Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **October/November 2016**

MARK SCHEME

Maximum Mark: 60

Published

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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
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

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1 (a)

A nuclear envelope **;** **A** nucleus **A** nuclear membrane
I nuclear pore

B mitochondrion **;** **A** mitochondria **A** mitochondrial envelope

C lysosome / Golgi vesicle / secretory vesicle **; A** vesicle / vacuole **A** plural
I qualification e.g. transport / temporary / phagocytic [3]

(b) ribosome(s) / cell surface membrane **; A** vesicles **A** plasma membrane **I** cytoplasm [1]

(c) *two from*
organise microtubules **;**
(to), form spindle / assemble spindle fibres (in prophase) **;** AW
ref. to centriole pair / centrioles, at (both) poles **; R** if description is linked to incorrect mitotic stage
ref. to role in contraction of spindle fibres, at anaphase / to separate sister chromatids **;**
AVP **;** e.g. make microtubules (as part of the centrosome) [2]

(d) *three from*
(sodium ions are) charged / hydrophilic **; I** *ref. to* size / polar
cannot pass through hydrophobic, core / interior, (of phospholipid bilayer) **;**

(so) must pass through, transport proteins / carrier proteins / channel proteins *(facilitated diffusion)* **;**

ref. to hydrophilic (amino acids lining) channels **;**
ref. to active transport only way to move sodium ions against concentration gradient / AW **;** [3]

[Total: 9]

2 (a) (i) loss of water vapour from the, leaves / aerial parts of a plant **;**
R water evaporates from the surface of the leaf [1]

(ii) *each factor 1 mark, explanation for each factor 1 mark*
look for ora for explanation

temperature **; I** high / low or hot / cold

increased temperature, increased rate as higher rate of, evaporation (from spongy cell surfaces) / diffusion (of water vapour out via stomata)
or
at very high temperature stomata close so transpiration, stops / slows **;**

humidity **; I** high / low

one from
increased humidity, decreased rate as, less steep water potential gradient / decreased diffusion rate (of water vapour out via stomata) **;**

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wind (speed) / air movement **;** **I** fast / slow

higher wind speed steeper, water potential gradient / higher diffusion rate
(of water vapour out via stomata) / diffusion shells do not build up /
wind moves moist air away / AW
or
at high wind speed the stomata close so transpiration slows **;**

water availability **;** **I** high / low
reduced water availability causes stomata to close (so reduced rate of
diffusion)
or
more water available, steeper water potential gradient between roots and leaves **;**

light intensity **;** **I** high / low

higher light intensity, increased rate as stomata open more widely
A more light (as ecf from stating factor)
or
at very high light intensity the stomata close so transpiration slows **;** **A** stops [4]

(b) *three from*
cohesion and adhesion **;** *in correct context*
transpiration stream / transpiration pull **;** **A** continuous column of water moving up (to leaves)
attraction / cohesion, between water molecules **;** **A** water is cohesive
A stickiness between water molecules
adhesion / AW, of water molecules to lining of xylem (vessels) **;**
only needs 'molecules' once
adhesion to / AW, cellulose molecules / hydrophilic parts of lignin **;** [3]

[Total: 8]

3 **(a)** **(i)** peptide and disulfide **;** **R** sulfide [1]

(ii) sequence / arrangement / order, of amino acids **;** **I** *ref. to* disulfide bonds [1]

(b) **(i)** breaking a (covalent) bond with addition of water **;** [1]

(ii) peptidoglycan / murein **;** **A** carbohydrate / polysaccharide / amino sugar [1]

(iii) *four from*
substrate shape not (exactly) complementary to active site shape / AW **;**

active site (partially) flexible / changes shape slightly, when substrate,
enters / binds **;**
(so) active site and substrate, now complementary / better fit **;**

(allows) formation of enzyme-substrate complex **;** **A** ES complex / ESC

AVP **;** e.g. role of R-groups in active site interacting with substrate
lowers, activation energy / E_A, so products form [4]

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(c) outside cells **;** *can be in a general context or in context of enzymes* [1]

(d) (i) 2.9 mmol **; A** 2.75–3.0 mmol [1]

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

(e) single graph line with lower gradient **;**
reaches or approaches plateau **;** [2]

[Total: 13]

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

(ii) **R** if other modes of transmission listed

ref. to 'infected' and 'uninfected' not required (as in question) but statements must be in correct context

I polluted water

one mark for infected person
passed in, faeces / stools / sewage **; R** waste, unqualified

one mark for uninfected person
ingests / eats, contaminated, food / crops
or
drinks / ingests, contaminated, water / liquids **;**
A uses utensils washed in contaminated water / AW

if above 2 mps not gained, one mark for
idea of (infected person) sharing drinking bottles / utensils (with uninfected person)

two marks for
faecal-oral, route / transmission **;;** [2]

(iii) **A** poor sanitation *once only for mp 1 or 3*
two from
1 damage to, sewers / drains / foul water systems **;**
2 (so) mixing of sewage and drinking water **;**
3 (contaminated) water supplies cannot be treated **;**
A water (for drinking) from untreated (contaminated) sources
4 *ref. to* spread by flies exposed to, contaminated faeces / untreated sewage **;**

5 *idea of* people in high density temporary accommodation facilitating spread **;**
6 unable to practice good hygiene **; A** examples e.g. lack of soap
restrictions on (treated) water for cleaning
7 unable to thoroughly cook foods **;**
8 need to share (contaminated) water containers / cooking pots / AW **;**

9 disruption to health care facilities / AW **; A** example
e.g. lack of ORT (so higher proportion of infected people)

10 AVP **;** e.g. increased risk of malnutrition linked to increased risk of disease [2]

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(b) (i) *two from*

different mRNA codon (formed during transcription) **;**
A triplet / triplet of bases / triplet code / 3-base code
R codons

idea that, each codon specifies a particular amino acid / a different codon specifies a different amino acid **; A**

(different) tRNA with different amino acid binds to, ribosome / mRNA **;** [2]

(ii) *two from*

change in, tertiary / quaternary, structure (of enzyme) **;**
A change in polypeptide, folding / coiling **;**

(enzyme) binding site for antibiotic, lost / changes shape **;**
R active site *unless clear that substrate binding and catalytic site remains unchanged*

antibiotic / nalidixic acid, cannot bind (so enzyme remains active) **;**
allow ecf for active site [2]

(c) *four from*

1 risk of, further spread / wider epidemic, (from people still infected) **;** AW
2 reduces chance of succesful treatment / higher death rates **;**
3 increased, treatment / hospitalisation times **; A** takes longer to treat
A more complex treatment
4 increased costs of treatment / strain on health budget / AW **;**

5 risk of, further resistance / resistance to all antibiotics **;**
6 fewer antibiotics left that are effective **;**
A risk that no antibiotics will be left to successfully treat

7 need to find, new antibiotics / alternative treatment **;**
A difficulty in finding new treatments / AW
8 (so) cost of research **;** *allow cost once*

9 AVP **;** e.g. strain on, resources / health personnel, to treat other diseases
need to identify type of resistance so that effective treatment is given
education, qualified [4]

[Total: 13]

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5 (a) (i) antigen binding site / variable region / V_H and V_L **;** **A** F_V [1]

(ii) *four from*

1 *ref. to* monoclonal antibody, is recognised as, non-self / foreign **;**
or
diseased cell (now) recognised as non-self / foreign **;**

2 stimulates an immune response **;**

max three suggestions from

3 recognition and binding by / activation of / AW, T-lymphocytes / B-lymphocytes / AW **;** **A** clonal selection
A T- / B-, cell

4 *ref. to* specificity so healthy cells not destroyed **;**

5 clonal expansion / mitosis **;**

6 plasma cells (formed that) secrete antibody **;** **A** B-lymphocyte

7 consequence **;** e.g. antibody binds monoclonal antibody to lead to cell destruction

8 T-helper lymphocyte secretes cytokine, to activate macrophages / B-lymphocyte response / T-killer response **;** AW
e.g. stimulates humoral response

9 T-killer / T-cytotoxic, releases, perforin to, punch holes in (cell) membrane / cause death of cell **;** AW

10 detail of involvement of phagocytes / macrophages **;**
e.g. receptor recognition of (monoclonal) antibody
engulf the diseased cells with monoclonal antibody attached / AW
A diseased cell (with monoclonal antibody) destroyed by phagocytosis [4]

(b) *one of*
failure to distinguish self and non-self (antigens) **;** **A** foreign *for non-self*
immune response / antibodies produced, against self antigens **;**

in context of lack of good health **R** does no harm [1]

[Total: 6]

6 (a)

	cartilage	cilia	elastic fibres	
trachea	✓	✓	✓	;
bronchioles	✗	✓	✓	;
alveoli	✗	✗	✓	;

[3]

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(b) *changes max 2*
fewer / no / damaged / AW, cilia **;** **A** paralysed / destroyed **R** killed
A ciliated (epithelial) cells destroyed
scar tissue, develops / replaces ciliated (epithelial) cells / AW **;**
goblet cells enlarged **;**

increased risk max 2
thicker layer / more, mucus traps bacteria **;**
mucus not removed (by cilia action) so, (trapped) bacteria remain / longer time for bacteria to infect cells / AW **;**
bacteria multiply / bacterial population growth, in mucus
(so increases chance of infection) **;** [3]

(c) *four from*
oxygen used up in (aerobic) respiration (in tissues) **;**
low(er) / decrease in, partial pressure of oxygen / AW **;**
allosteric mechanism / described **;**
small decrease in partial pressure leads to a large dissociation of oxygen **;**

ref. to decrease in haemoglobin affinity for oxygen (so oxygen released) **;** AW

high(er) CO_2, partial pressure / AW **;**
haemoglobinic acid formation / H^+ combines with haemoglobin (causes oxygen release) **;**
AVP **;** e.g. H^+ from carbonic acid dissociation
A H^+ results from action of carbonic anyhydrase to form carbonic acid
effects of carbaminohaemoglobin formation [4]

(d) too large to pass through, (endothelial) pores / capillary walls **;** [1]

[Total: 11]

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1 **A** = chloroplast **;**
B = tonoplast **; A** vacuolar membrane
C = spindle / spindle fibre(s) **;**
D = (bacterial / prokaryotic) cell wall **; R** eukaryotic / cellulose / chitin / plant
E = nucleolus **;** [5]

[Total: 5]

2 **(a)** **(i)** tubing drawn more swollen **;** [1]

(ii) *three from*

1 (mass) increased / AW **;**

2 water in by osmosis **; A** diffuse in by osmosis

if direction of water movement is out in mp2, allow ecf for mp 3

3 lower / more negative, water potential / Ψ **(**inside tubing) **;** ora

A down the water potential gradient / from high to low water potential / from less negative to more negative water potential
R across
R water moves from a high water potential gradient to a low water potential gradient
I *ref. to*, solute / osmotic, potential
I water moves down the concentration gradient

4 sucrose too large to leave (tubing) / pores too small for sucrose to leave **;**

5 (Visking tubing) partially permeable membrane **; A** selectively-permeable [3]

(b) *'source' and 'sink' not required but statements should be in correct context*

three from (source)

1 *idea that* sucrose presence in, phloem / sieve tubes, causes, low(er) / more negative, water potential / Ψ **;** AW
A assimilates / photosynthates / sugars / named, *for sucrose*

2 water, enters / AW (sieve tube by osmosis) **;** *can be in context of direct entry or from surrounding cells* **R** from root hairs

3 presence of water increases hydrostatic pressure **; A** turgor *(for hydrostatic)*
A *idea of: causes high(er) hydrostatic pressure because of entry of water (hence increase in volume)*

(sink)

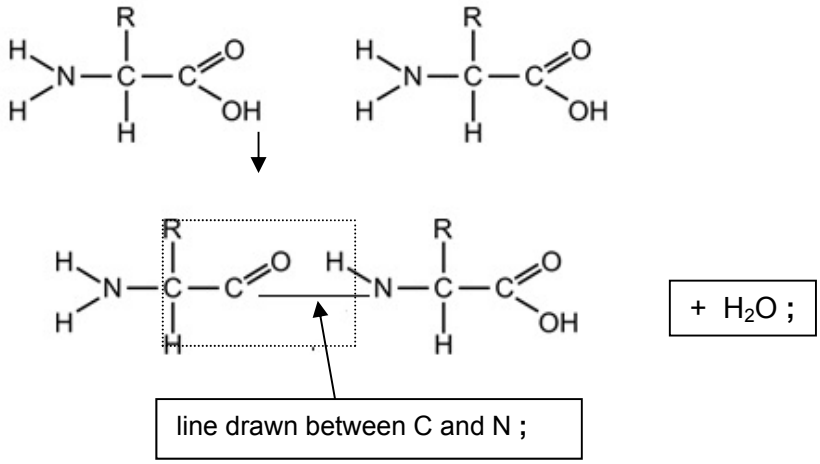
4 *idea that* water follows sucrose (via companion cell to sink cells, hence osmosis) **;**

5 lower hydrostatic pressure (at sink) **; A** low *if in context of high at source hydrostatic or turgor needed only once (in mp3 or mp5)*

6 movement / mass flow (of sap), down a pressure gradient / from high to low pressure **; R** if osmosis implied for mass flow [3]

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(c) *can gain 2 marks if printed diagram is clearly modified to show correct bond and formation of water or/and if described as text*



dotted line area is minimum to gain mark
'peptide bond' label not required to gain mark

bond forms between the C of the carboxyl group and the N of the amino group **;**
A amine *for amino*
water / H_2O, is formed **; A** condensation (reaction) **R** hydrolysis [2]

[Total: 9]

3 (a) *two from*

fructose		*sucrose*
no glycosidic bond **;**	(v	glycosidic bond) *look for ora*
monosaccharide / one sugar unit **A** monomer *('sugar', is in question)*	v	disaccharide / two sugar units / fructose and glucose **;** **A** two monomers / dimer **I** polysaccharide

R if a disaccharides is stated as one of the two monomers

A sucrose is a disaccharide made from the monosaccharides glucose and fructose

one ring (structure)	v	two rings **; A** *sketch to show one ring v two rings*
$C_6H_{12}O_6$ **A** fewer / less, C and H and O atoms	v ora	$C_{12}H_{22}O_{11}$ **;**

additional points accepted

powder	v	crystalline
linear or ring structure	v	two rings / only ring(s)
reducing, end / AW	v	(no reducing ends)

I reducing sugar **I** non-reducing sugar [2]

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(b) *look for ora throughout if describing the other enzyme with low optimum*

three from

1 *idea of* can use high(er) temperatures for process **;**

2 increased temperature increases, number of collisions (between enzyme and substrate) / number of ES complexes (formed) **;**

3 more product / high(er) rate of reaction **;** AW

4 less prone to denaturation **;** **A** won't denature
A described in terms of loss of active site

5 more stable / lasts longer **;** **A** thermostable **A** reused over and over
I temperature resistant [3]

(c) *accept 'glucose isomerase' for 'enzyme'*
accept '100 percent activity' for 'maximum activity'
accept (initial) rate of reaction for activity

penalise once if 'pH' and/or percentage activity (or %) not stated

three from

1 maximum / peak of, activity, at lower pH for free enzyme ora
or
free enzyme lower optimum pH ora
or
free enzyme pH 7.4 / 7.5 / 7.6 v immobilised pH 8.5 **;**

2 free enzyme has higher / AW activity, at pH, 6 / 6.5 / 7 / 7.5 **;** **A** up to pH 8
ora for immobilised (lower up to pH 8) *
or
free enzyme has higher activity over greater range of pH** (between pH 6–9) **;**

3 data to support mp 2 **;** ***any one pH and comparative activity***
***** needs two pHs and comparative activities***
A manipulated data

4 free enzyme has lower activity, pH 8 to pH 9 **;** **A** after pH 8.0
ora for immobilised (higher after pH 8)

5 data to support mp 4 **;** *any one pH and comparative activity / manipulated data*
increase to max activity

6 free enzyme has (slightly) steeper increase in activity as pH increases to pH 7 **;** ora

7 data to support mp 6 **;**

allow ecf to 2 max if free and immobilised the wrong way round but <u>all</u> statements are correct [3]

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(d) (i)

amino acid sequence	met	tyr	glu	pro	lys
student's nucleotide sequence	AUG	UAU	GAC	CCU	UGU
correct = ✓ incorrect = ×	✓	✓	×	✓	×

one mark if bottom row correct **;** [1]

(d) (ii) *three from*

1 genetic code is, degenerate **; A** redundant

2 64 codons and 20 amino acids **;**
A 61 codons for 20 amino acids (*3 STOP codons)*

3 *idea that* more than one, codon / triplet, specifies an amino acid **;**

specific to the first five amino acids of glucose isomerase

4 example of choice of codons to specify the same amino acid **;**
(must use Table 3.2 to find codons for the amino acids from Table 3.1)
tyr UAU UAC
glu GAA GAG
pro CCU CCC CCA CCG
lys AAA AAG
use of another example from Table 3.2 may be used to support mp3

5 AVP **;** e.g.
start codon always AUG / met has only one codon, so only sequence for amino acids 2-5 may be different
start codon, may be different / may not always be AUG $_{met}$ [3]

[Total: 12]

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4 (a) *allow middle coat / intermediate layer / middle layer, for tunica media*
allow adventitia for externa

one from
a thick tunica media **;**
a thicker tunica media than tunica externa **;** ora

a thick layer of, (smooth) muscle / muscle and elastic tissue **;**
A thick muscular wall
R striated / skeletal, muscle
many (layers of) smooth muscle cells **;**

a, well-defined / firm / oval / regular / AW, shape (in cross section) **;**

narrow / AW, lumen in relation to thickness of wall **; A** narrow lumen

convoluted / folded / AW, endothelium / tunica intima **;** [1]

(b) *2 correct functions with no link to a structural feature – award one mark only*

R muscle / collagen, stretching and recoiling / recoiling
R elastic tissue contracting and relaxing

two from
1 (smooth) muscle / elastic tissue, maintains (blood) pressure **;**
A increases blood pressure

2 thick (tunica media) / elastic tissue / (smooth) muscle / collagen (fibres), withstands high pressure / prevents rupture / AW **;** **A** bursting

3 elastic tissue to smooth out (pulsatile) flow **; R** smooths flow to give pulses

4 muscle / elastic tissue, helps to, maintain blood flow / move blood / keep blood moving forwards / AW **;**
R *idea of* pumping / forcing blood forward / pushing blood

5 (smooth) muscle, contraction / relaxation, altering volume of blood delivered **;**
A *idea of*, diverting blood / regulating blood flow
I muscle dilates [2]

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(c) magnification = image diameter ÷ actual diameter **;** **A** M = I ÷ A

allow one mark only if correct answer but units given

if calculation is shown measurement must be correct and working must lead to correct answer

× 3.5 **;;** 18 (mm) / 5.2 (mm) = 3.46
A × 4 if correct working, and / or, 3.5 shown
A × 3 if 3.46 only shown from correct working

other acceptable answers using same criteria
× 3.3 **;;** 17 / 5.2 = 3.27 **A** × 3

× 3.4 **;;** 17.5 / 5.2 = 3.37 **A** × 3

× 3.6 **;;** 18.5 / 5.2 = 3.56 **A** × 4

× 3.7 **;;** 19 / 5.2 = 3.65 **A** × 4 [3]

(d) *three from*

1 (good) solvent **;** **R** organic solvent

2 statement linking solvent properties to role of plasma **;** e.g.
standalone statements do not need mp1
polar molecules / ions / ionic compounds / named substance(s), dissolve in, water / plasma **R** blood cells
ions dissociate, in water / plasma
many / AW, substances dissolve in, water / plasma **R** blood cells
water is attracted to (many different) substances
water / plasma, is the transport medium for substances / transports substances
presence of solutes to maintain (constant) water potential

3 cohesion between water molecules / water is cohesive **;**
A water molecules are sticky

4 so, continuous / uninterrupted / AW, blood flow **;** *in context of mp3*

5 high specific heat (capacity) **;**

6 statement linking high specific heat capacity to role of plasma **;**
allow ecf for high heat capacity / specific heat capacity
e.g. helps, stabilise / (body to) regulate, temperatures
helps maintain constant (blood) temperature
water resists changes to temperature

7 high (latent) heat of, vaporisation / evaporation **;**

8 in body temperatures, plasma stays liquid / water does not evaporate **;** AW

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other acceptable points – note that mps 10, 12, 14 are linked to water property

9 low compressibility **;** **A** incompressible

10 maintains efficient blood flow / helps to push blood through vessels **;** AW

11 low viscosity **;**

12 allows efficient circulation of blood / AW **;**

13 pH 7 / neutral **;**

14 *ref. to* stability proteins **;** **A** prevents denaturation [3]

[Total: 9]

5 (a) (i) *non-infectious to max 1*
not caused by a pathogen **;** **A**
not, communicable / transmissible **;** **A** not passed from one living, organism / person, to another AW

disease to max 1
R *if in context of an <u>infectious</u> disease*

abnormal condition (affecting an organism) / condition that reduces the effectiveness of the functions of the organism / lack of good health / AW **;** [2]

(ii) *four from*

1 *ref. to* mutation **;**

2 further detail **;** e.g.
change in sequence of, nucleotides / bases, of, DNA / gene
tumour suppressor gene, switched off / stops functioning / alters / AW
formation of oncogene
proto-oncogene altered

3 uncontrolled, mitosis / cell division / cell replication **;** AW

4 *ref. to* changes to checkpoints / coordination of cell cycle lost **;**
A cell does not, receive / respond to, signals (to stop dividing)

5 loss of function / lack of differentiation / lack of specialisation / AW **;**
allow loss of function idea if referring to the mass of cells

6 other detail of, tumour cell / cellular changes **;**
e.g. immortal / no apoptosis / no programmed cell death
no contact inhibition / grows to invade healthy tissue / AW
more protein synthesised (for growth)
(release cell signalling molecules for) vascularisation / blood vessel formation
changed size compared to normal cell size
telomeres do not shorten / AW [4]

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(b) (i) **A** = protoctist **;** **A** protoctista, protist(a), protozoa(n), sporozoa(n)
B = bacterium **;** **A** bacteria

[2]

(ii) aerosol infection / droplet infection **;** **A** described **A** airborne droplets
A direct contact **;** **A** *description in this context,* e.g. body contact [1]

(iii) smallpox **;** [1]

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

(c) *three from*

1 vaccination, gives (active) immunity / stimulates an immune response **;**
must be in context of active artificial immunity

2 detail **;** e.g. primary immune response
clonal, selection / expansion (specific, B / T, lymphocytes)
formation of antibodies
formation of memory cells
artificial active (immunity)

3 secondary (immune) response, when, pathogen / antigen, present
or
presence of antigen / pathogen, gives, faster response / higher antibody production / AW **;** **R** disease (for antigen / pathogen)

4 (effects of vaccination / immunity) long-lived / AW **;**
A memory cells remain (in circulation) for a long time

5 herd effect **;**

6 explained **;** e.g. sufficient, (successfully) vaccinated / immune, so, susceptible / non-vaccinated, people protected

7 stops the transmission cycle **;**
A less people with disease so reduces spread

8 AVP **;** *ref. to* ring vaccination [3]

[Total: 14]

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6 (a) (i) **J** = mitosis ; **A** mitotic division **I** nuclear division
R mitotic cell division
K = cytokinesis; **A** cytoplasmic, division / cleavage **I** cell division
L = interphase; [3]

(ii) interphase ; **A** S-phase / synthesis phase / late interphase
R early interphase [1]

(b) (i) bone marrow ; [1]

(ii) lobed / irregular ; [1]

(iii) lysosomes / vesicles ; [1]

(c) (i) *two from*
ref. to loss of control over entry and exit substances ;
A membrane no longer partially / selectively, permeable
A becomes more permeable
lose, ions / nutrients ; **A** gains, ions / nutrients
lose water ; **R** gains water *(as cell wall still intact)*

metabolic reactions, prevented / impaired ; AW
enzymes no longer function ; AW

water potential affected ;
increase or decrease depends on rest of answer
e.g. gains ions so decreases water potential

cytoplasm shrinks ; AW **R** lysis / bursting
contents leak out ; [2]

(ii) breakdown / weaken / digests / AW, cell wall ; **A** destroyed / damaged
I breaks cross-links / cross-links cannot form

(water enters so) lysis occurs / bursts / AW ; [2]

[Total: 11]

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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)

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1 (a) *one mark per column* [4]

feature	amylopectin	cellulose	RNA	polypeptide
synthesised from amino acid monomers				✓
contains glycosidic bonds	✓	✓		
polymer is branched	✓			
contains nitrogen			✓	✓
can be found in both animal and plant cells	;	;	✓ ;	✓ ;

(b) *points can be awarded as annotations to the diagram*

*max 2 for structure – **mp1** to **mp3***

1 *ref. to* hydrophilic / polar, phosphate, head / group
and
hydrophobic / non polar, hydrocarbon / fatty acid, tails / chains **;**
R *if labelled correctly but incorrectly described in the text*
2 *ref. to* forms part of a bilayer **;**
3 (fatty acid) tails / chains, may be saturated or unsaturated **;**

*max 2 for function – **mp4** to **mp7***

head
4 forms hydrogen bonds with water / interacts with water / AW **;**
5 stabilises the membrane **;**

tails
6 *idea that* unsaturated fatty acids contribute to fluidity (of membrane) **;**
7 barrier to, hydrophilic substances / water soluble substances / polar substances / ions / AW **; ora**
A movement of, non-polar / AW, substances [3]

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(c) *max two components, one mark each*
one mark for function to match the stated component

I carbohydrate chains *for component but allow ecf 'cell recognition' for function*

glycoprotein **;**
one of
antigen / markers / tags / described in terms 'self' **;**
receptor (for signalling molecule) / AW **;**
cell recognition **;**
cell adhesion **;**
interacts / AW, with water to stabilise the membrane **;**

cholesterol **;**
one of
stabilises membrane **;**
regulates / maintains / AW, fluidity of membrane **;**
A in low temperatures increases fluidity / in high temperatures decreases fluidity
prevents passage of ions / polar molecules, through membrane **;**

glycolipid **;**
antigen / markers / tags / described in terms 'self' **;**
cell adhesion **;**
interacts / AW, with water to stabilise the membrane **;**

protein **; I** *any qualification of component* e.*g. channel / carrier / transport*

receptor (for signalling molecule) / AW **;**
enzyme / co-enzyme **;**
anchoring cytoskeleton ;
for cell to cell adhesion / any named type *e.g. desmosome, tight junction* **;**

channel / carrier, allows facilitated diffusion / description **;**
A for, protein **/** carrier protein **/** channel protein / transport protein

carrier, for active transport / description **;**
A for protein **/** carrier protein **/** transport protein [4]

[Total: 11]

2 **(a)** *two from*
1 provide an alternative pathway **;**
2 brings reactants close together (in active site / to form ESC) **;**
3 put a strain on the reactant(s) **;**
4 so bonds, break / form, more easily **;**
5 transfer of, charges / groups **;**
6 AVP **;** e.g. involvement of R groups [2]

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(b) (i) *quoting figures with no qualitative description = **mp4** only*

four from

1 as time increases the concentration of PABA increases **;**

2 increasing the concentration of inhibitor, decreases concentration of PABA / slows the reaction **;**

3 from 0 to 2 / 2.5 / 3 minutes, no difference in concentration of PABA produced / same rate, for all concentrations of inhibitor **;**

4 use of data **;** *from plotted points or from curves*
e.g. concentrations of PABA at different times for any one inhibitor
e.g. concentrations of PABA at same time for two different inhibitor concentrations
e.g. concentration of PABA = 2 – 3.5 μM at a specific time

5 AVP **;**
e.g. for all concentrations of inhibitor, rate becomes less steep after approximately 5 minutes
e.g. for last 20 minutes rate of reaction is linear (for all or any one concentrations of inhibitor)
e.g. little difference, in rate / final [PABA], between 0 and 1 μM
e.g. greater difference, in rate / final [PABA], between 1 μM and 3 μM [4]

(ii) *three from*

1 carry out / AW, with different concentrations of substrate **;**
A use a low concentration and a high concentration of substrate *if a number of different concentrations of substrate without any reference to high and low this must be a minimum of 5*

2 with and without inhibitor **;**

3 all other variables constant **;**
A one key variable, e.g. enzyme concentration / temperature / pH

4 interpretation of results **;**
e.g. draw a graph to see change to, K_m / V_{max}
e.g. *idea that* if the effect of the inhibitor decreases with an increase in substrate concentration then inhibitor is competitive **ora**
e.g. competitive: increase in K_m / no change in V_{max}
e.g. non-competitive: no change in K_m / decrease in V_{max} [3]

(iii) *one from*
bacteria, cannot make / make less, folic acid, so they die / cannot grow / cannot reproduce / cannot multiply **;**
inhibitor targets only bacterial cells **;**
inhibitor will not harm human cells **;** [1]

(iv) *allow drugs for antibiotics throughout*

two from

1 *idea that* there are few targets for drugs **;**
A e.g. virus has no, cell wall / cell membrane / ribosomes

2 no / few, enzymes **;**

3 antibiotics only work on, growing / living, cells **;**
A viruses have no, metabolism / growth

4 viruses are inside (host) cells / not within reach of antibiotics **;**
R if antibodies

5 antibiotics do not work on, protein coat / capsid / viral envelope **;**
I capsule [2]

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(c) *two from*
do not use for viral infections **;**
do not use as preventative medicine **;**
antibiotics should only be used (for treatment) when necessary **;**

carry out antibiotic sensitivity test **;**
ensure, correct / effective, antibiotic, prescribed / used ; AW
ensure people take the correct dose **;**
ensure people complete the course of their antibiotic **; A** ensure people follow the instructions
ensure people do not use, left-over / other people's, antibiotics **;**
only supply on prescription / not over the counter / AW **;**

only use, wide / broad, spectrum antibiotic when pathogen not known **; A ora** use narrow spectrum antibiotic when pathogen is known
use more than one antibiotic (at the same time) **; A** mixture of antibiotics / antibiotics in combination
monitor antibiotics to check that they are effective **;**
report cases of antibiotic resistance **;**
reporting patterns of antibiotic resistance (temporal and geographical) **;**

rotate antibiotics so not used all the time **;**
keep some antibiotics to use as a last resort **;**
do not use the same antibiotics for animals as for humans **;**
reduce use of antibiotics in, food production / (livestock) agriculture **;**

use other antimicrobial drugs **;**
develop new, types of antibiotics / drugs, to kill bacteria **;**
ensure / improve, knowledge of, healthcare professionals / public **; A** *ref. to* education about awareness of antibiotic resistance
ref. to breaking transmission cycle / described example of a method **;** e.g. vaccines / good hygiene in hospitals
break transmission cycle of resistant bacteria / described example **;** e.g. quarantine [2]

[Total: 14]

3 (a) **A** = cortex / parenchyma **; A** cortical **R** cortical / parenchyma, cells

B = <u>endodermis</u> **; A** endodermal **R** endodermal cells / pericycle

C = xylem **; I** vessels / tracheids

D = phloem **; I** sieve tube (elements) [4]

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(b) *allow ecf from incorrect naming of **A** and **B** in (a)*

four from
*from **X** to endodermal cell (**B**) or **X** to **Y** to 3 max*

1 (movement of water) via cell membrane / via tonoplast / by osmosis **;**
2 (movement of water) through plasmodesmata **;** *do not award **mp1**for 'by osmosis through plasmodesmata'*
3 symplast pathway **;** *in correct context only*

*from after **B** to **Y** to 3 max*

4 water moves by apoplast pathway **;** *in correct context only*
5 water moves through cell walls **;**
6 via pits in cell walls of, xylem (vessel) / **Y** **;**
7 down a water potential gradient / described as higher water potential at **X** **;** [4]

[Total: 8]

4 (a) hydrogen (bond) **;** [1]

(b) *three from*

1 tRNA carries an amino acid to ribosomes **;**
2 (each type of) tRNA carries a specific amino acid **;**
3 anticodon (on tRNA) binds to <u>codon on mRNA</u> **;** *anticodon may be labelled on Fig. 4.1*
4 tRNA molecules hold amino acids, in place / in P and A sites (of ribosome), for peptide bond formation **;**
5 tRNA molecules, reused / described **; I** tRNA leaves ribosome unqualified
6 AVP **;** e.g. amino acid is attached to ACC region **I** examples of complementary base pairing between codon and anticodon [max 3]

(c) *max 2 if in context of making mRNA*

1 gene for each tRNA (molecule) is transcribed **;**
2 hydrogen bonds in DNA are broken **;**
I unwinding / unzipping
3 one strand of DNA is the template **;**
4 RNA polymerase **;**
5 (free RNA) nucleotides joined together / formation of phosphodiester bonds **;**
I complementary base pairing
6 AVP **;** e.g. correct ref. to helicase in breaking hydrogen bonds [max 3]

[Total: 7]

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5 (a) (i) 98.5 / 98 / 98.48 (%) **;** **R** 98.4 [1]

(ii) (in solution / dissolved) in the plasma / cytoplasm of red blood cells **;** [1]

(iii) *two from*
carbon monoxide, combines with haemoglobin / forms carboxyhaemoglobin **;**
irreversible / permanent / stable compound / AW **;**
reduces haemoglobin available to transport oxygen **;**

alveolar walls / elastin, broken down (in emphysema/COPD) **;**
less surface area for, absorption of oxygen / gas exchange **;** [2]

(b) *accept steps of reaction if in reverse – as in the lungs*

1 catalyses / AW, the reaction (in red blood cells), between carbon dioxide and water / to form carbonic acid **; A** correct equation
2 (carbonic acid dissociates to form) hydrogencarbonate ions / bicarbonate ions / HCO_3^- **;**
3 very fast reaction **;**
4 maintains (steep) concentration gradient for diffusion of carbon dioxide from tissues to blood **;**
5 catalyses reverse reaction in the lungs **;**
6 hydrogencarbonate ions / bicarbonate ions / HCO_3^- , diffuse / AW, into the plasma **;** [3]

(c) 1 Bohr, effect / shift **;**

AND

to max 2 ('more' only needs to be used once)
2 carbon dioxide decreases affinity of haemoglobin for oxygen **;**
3 more oxyhaemoglobin dissociates (than at a lower concentration of carbon dioxide) **;**
A oxyhaemoglobin dissociates more readily
A haemoglobin, releases / AW, more oxygen
4 more oxygen for (rapidly) respiring, tissues / cells **;**
5 to meet the demand for increase in (aerobic) respiration **;**
A to provide, enough / sufficient, oxygen for respiration
ora e.g. delays onset of / prevents, anaerobic respiration [3]

[Total: 10]

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6 (a) *Morbillivirus* **;** **A** *Morbilivirus / Morbili virus / morbillivirus* [1]

(b) *three from*
- **1** number of cases fluctuates (between 2008 to 2012 / in all years) **;**
- **2** number of cases (much) higher in 2010 **;**
- **3** epidemic lasted longer in 2010 **;**
- **4** highest peak is 42 000 – 43 000 in 2010 **; R** 45 000 **A** 30 000 – 35 000 in Africa
- **5** numbers are higher at beginning of each year (than at end) **;**
- **6** five, outbreaks / peaks / epidemics / AW **; A** four as no data before Jan 2008
- **7** numbers of cases in Africa are greater than in the rest of the world in every year except 2010 **; ora** numbers of cases in Africa were less than in the rest of the world in every year except 2010 [3]

(c) **I** *the term primary immune response*
I *any ref. to, T cytotoxic / T killer cells*

four from
- **1** antigen presentation **;**
- **2** clonal selection / described **;**
- **3** clonal expansion / described **;**
- **4** B-lymphocytes / B cells, develop / AW, into plasma cells **;**
- **5** plasma cells, secrete / produce / AW, antibody **;**
- **6** any correct ref. to T helper cells **;** [4]

(d) **I** virus mutates / different strains *(as one vaccine is effective)*

two from
- **1** measles introduced by people who caught the disease when abroad **;**
  A any e.g. tourists / visitors / travellers / returning tourists / migrants / displaced people
- **2** *idea that* herd immunity, needs to be >90% / is not 100% **;**
  A herd immunity not achieved
- **3** some people in these countries have not been vaccinated **;**
  A too young to receive vaccine / refusal of vaccination / live in remote places / war zones / AW **;**
- **4** some people do not respond to the vaccine **; A** people have weak immune system / malnutrition
- **5** some people do not receive booster(s) **;**
- **6** (reconstituted) vaccine is not thermostable / difficult to maintain the cold chain **;** [2]

[Total: 10]

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