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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9700 BIOLOGY

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

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;	separates marking points
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R	reject
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max	indicates the maximum number of marks that can be given
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AVP	alternative valid point (examples given)

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1 (a) microvilli **;** **R** villi

increase the surface area for absorption/movement across membrane/AW **;**
A excretion/secretion [2]

(b) (mitochondria) synthesis/AW, ATP **;** **R** energy **A** provide, energy/ATP
for active, uptake/transport **;** **A** any other active method such as pinocytosis/secretion [2]

(c) 4.7/4.8/5.0/5.2 **;;** **A** 5

$\frac{29\,\text{mm}/29\,000}{6000}$

or

$\frac{30\,\text{mm}/30\,000}{6000}$

Award one mark if answer incorrect or length incorrectly converted but correct formula used
i.e. image length divided by magnification of 6000 [2]

(d) secrete/make/produce/release mucus **;**
pathogens/bacteria/viruses/microorganism/dust/AW stick to mucus **;** **A** trapped by mucus
idea that pathogens/AW do not reach
the cells lining the trachea
or the cells lining the bronchi
or the alveoli **;**
prevents pathogens/AW entering the circulatory system **;**
reduces chances of infection **;** [max 3]

(e) thin(ner)/flat(ter) **;** **A** squamous not columnar **;**
(far) fewer mitochondria **;**
no microvilli **;** [max 2]

[Total: 11]

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2 **(a)** abnormal condition/abnormal state/disorder/ill-health/AW, qualified
e.g. having an adverse effect (on an organism)
reduces the effectiveness of functions
produces (specific) signs/symptoms
infectious and non-infectious causes ; [1]

(b) natural active ; artificial active ; natural passive ; artificial passive ;

Allow one mark for active and passive correct [4]

(c) number of cases fluctuates ; **A** description of increases and decreases over time

(overall trend) number of cases decreases (over time) ;
overall decrease, data quote to support ;
e.g. (India) 155 000/160 000 cases in 1950 to 0 in 1980
(all countries) 330 000 cases in 1950 to 0 in 1980
(India) 250 000/160 000 cases in 1951 to 0 in 1980
(all countries) 485 000 cases in 1951 to 0 in 1980

India/all countries, three major peaks ;
data quote to support ; e.g. 1951, 1958, 1974

eradication, no cases from 1975/1976, for India or 1978 for world ;
A (almost zero) from 1976 for world [max 3]

(d) 1 smallpox virus was stable/did not mutate ;
2 same vaccine was used for whole programme/vaccine did not need to be changed ;
3 vaccine was live/gave a strong immune response ; **A** effective
4 one dose was enough to give life-long immunity/no boosters required ;
5 heat stable/freeze dried vaccine ;
6 suitable for hot countries/isolated areas/rural areas ;
7 bifurcated/steel, needle, could be re-used/easier delivery/AW ;
8 herd/mass, vaccination/immunity ; **A** (many countries) mandatory vaccination
9 ring vaccination/ref. to contact tracing ;
10 few/no symptomless carriers ;
11 no animal reservoir/only in humans ;
12 infected people easy to identify ;
13 isolation of cases to prevent spread ;
14 AVP ; e.g. comparatively low cost, qualified; many volunteers became vaccinators/AW ;
[max 4]

[Total: 12]

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3 **(a)** condensation ; **A** dehydration [1]

(b) accept glycine-valine or valine-glycine

peptide bond drawn correctly ;
amino and carboxylic acid ends shown ;
correct R-groups ;
water eliminated ; [4]

(c) **(i)** GAU GUU AAG ; [1]

(ii) messenger ; [1]

(d) during systole semi-lunar valve is open ;
during diastole semi-lunar valve is closed ;
proximity/AW pulmonary artery to (right) ventricle (so no pressure lost) ;
elastic recoil of pulmonary artery maintains blood pressure/AW ;
no/little blood in (right) ventricle, after contraction/during diastole ;
fills with blood at low pressure ; [max 3]

(e) increase in power of contraction ; AW
increase in (systolic) blood pressure ;
strain on right ventricle/right ventricle does not function efficiently ;
growth of muscle in/right ventricle increases in thickness ;
insufficient oxygen to, heart/cardiac, muscle ;
heart failure/heart attack ; [max 2]

(f) persistent/AW, cough ;
cough produces much mucus ;
wheezing ;
rapid breathing/difficulty breathing/breathlessness ;
bluish colour to the skin ;
recurrent chest infections/frequent colds *or* 'flu/AW ;
barrel-shaped chest ;
chest pains ; **R** heart pains
fatigue/weakness, (with exercise) ; [max 2]

[Total: 14]

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4 **(a)** one mark for correct cells in column 2 ;

name of stage	cell in Fig. 4.1	behaviour of chromosomes	nuclear envelope
interphase ;	**B**	chromosomes uncoiled, may be replicating	intact
prophase	**D**	chromosomes, coiling/condensing/seen as two sister chromatids/AW ;	intact, but then breaks down
metaphase	**A**	chromosomes on equator/AW ;	not present
anaphase	**C**	chromosomes/chromatids, moving to opposite poles	not present ;
telophase	**E**	chromosomes uncoiling	reforming/present/intact ;

[max 5]

(b) *mitosis*
needs number of chromosomes to remain constant/diploid ;
needs all daughter cells to be genetically identical/have no genetic variation ; **A** clones
needs genetic stability ;

meiosis
halves the number of chromosomes/diploid → haploid ; **A** undergoes a reduction division
daughter cells are all genetically different ; *accept once only*
produces genetic variation ; *accept once only*
involved in sexual reproduction (in flowering plants) not growth ; **A** production of gametes
idea that cells that are genetically different will not function together in tissues ; ora [max 3]

(c) asexual reproduction/vegetative propagation ;
(tissue) repair ; **R** cell repair
(cell/tissue) replacement ;
AVP ; e.g. clonal expansion/part of gametogenesis/spores in fungi [max 2]

[Total: 10]

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5 **(a)** *autotroph to max 3*
carries out photosynthesis/photosynthetic **;** **A** acts as a producer
synthesises (complex) organic compounds from inorganic, compounds **;**
uses light energy **;**

heterotroph
obtains energy from, complex/organic, compounds **;** **A** insects/animals
ref. digestion/absorption soluble products **;** AW
acts as a consumer/feeds on other organisms **;** [max 4]

(b) less nitrification/ammonia to nitrite/ammonia to nitrate/nitrite to nitrate **;**
limits/AW uptake of ammonia/nitrate, by producers/(aquatic) plants/phytoplankton **;**
N becomes/is limiting factor for growth of producers **;** **A** decreased growth
less N for synthesis of amino acids/proteins/other named nitrogenous compound(s) **;**

less food available for consumers/higher trophic levels **;**
reduces production/productivity in these ecosystems **;** [max 3]

[Total: 7]

6 **(a)** ref.to <u>cell wall</u> freely permeable **;**
(through) cell surface membrane/vacuolar membrane or tonoplast **;**
A partially permeable, membranes
(by) osmosis **;**
movement from high water potential to low water potential **;** **A** down water potential gradient
ref. aquaporins **;** [max 3]

(b) **(i)** **K** – plasmodesma **;**
L – vacuolar membrane/tonoplast **;** **A** vacuole [2]

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

[Total: 6]

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1 (a) *mp 1 for naming the cell types in the epithelium*
cell names not required for mps 2 and 4

1 goblet cells and ciliated epithelial cells **;** **A** ciliated cells

goblet cells
2 produce / **AW**, mucus **;** **R** ciliated cells produce mucus

3 mucus, traps / **AW**, pathogens / **AW** **;**
treat, dust / particles, as neutral unless qualified
e.g. allergens / asbestos dust *can be credited*

ciliated (epithelial) cells
4 cilia / ciliated cells waft / move mucus to back of throat / away from lungs / to be swallowed **;**
A away from alveoli / gas exchange system
R goblet cells waft
R *idea that cilia present all the way to the stomach*
R *idea that whole ciliated cells move* [max 3]

(b) *in context of smooth / involuntary muscle*
need a large supply of / **AW**, ATP / energy **;**
so able to synthesise large supply of ATP **;** **R** energy
energy / ATP, for muscle / contraction **;** [max 1]

(c) bronchi / bronchus, and trachea **;** [1]

[Total: 5]

2 (a) **X =** transpiration **;** **A** evaporation
Y = nitrification **;** **A** oxidation [2]

(b) *Nitrosomonas / Nitrobacter / Nitrococcus / Nitrosococcus* **;** [max 1]

(c) *stomata, open / are open*
stomata open for, gas exchange / entry of CO_2 **;**
inevitable consequence of gas exchange **;**
water potential gradient between (inside) leaf and atmosphere **;**
diffusion of water vapour out (of leaf) from high to low water potential **;**

occurs even if stomata closed
water is lost through, cuticles / lenticels **;**

balance between disadvantage and plant requirements
idea of maintains transpiration pull, qualified **;** e.g. to bring ions / for water for photosynthesis / to replace water lost / to maintain turgidity

I cooling effect [max 1]

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(d) *treat as neutral smaller leaves / less SA*
any two from

stomata:
- sunken ;
- in pits / in grooves / in crypts ;
- fewer (per square unit of area) ;
- only on the lower surface / underside ; **ora**
- closed during the day ;

leaves:
- curled / rolled / folded inwards ;
- needle-like ; **I** spines / thorns

other:
- thick cuticle ;
- trichomes / hairs ;
- epidermis / hypodermis, has layers ;
- thick walled epidermal cells ;
- **AVP ;** e.g. secretion of resins

[max 2]

(e) **1** active transport / uptake ; **A** description
A facilitated diffusion *(may occur in initial stages)*

2 carrier protein ; **A** *for active transport and facilitated diffusion*
transmembrane / integral / intrinsic / transport
A protein pump *only with active transport*
A channel protein *only with facilitated diffusion*

3 specific membrane protein / binding site ;

4 hydrophobic core / fatty acid tails / phospholipid bilayer prevents entry ; [max 2]

(f) **I** *descriptions across the root, e.g. symplastic and apoplastic route*
I *ref. to* hydrostatic pressure

1 nitrates dissolved in water ;

describe:
- **2** in an apoplastic / a non-cytoplasmic route (in xylem) ;
- **3** passive (transport) / does not require energy ;
- **4** transpiration pull / idea of column of water pulled up ;

5 movement of water out of xylem creates tension ; **A** negative pressure

explain:
- **6** cohesion of water molecules / explanation in terms of hydrogen bonding ;

7 adhesion of water molecules to cellulose / lining ; **I** lignin

8 **AVP ;** e.g. water potential gradient root to leaf
mass flow caused by evaporation [max 4]

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(g) in bases / adenine / cytosine / guanine / uracil **;** **R** thymine
A A, U, C, G
A purines / pyrimidines [1]

[Total: 13]

3 **(a)** blood is in vessels / blood is in heart, arteries, veins, capillaries **;**
any three

pulmonary and systemic circulations / described
or
blood passes through heart twice for one circuit round the body / **AW ;** [2]

(b) **1** globular (shape) **;** **A** rounded / spherical **R** circular

2 hydrophilic, amino acids / R-groups, face cytosol
or
hydrophobic, amino acids / R-groups, to the interior **;** **AW**

3 (so) soluble **or** dissolved in cytoplasm / cytosol **;**

4 *ref. to* haem / prosthetic (group) / porphyrin (ring) / Fe^{2+} / ferrous ion / iron (ion), binding oxygen **;** **R** forms bonds with

5 four polypeptides / haems / **AW**, so 4 oxygen molecules / 8 oxygen atoms **;**
A four polypeptides, each carrying an oxygen molecule / O_2

6 cooperative binding / allostery / described **;**

7 **AVP ;** e.g. tertiary structure allows association of prosthetic group [max 4]

(c) 13–15% **;;**

one mark for correct data extraction
96 / 97% at sea level and 82 / 83% at altitude [2]

(d) **1** more haemoglobin (molecules) / Hb **;**

2 *idea of* compensation **;** e.g. for decreased saturation of haemoglobin as less oxygen available so more can be taken up / transported so tissues receive same / sufficient concentration of oxygen [2]

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(e) **1** reduces (rate of enzyme activity) **;**

2 binds at a site on the enzyme other than at the active site / allosteric site **;**

3 change in tertiary structure **;**

4 change in shape / conformation / configuration of active site **;**

5 substrate unable to bind / product unable to form / ES complexes do not form / fewer ESC **;**

6 **AVP ;** e.g. V_{max} not reached / increasing substrate concentration no effect [max 3]

(f) *accept Hb for haemoglobin throughout*

1 carbon monoxide binds to Hb / Hb has higher affinity for CO than O_2 **;**
A carboxyhaemoglobin forms (heavy smoker)

2 (with CO) Hb reaches lower % saturation / lower percentage saturation (after 3.6–, 4.0–4.2 kPa) **;**
A correct figures quoted
R lower saturation at <u>all</u> partial pressures of oxygen

3 less oxygen taken up, in lungs / at higher partial pressures
or
reduces the volume of oxygen transported **; AW**

4 below 3.6–4.2 kPa (with CO), curve shifts to left / Hb has (relatively) higher saturation **;**

5 less oxygen unloaded at lower partial pressures / in tissues **;**

6 heart rate increases to deliver sufficient oxygen **;**

7 *ref. to* insufficient oxygen to heart muscle and effect on people with CHD **;** [max 3]

[Total: 16]

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4 (a) (i) *neutral points = poor diet / poor living conditions*

look for comparative statements
***A** points if both sides are compared even without ref. to high or low economic country*
*if not comparative, **A** if stated as low (or high if **ora**) economic status country*
max 1 if no points stated as low or high but all points themed as low or high

points below are for low economic status countries – **ora** *for high*

poor sanitation **;**
water
no / poor water treatment
or
ref. to unable / do not know to boil water **;**

no bottled water
or
have to drink contaminated / unsafe / unclean water **;**

sewage
inadequate / poor treatment of sewage
or
sewage contamination of crops **;**

medical
no / poor access to (oral) rehydration therapy **;**
vaccines not available / effective (because poor diet) **;**
I vaccination <u>programmes</u> in Canada
antibiotics / drugs / medication not available **;**

other
greater number of refugee camps / squats **;**
less able to cope after natural disasters **;**
less education about disease prevention / transmission **;**
poor hygiene / described **;** e.g. not washing hands after defecating [max 3]

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(ii) 1 Angola / Cameroon, comparative data to show decrease in cases over time

or

comparative data, Cameroon fewer than Angola for 2006 / 2008 **;**

2

	2006		**2008**		**2010**
Angola	67257 (66335) ↓	(of 56746)	10511	(of 9027)	1484
		→ decrease (of 65773) →			
Cameroon	922	decrease	0		

3 explanations for decrease in cases (Angola / Cameroon) / fewer cases in Cameroon (than Angola) **;;** *examples in context of cholera*

4 control methods prevent transmission / spread **; AW ora**

5 pool of infected people reduced, reducing transmission **; AW ora**

6

	2006		**2008**		**2010**
Cameroon			0	increase	10759

Cameroon, steep / **AW** increase, 2008–2010
or
cases increase in Cameroon from 0 to 10759 **;**

7 explanation for steep increase in / high number of cases **;**
e.g. war
natural disaster
refugee camps
breakdown of infrastructure (due to population increase)
influx of immigrants with cholera
can be credited if linked to high number of cases in Angola in 2006 [max 4]

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(b) (i) *look for **AW** throughout*

1 required percentage cover not reached / high percentage cover required / not enough people vaccinated ;

2 some do not respond successfully to vaccine ;

3 poor diet / lack of vitamin A ;

4 poor storage of non-thermostable vaccine ;

5 vaccine not cost-free to population ;

6 inaccessible vaccination stations for some of the population ;

7 *ref.to* difficulty in giving boosters ;

8 *ref.to* reluctance to have children vaccinated ;

9 lack of advertising / campaigns / education to encourage vaccination ;

10 different strain (to the one used in vaccine) / antigens changing ;
R *ref.to* resistance [max 2]

(ii) 1 *ref. to* secondary (immune) response ;

2 memory (B), lymphocytes / cells ;

3 recognition of / binding to antigens ; **A** clonal selection
A proteins / glycoproteins (on *Morbillivirus*)

4 clonal expansion / described ;

5 plasma cells secrete antibodies ;

6 *idea of* faster production / higher levels of antibody ;

7 *ref. to* T (helper)-lymphocytes, release cytokines / stimulate humoral response ;
[max 3]

[Total: 12]

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5 (a)

event	three marks	two marks	one mark
impulses pass down septum through conducting fibres known as the bundle of His	**4**	any four / five correct **;;**	any two / three correct **;**
atrioventricular node sends out impulses	**3**		
impulses travels across atrial walls	**2**		
impulses reach base of ventricles (apex of heart)	**5**		
impulses pass up through Purkyne fibres in ventricle walls	**6**		
sinoatrial node sends out impulses	**1**		

[3]

(b) following ventricular systole / contraction
or
when ventricles in diastole / relaxation **;**

when pressure in arteries higher than that of ventricles
or
when pressure in ventricles lower than in arteries **;**
A aorta / pulmonary artery [2]

(c) *in blood*
idea that red blood cells too large to leave capillaries **;**
idea that (some plasma) proteins too large to leave capillaries **;**

higher concentration of oxygen, qualified **;**
e.g. from lungs
not yet unloaded (from haemoglobin)
not yet diffused out (from red blood cell)
not yet forced out of capillary (in plasma)

(higher concentration of) glucose / nutrients / named nutrient, qualified **;**
e.g. to be delivered to cells / from absorption

tissue fluid contains
ref. to products excreted by cells (yet to enter blood) **;**
e.g. waste products / (more) carbon dioxide / lactate [2]

[Total: 7]

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6 (a) 1 proteins produced (for growth) **;**

2 DNA replication **;**

3 organelles / named organelles synthesised **; A** more organelles

4 uncontrolled mitosis / **AW**
or continuous cell cycle
or cell cycle checkpoints not controlled **;**

5 (new cells) do not differentiate **; A** do not become specialised

6 loss of function (of tissue) **; A** changed function / new cells do not function as tissue of origin

7 (abnormal) mass of cells formed **;**

8 **AVP ;** e.g. no programmed cell death / apoptosis / cells immortal / cells grow independently of normal programming / no contact inhibition [max 4]

(b) travels in phloem / phloem sap / translocation **; R** in xylem
from cell to cell via plasmodesmata **;**
in symplast pathway **;**
in apoplast pathway **; R** in xylem
ref. to bacterial motility, e.g. flagella **;** [max 1]

(c) 1.1–1.13 (μm) **;;** **OR** 1.2–1.22 (μm) **;;**

$\left[\frac{13\,\text{mm}/13000\,\mu\text{m}}{11500}\right]$ $\left[\frac{14\,\text{mm}/14000\,\mu\text{m}}{11500}\right]$

one mark only for
correct formula and measurement (13 / 14 mm) but incorrect conversion
or for correct formula used with a measurement of 12 or 15 mm **2**

[Total: 7]

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1 (a) cell wall(s) **;**
vacuoles **;**
regular shape of cells / fixed shape / description of shape / AW **;**
I 'no centrioles', 'thicker' as in 'thicker cell walls' [max 1]

(b) (i) **B ;** [1]

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

(c) chromosomes / chromatin / chromatids, condense / coil up / thicken / AW **;**
A chromosomes / chromatids, become visible / shorten
spindle formation / spindle fibres made / assembly of microtubles / AW **;**
nucleolus disappears **;**
nuclear envelope, breaks down / disintegrates / disassembles / AW **;**
A nuclear membrane
I *ref. to* centrioles and centromeres [max 2]

(d) (i) producing (more) cells **;**

genetically identical / no genetic variation **;**
same, number / type, of chromosomes **; A** 'remain diploid'
I 'set of chromosomes'
repair / replacement (of root tip / tissue) **; R** 'repair of cells'

idea that mitosis makes cells for, different tissues / for differentiation **;**
e.g. use of examples, xylem / phloem / root hair / epidermis

I *ref. to* elongation [max 2]

(ii) change in DNA, nucleotide / base, sequence **;**

substitution, deletion, insertion, inversion, frameshift
change in, DNA / (m)RNA, codons / triplets
change in, amino acid sequence / primary structure, protein / polypeptide **;** [2]

(e) *acceptable range for measuring line 14 mm to 16 mm*
if the answer is between 700 and 800 allow 2 marks

if measurement of 14–16 mm is incorrectly converted allow one mark for correct measurement and correct formula – scale length divided by 20

15 000 / 20

750 **;;** [2]

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2 **(a)** produces / synthesises, (named) organic compounds from inorganic (named) compounds **;** **A** substances / materials / molecules
using, light / chemical, energy **;**
A photosynthesis / converts light energy to chemical energy / chemosynthesis [2]

(b) primary consumer / feeds on diatoms **;**
provides, energy / food / nutrients / biomass, to, secondary consumers / pondskater / next (named) trophic level / next level in food chain **;**
A 'pondskater eats it' [2]

(c) *idea of* less energy available to (population of) heron(s) **;**
energy 'lost', between / at, each trophic level **;**
any example – respiration / excretion / egestion / movement / to decomposers / heat / not all organisms are eaten / AW **;**
ref. to sizes of individuals **;** [max 2]

(d) **1** *pond skater*
can stand on water / use surface for habitat, because of surface tension **;**
A strong surface because of, hydrogen bonding / cohesion between water molecules
I adhesion

2 *ref. to* its food comprising animals that fall onto water **;**
pike – to max 3

3 solvent, provides (dissolved) oxygen **;**

4 solvent for, carbon dioxide / excreta / ammonia **;**

5 water, has high density / is a medium that, provides support / buoyancy **;**

6 liquid so pike can move **;**

7 transparent, so pike can see **;**

8 high specific heat capacity (of water), provide stable temperature / environment **;**

9 ice less dense than water / ice floats, so can survive (when water freezes) **;**
A idea of life beneath the ice / insulation

10 AVP **;** e.g. high latent heat of fusion, water does not freeze easily [max 4]

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(e) *ignore nitrogen fixation, formulae must be correct if names are not used*

1 decomposers / saprotrophs / bacteria / fungi **;**
I microorganisms / microbes

2 protein broken down to amino acids **; A** *ref. to* proteases

3 urea / amino acids / protein, converted to, ammonia / ammonium (ions) / NH_3 / NH_4^+ **;**
A deamination produces ammonia / ammonification from urea etc.

4 ammonia / ammonium ions, to, nitrite / NO_2^- **;**

5 nitrite / NO_2^- , to, nitrate / NO_3^- **;**

6 oxidation / nitrification (in correct context) / nitrifying bacteria **;**

7 *Nitrosomonas* and *Nitrobacter* in correct contexts **;**
if ammonia to nitrate or *ammonia to nitrite and nitrate* = 1 mark
*ammonia to nitrite and **then** nitrate* = 2 marks [max 4]

3 (a) 1 vaccine / attenuated virus, has antigen which stimulates immune response **;**
A AW for stimulates **A** description of immune response

2 macrophages, take up virus (by phagocytosis), and, present antigens / act as antigen presenting cells **; A** APCs
A antigen presentation by B cells

3 *ref. to* T, lymphocytes / cells **; A** helper T cells / killer T cells

4 B / T, lymphocytes, bind to APC / are recognised / undergo clonal selection / have appropriate receptor **;**

5 (lymphocytes) divide (repeatedly) by mitosis / undergo clonal expansion / clone rapidly / proliferate **;**

6 *ref. to* specificity **;**

7 memory cells formed **;**

8 idea that booster used, to further stimulate memory cell formation / in case first dose did not work / to increase strength **;**

9 on infection by virus, fast(er) response / higher levels of antibody formed / no symptoms **;**

[max 5]

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(b) *accept use of data to make these 5 points*

1980 – 1990
percentage vaccinated increased **;**
number of cases decreased (steeply) **;**

1990 – 2002
percentage vaccinated, levels off / remains constant **;**
number of cases decreases (less steeply than earlier) **and** levels off **;**

in either section
number of cases / percentage vaccinated, fluctuates with an example **;**
e.g. number of cases in year 1981
e.g. number cases in year 2000 increases from 1999
e.g. percentage vaccinated decreases, after 2000 / in 2001 [max 4]

(c) **1** CD–46 is a receptor **;**

2 tertiary structures / (3D) shapes, of MV–8 and CD–46 (may be implied) **;**
(shapes are) <u>complementary</u> **;**

3 *ref. to* interaction of, R-groups / amino acid side chains **;**
A formation of hydrogen bonds / ionic bonds **R** disulfide / peptide

I 'active site'

'shape of MV–8 is complementary to shape of CD–46' = mp2 and mp3 [max 2]

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4 (a) 1 glucose / substrate, is not complementary / is partially complementary, to active site **;**

2 enzyme / active site, changes shape / moulds around / fits around, when substrate, enters / binds **; R** if substrate / glucose changes

3 stronger binding of substrate to active site **;**

4 further detail **;** e.g. becomes complementary to / fits more tightly to, glucose / substrate
interaction of, functional groups / R–groups / side-chains
formation of (named) bond but not disulfide *or* peptide bond [max 3]

(b) 1 (competitive) inhibitor has, same / similar, shape to substrate **;**

2 inhibitor does not induce the same change in, 3D shape / tertiary structure / active site (as the substrate) **;**

3 (so inhibitor) less likely to bind (successfully) in active site **;**

4 *idea that* because it does not have same functional groups (in same positions) / AW **;**

5 in lock and key the inhibitor, fits directly into / is complementary to / binds to, active site **;** [max 2]

(c) enzymes / hexokinase, denatured **;**
all enzymes molecules are partially denatured / some enzyme molecules are denatured **;**

changes / disrupts / loss of (specific shape / structure) active site **;**
A no longer complementary to, glucose / substrate
breakage of, ionic / hydrogen, bonds **; R** disulfide / peptide bonds

idea that loss of structure makes E–S complex formation more difficult / fewer E–S complexes are formed / substrate does not fit into active site **;** [max 3]

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(d) (i) *accept* ***ora***
active transport requires, ATP / energy (whereas facilitated diffusion does not) **;**
active transport moves substances against the concentration gradient (whereas facilitated diffusion moves substances down the concentration gradient) **;**
active transport uses only carrier proteins (whereas facilitated diffusion uses both carrier and channel proteins) **;**
A active transport can involve cotransport but facilitated diffusion does not [max 2]

(ii) too large / too big **; R** 'it is a big molecule' unqualified

polar / charged, so cannot pass through hydrophobic region of membrane **;**
A fatty acid tails for hydrophobic
no, specific / AW, protein, in membrane / carrier / channel **;**
e.g. AW = no protein for G–6–P
AVP **;** e.g. gated channels are closed [max 2]

5 (a) (i) alveoli **; A** alveolus / aveoli [1]

(ii) emphysema **; A** emphasema etc. [1]

(b) damage / paralyse / destroy / inhibit, cilia / ciliated epithelium **;**
goblet cells, enlarge / produce more mucus **;**
mucus, accumulates / not swept away (by cilia) **;**
bacteria / pathogens, can multiply in mucus / AW **; A** grow in mucus
I mitosis
bacteria / pathogens, not removed **;**
increased time available to infect cells **;**
AVP **;** e.g. increased permeability of alveolar walls to pathogens depressed antigen-presenting ability of lung macrophages [max 3]

(c) CO, binds to / combines with / joins with, haemoglobin **;**
A forms carboxyhaemoglobin
I carbaminohaemoglobin

binding is irreversible / carboxyhaemoglobin is stable / AW **;**
R carbaminohaemoglobin is stable

haemoglobin, cannot become fully saturated with oxygen / has a lower affinity for oxygen / carries less oxygen / AW **; A ora**
R 'carries no oxygen' [max 2]

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6 (a) *(xylem row 1)* no / dead cells +
(xylem row 2) water and, (named) minerals / ions / salts **;**
I nutrients

(phloem row 3) bidirectional / in both (or any) directions / in one direction / described / source to sink **;**
R sink to source

(phloem row 4) yes / (freely / fully) permeable **;**
R partially / semi / differentially, permeable

(xylem row 5) cellulose **and** lignin
(phloem row 5) cellulose **;** [4]

(b) (synthesis of) <u>chlorophyll</u> **;**
light, absorption / capture (for photosynthesis) **;**
prevents chlorosis **;**

enzyme, cofactor / activator / decribed **;**
required, for enzyme catalysis / DNA polymerase **;**
stabilises, cell wall / proteins / nucleic acid / membranes **;**
important in, energy transfers / ATP synthesis **;**
A *ref. to* ATP synthase
binds to ATP **;**
DNA, synthesis / replication **;**
involved in translation / joining large and small ribosome subunits / as part of ribosome **;**
AVP **;** [max 1]

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