maximum / peak, activity **;** **A** most efficient / works best
2 above / below, optimum, activity declines **;**
A description / graph sketched with pH and rate / activity
3 changing pH changes hydrogen ion concentration **;**
4 hydrogen / ionic, bonds (between amino acids), break / disrupted **;**
5 hydrogen / ionic, bonds, important in maintaining shape of, tertiary structure / active site **;**
R 4 and **5** if refer to disulfide, hydrophobic interactions, peptide
at sub-optimum pH
6 active site / tertiary, shape altered **;** **A** enzyme denatured
7 charges at the active site may be affected **;**
8 further detail **;** e.g. transfer of electrons may not be possible
9 the substrate may be altered by pH changes **;** **R** cell wall unqualified
10 (therefore) substrate no longer fits / ES complexes not formed **;** [max 3]

(c) osmosis, defined in terms of water potential / used in correct context **;**
0% and / or 0.4%
higher / less negative, water potential outside so water enters **;**

0%, higher / less negative, water potential than 0.4%, so cells burst **;** *ora*

0.9%
equal / same, water potential inside and outside cells, water in = water out **;**
A no net movement of water / ref. to isotonic / no water potential gradient
R 'no osmosis' / no movement of water

1.5% and / or 3.0%
lower / more negative, water potential outside so water moves out **;**

3.0%, lower / more negative, water potential than 1.5% so cells, smaller / AW **;** [max 4]

(d) cells, increase in size / burst **;** **A** vacuole increases in size **R** becomes turgid
no cell wall to, prevent cell bursting / withstand (turgor) pressure **;**
A *idea that* cell membrane alone cannot withstand increase in size / bursting [2]

[Total: 14]

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4 (a)

vaccine / macrophages ; ;

antigens ; lymphocytes / mitosis ;

plasma cells *and* T_h-lymphocytes ;

[3]

no ecf from **(a)** to **(b)**

(b) 1 active (artificial) immunity **;**

2 memory cells / immunological memory **;**
3 *idea that* many specific, B-cells / T-cells / lymphocytes, in the body **;**
A large(r) clones of specific, B- / T-cells *or* lymphocytes

actual invasion by the pathogen
4 fast secondary (immune) response **;**
5 fast increase in antibodies / immediate production of antibodies **;**
ignore incorrect type of cell secreting antibodies

6 high(er) concentration of antibodies are produced **;** **A** more antibodies produced
7 pathogen destroyed before person becomes ill / AW **;** **R** antigen
A pathogen do not, increase in number / infect cells / AW [max 3]

(c) *two points to look for*

(if) most / sufficient / many / AW, people / children, immunised / vaccinated **;**
A herd immunity

reduces the pool of infected, people / children, in the, community / population **;**
A fewer people can catch disease and be source of infection
A protects those unvaccinated as, disease / illness, does not spread
A less chance of transmission
A pathogen cannot develop in immunised people
A reduced exposure to pathogen [max 2]

[Total: 8]

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5 **(a)** glycogen **;** [1]

(b) xerophyte / xerophyllic **;** **A** phonetic e.g. zerophyte [1]

(c) haploid (cell) **;** **A** monoploid [1]

(d) (primary) producer **;** **R** first ***ignore*** autotrophic [1]

(e) (nitrogen) fixation **;** **A** nitrogen fixing bacteria [1]

[Total: 5]

6 **(a)** **(i)** squamous / pavement (epithelial) **;** [1]

(ii) stretch / expand, on inspiration and recoil on expiration **;** **R** contraction

(stretch) to increases, surface area / volume of air, for, diffusion / gas exchange **;**

(recoil) to help, expel air / force air out **;** **A** carbon dioxide
A if destroyed then cannot expel air

prevent alveoli, bursting / breaking / AW **;**

ref. to emphysema if elastic fibres destroyed **;** [max 2]

(b) *award two marks if correct answer (anything in range 336–346)*
allow +/– 1 mm in reading the line (74–76 mm)

75000 μm / 220 μm =
341 **;;**

if answer incorrect, award one mark for correct measurement with unit and division by 220
award one mark if correct answer given to one or more decimal places [2]

(c) *look for two ideas – follow usual rules for marking numbered answer lines*

thin, alveolar wall / epithelial lining / AW **;**
A short diffusion distance (between air in alveolus and blood in capillary)
A squamous cells are thin
R thin, membrane / cell membrane **R** large surface area

surrounded by, capillaries / capillary network **;**
A close contact with, capillaries / blood (vessels / cells)
A many capillaries
A large area of alveolus in contact with, capillaries / blood [2]

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(d) ***max 3 if no ref. to diffusion***

(named) gas(es), <u>diffuse</u> down, pressure gradients / concentration gradient / AW **;**
A from high(er) partial pressure to low(er) partial pressure
A high(er) concentration to low(er) concentration
ignore 'along a concentration gradient'

in the answers accept the following AWs
capillaries / haemoglobin for blood
lungs for alveoli
body for tissues

lungs

valid statement linking information in table below – 1 mark for each row

comparison in partial pressure may be 'higher / lower' not both or high and low, but if not then figures have to be given

blood	ref. to gas	blood partial pressure	alveolar air partial pressure	gas exchange	
in pulmonary artery / entering alveolar capillaries	pO_2	5.33 / lower	13.87 / higher	into blood from alveolus	;
	pCO_2	6.00 / higher	5.33 / lower	out of blood into alveolus	;

respiring tissue

valid statement linking information in table below – 1 mark for each row

blood	ref. to gas	blood partial pressure	tissue partial pressure	gas exchange	
in systemic artery / entering tissue capillaries	pO_2	13.33 / higher	< 5.33 / lower	into tissue from blood	;
	pCO_2	5.33 / lower	> 6.00 / higher	out of tissue into blood	;

[max 4]

R differences between pO_2 and pCO_2 in the same place

[Total: 11]

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1 (a) (i) **A** phospholipid **;** (1)
B protein **;** *ignore protein descriptions* **R** glycoprotein **R** lipoprotein (1) [2]

(ii) polar / hydrophilic, head / group **;**
attracted to / AW, water / aqueous environment **; A** water-loving
ref. hydrogen bonding (polar head to water) **;**

non-polar / hydrophobic / hydrocarbon / fatty acid, tails / chains / groups **;**
repelled by / away from, water / aqueous environment **;** AW **R** water-hating [max 3]

(b) C *any one of*
(channel) allows, ions / water / polar molecules / water-soluble molecules / hydrophilic molecules, to, pass through membrane / enter cell / leave cell **;**
R transport, without qualification e.g. across, through
facilitated diffusion **;**
active transport **;** (max 1)

D *any one relevant e.g.*
cellular recognition
cell identification
antigen
cell signalling
receptor
binding site
ref to hydrogen bonding with water / forms bond with water to stabilise membrane
cell adhesion (max 1) [2]

(c) 1764 **;;**

if correct working (588 × 3) is shown, but no answer or incorrect answer, award one mark [2]

[Total: 9]

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2 (a) *Mycobacterium tuberculosis* / *Mycobacterium bovis* **;** (1)

(infected person) coughs / sneezes / spits / exhales / breathes out / aerosol (infection) / droplet (infection) / moist air (containing the pathogen) **;**
(uninfected person) inhales / breathes in / inspires **;**
ignore ref. to cattle
treat ref. to virus etc as neutral (2) [3]

(b) 1 ref. patient does not complete course / takes inadequate dose / stops taking when feels better **;**
2 problems with continuing supply (of antibiotics) **;**
3 not all bacteria killed **;**
4 ref. mutation to become resistant **; R** immune
5 likelihood of resistance increases if only one antibiotic used **;**
6 ref. to changes in bacterium to enable resistance **;**
7 ref. to changes in host cell (membrane structure) **;**
8 AVP **;** e.g. repeated exposure to different drug regimes (because of mp. 1)
exposure to bacteria with different resistance [max 2]

(c) 1 ref. to, worldwide incidence of TB / TB found worldwide **;** AW
2 highest, incidence / AW, (sub-Saharan) Africa / LEDC / developing countries **;**
3 problem with, vaccine / BCG, qualified **;** e.g. doesn't work well, everywhere / in Africa / in Far East
doesn't work well for all ethnic groups
less efficient with age
ref. cold chain / needs to be kept cold
knowing when enough people vaccinated
ref. to cost
R vaccine doesn't work
4 difficult to identify infected people / ref. symptomless carriers / AW **;**
5 difficulty with, contact tracing / described **;**
6 difficult to diagnose / time to diagnose (can infect others) **;**
7 ref. to transmission from animals to humans **;**
8 weakened immune systems / link with HIV/AIDS / TB is opportunistic **;**
9 ref. social factor **;** e.g. overcrowded living conditions, poor diet, remote areas
10 coordination of, vaccine / treatment **;**
11 ref. to difficulty of administering, drugs / DOTS **;**
12 lack / availability, of trained personnel **;**
13 ref. to political problems **;** e.g. war , unstable regimes, refugees, migration
14 cost, qualified with additional relevant point **;**
15 AVP **;** e.g. ref. to countries (e.g. Russia) with large area / low population density,
16 AVP **;**ref. to quarantine problems, travel qualified, other social factor [max 5]

[Total: 10]

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3 (a) (i) glucose and fructose **;** *ignore monosaccharides* [1]

(ii) **1** active site, gives specificity **;** **A** specific active site
ignore ref to specific substrate
2 substrate binds with active site or enzyme-substrate / E-S, complex forms **;**
3 complementary (shape) / substrate fits into active site **;** **A** 'lock and key'
A matching shape
R 'same shape'
4 induced fit / described **;**
5 further detail of substrate and active site **;** e.g. binding by hydrogen bonding, e.g. transfer of electrons
6 lowers activation energy / described e.g. causes strain in substrate / AW **;** **A** Ea
7 breaks glycosidic bond **;**
8 glucose and fructose / products, no longer fit / AW **;** [max 4]

(iii) non-competitive (inhibition) **;**
irreversible (inhibition) **;** [max 1]

(b) (i) idea of, hydrolysis / product formation / further metabolism, lowering sucrose concentration (in, companion cells / sink cells) **;**
maintains, concentration / diffusion, gradient (between phloem sieve tubes and, companion cells / sink cells) **;**
to remove sucrose from the phloem (sieve tubes) **;**
AVP **;** e.g.ref. easier transport of, glucose / fructose, through membranes **;** [max 2]

(ii) ref. facilitated diffusion out / may be lost from cells **;**
products / glucose / fructose, are soluble / AW **;**
(so) will lower the water potential / water potential becomes more negative **;**
causes water to move into cells by osmosis **;** **A** osmotic, problems / stress
reactive / easily metabolised, qualified **;** e.g. so interferes with, other metabolic processes / cell chemistry **A** more reactive than starch [max 3]

[Total: 11]

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4 (a) **R** if mark points are in context of secondary response

sensitised / activated / AW, by (foreign) antigen / epitope **;** *accept once only*
correct ref. specificity **;** *accept once only*
production of memory cells **;** *accept once only*

T lymphocytes
(T-helper / Th) secrete, cytokines / lymphokines **;**
(T-helper / Th) stimulate, B cells to divide **; A** stimulate humoral response
(T-killer / Tk / T-cytotoxic / Tc) secrete, perforin / hydrogen peroxide / AW **;**
A toxins
R hormones
(T-killer / Tk / T-cytotoxic / Tc) kill / destroy / AW, non-self cells / pathogens / infected cells **;**
(T-surpressor / Ts) ref., surpresses / reduces, response (on recovery) **;**

B lymphocytes
formation of plasma cells **;**
antibody production **;** [max 4]

(b) no more antigen / AW **;**
(remaining) antibodies, removed from the blood / broken down (in the liver) **;**
R excreted
plasma cells, are short-lived / begin to die / are not replaced **;**
no more antibody produced **;**
AVP **;** e.g. detail of removal / macrophage engulfs, digested, peptide bonds broken [max 3]

(c) line drawn continuous with that provided **;**
and rising more steeply before day 55 **;** *should start to rise from day 40 / should rise more steeply initially /should not remain as a plateau from day 40*

reaches higher than primary response between day 45-55 and, peaks / plateaus **;**
must not go below the day 40 antibody concentration [3]

[Total: 10]

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5 (a) 1 thin (alveolar) walls / one cell thick / thin epithelium / squamous epithelium **;**
A pavement epithelium
R thin cell wall
R thin layer
2 short diffusion distance (between air and blood) **;**
3 elastin / elastic fibres **;**
4 stretch to increase surface area / increase surface area on inspiration / recoil to expel air **;**
5 ref. to maintaining, diffusion / concentration, gradient **;** *linked to marking points above*
6 large surface area for, diffusion / AW **;**
7 some cells secrete surfactant **;**
8 prevent collapse **;** [max 3]

(b) (i) (cigarette / tobacco) smoking **;**
infection **;**
inflammation / detail of inflammation **;**
(excessive) coughing **;** [max 1]

(ii) *max 1 for structure*
fewer alveoli **;** **A** alveolar walls broken down / fewer air sacs / alveoli burst / alveoli destroyed / reduced surface area **R** elastin broken down
or
fewer capillaries **;**

effect
less gas exchange / less uptake oxygen / less removal carbon dioxide **;** [2]

(c) *look for symptoms*

shortness of breath / breathlessness / AW **;** **A** breathing difficulty
wheezing (on inspiration) **;**
rapid breathing rate / hyperventilation / decreased ability to hold breath **;**
R heavy breathing
chest, tightness / pain **;**
cyanosis / bluish appearance to the skin / AW **;** **A** pale
fatigue / tiredness / lethargy / weakness / dizziness / reduced mobility / AW **;**
coughing / coughing up blood **;**
lots of / AW, mucus produced / much phlegm **;**
expanded / barrel, chest **;**
R refs to oxygen concentration of the blood
R small vital capacity [max 3]

[Total: 9]

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6 (a) (i) (for) chlorophyll (structure / synthesis) **;**
(for) ATP functioning **;**
(for) enzyme functioning / enzyme cofactor **;**
signalling ion / regulates carbon fixation **;**
(for) DNA / RNA, synthesis **;**
stabilises, DNA / RNA, structure **; A** required in translation
(matrix of) bone **;** [max 1]

(ii) mutualistic association / AW **; A** ref. to mycorrhiza
qualified**;** e.g. further detail of relationship, named nutrients

arrow from plant to fungi
ref. (some) fungi are, parasitic / pathogenic (on plants) **; A** pathogens
leakage (from plants) of assimilates **;**

arrow from fungi to plant
plants absorb nutrients, excreted by fungi / from decomposition by fungi **;** [2]

(b) (i) 5th / 6th **; A** top carnivore [1]

(ii) idea of little energy available, at / towards, top / end, of food chain **;**
too few organisms in level below **;**
expend much energy catching animals in trophic level below **;**
to obtain, a wider range of / varied, nutrients **;**
reduced competition **;** [max 2]

(c) (i) *community*
all, populations of all species / organisms, living in a particular area, at one time / AW **;** (1)

habitat
place / location / environment / AW, where, a population / an organism, lives **;**
A community (1) [2]

(ii) soil is source of nutrients for, plants / producers **;**
plants / producers, provide energy for ecosystems **;**
ref. recycling nutrients (by soil organisms) **;**
ref. to importance of, carbon / nitrogen, in, organic / complex molecules **;**
AVP **;** e.g. detail of nutrient cycling, maintains balance of nitrogen in air [max 3]

[Total: 11]

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