Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2022**

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6	Calculation specific guidance Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	Guidance for chemical equations Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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Question	Answer	Marks
1(a)	**A** – ciliated, epithelium / epithelial tissue **;** **B** – smooth muscle **;** **D** – cartilage **;**	**3**
1(b)	**1** produce / release / secrete, mucus / mucin **;** **R** excrete mucus *any **two** from:* **2** mucus forms a layer over the (ciliated) epithelium **;** **3** traps / sticks to, bacteria / viruses / pathogens / microorganisms / dust / pollen / (fungal) spores / AW **;** **4** mucus is, moved / AW, away from alveoli *or* lung tissue / towards back of mouth / AW, by cilia **;** **R** 'by ciliated cells' **5** *idea that* mucus prevents (named) pathogens reaching, epithelial cells / alveoli / gas exchange surface **;** **A** acts as a barrier to (named) pathogens	**3**
1(c)(i)	*pH 7.7* = 72(%) *pH 7.4* = 60(%) **;**	**1**
1(c)(ii)	*allow Hb or hb for haemoglobin* decrease in supply of oxygen to tissues / AW **;** (at lower pCO_2 / increase pH blood) affinity of, haemoglobin, for oxygen is higher **or** haemoglobin is more saturated ora **A** less oxygen, released / dissociates / AW, from haemoglobin (than normal) *must be in context of higher affinity in the tissues* **or** data quote for difference in saturation of haemoglobin in correct range of pO_2 (within 2–6 $kPaO_2$) **;**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>exocytosis ;</td><td>1</td></tr>
<tr><td>2(a)(ii)</td><td>one mark per row
<table>
<tr><th>cell structure in Fig. 2.1</th><th>name of cell structure</th><th>function of cell structure in plasma cell</th></tr>
<tr><td>P</td><td>nucleolus</td><td>production / assembly, of (sub-units of) ribosomes ;
A manufacture, ribosomal RNA / rRNA / transfer RNA / tRNA</td></tr>
<tr><td>Q</td><td>mitochondrion</td><td>R if answer refers to, ATP / energy, <u>for</u> aerobic respiration

<u>aerobic respiration</u> ;
A oxidative phosphorylation
A provide, ATP / energy
A produce / AW, <u>ATP</u></td></tr>
<tr><td>R</td><td>rough endoplasmic reticulum

R rough ER / RER / ribosome</td><td>protein / antibody, synthesis / transport ;
A synthesis of, polypeptide(s) / heavy and light chains
A (post-translational) modification of, polypeptide / protein / antibody
allow example
A forms (transport) vesicles</td></tr>
<tr><td>S</td><td>Golgi body

A Golgi, complex / apparatus</td><td>I lipids
(post-translational) modification of, polypeptide / protein / antibody
allow example
or
packaging, qualified ;
e.g. packaging of antibodies / protein, into vesicles

A formation of, vesicles / (primary) lysosomes</td></tr>
</table></td><td>4</td></tr>
</table>

Question	Answer	Marks
2(b)	*any **three** from:* **1** (named) small mammal, injected / AW, with antigen **;** **2** immune response occurs (over several weeks) **;** **A** immune response described **3** plasma cells / B-lymphocytes / B-cells / splenocytes, extracted from spleen **;** **4** plasma cells / activated B-lymphocytes / activated B-cells, <u>fused</u> with, myeloma / tumour / cancer / AW, cells (to form hybridomas) **;** **5** AVP **;** e.g. hybridoma cells separated (into wells) to produce clones screening / selection / AW, for hybridomas producing desired, (monoclonal) antibodies / Mabs *ref. to* large scale production	**3**
2(c)	*any **four** from:* **1** (artificial) <u>passive immunity</u> **;** **R** natural **2** no immune response **;** **I** primary / secondary **3** *idea that* antibodies are, broken down / degraded / destroyed (in the body / blood) **;** **R** 'antibodies die' **4** no long-term / only short-term / only temporary, immunity **;** **A** no formation of immunological memory **5** memory cells not produced **;** **A** memory cells only produced, in active immunity / during an immune response / after presentation of antigen **6** AVP **;** e.g. *ref. to* no, clonal selection / clonal expansion / antibodies produced	**4**

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Question	Answer	Marks
3(a)	**1** active site, shape / tertiary structure **;** **2** complementary to, substrate(s) / (intracellular) protein / ATP **;**	**2**
3(b)	*any **three** from:* **1** at low(er) concentrations / AW, of, substrate / ATP, lower rate of activity with GNF-5 **;** **2** as substrate concentration increases, effect of GNF-5 decreases **;** **3** maximum rate of reaction / V_{max} / described, is the same **;** **4** Michaelis-Menten constant / K_m, is higher with inhibitor **;** ora *accept comparative data quotes to support answers* *for ATP concentration, must use μmol dm^{-3} at least once*	**3**
3(c)(i)	*without inhibitor, activity of T315L* *any **one** from:* **1** no activity at 0.1 μmol dm^{-3} (ATP) **;** **2** maximum rate of reaction / V_{max}, is reached / AW, (for T315L) at a higher concentration (of ATP) **;** **3** Michaelis-Menten constant / K_m, is higher (for T315L) **;** ora *accept comparative data quotes to support answers* *for ATP concentration, must use μmol dm^{-3} at least once*	**1**
3(c)(ii)	*with inhibitor, activity of T315L* *any **two** from:* **1** activity does not reach TKR, maximum rate of reaction / V_{max} **;** **2** *idea that* drug / GNF-5, acts as a non-competitive inhibitor of T315L **;** **3** drug / GNF-5, has less of an effect at low concentrations on activity (of enzyme / T315L) **;** ora *accept comparative data quotes to support answers*	**2**

Question	Answer	Marks
4(a)(i)	ester **;**	**1**
4(a)(ii)	condensation **;**	**1**
4(a)(iii)	**1** (hydrocarbon chains of) different lengths / **Y** is longest / **Z** is shortest **;** **A** correct numbers of carbon atoms in each fatty acid (**X** 18, **Y** 20 and **Z** 16) *if no ref. to different lengths* **2** **Z** saturated, **X** and **Y** unsaturated **;** **A** only Z is saturated **3** **X** polyunsaturated, **Y** monounsaturated **;** **4** **X** 3, **Y** 1, **Z** 0 double (C=C) bonds **; only Z** only has single / C-C) bonds **or** (for whole molecule) **X** 4 double bonds , **Y** 2 double bonds, **Z** 1 double bond **;**	**3**
4(b)(i)	*any **two** from:* **1** (hydrocarbon / fatty acid tails, are) non-polar / have no polar groups **/** not charged **;** **A** equal sharing of electrons in molecule **2** not soluble / insoluble, (in water) **;** **3** cannot form hydrogen bonds with water **;** **I** repel water	**2**
4(b)(ii)	*any **two** from:* **1** no, hydrophilic / polar / phosphate, head / part, to, interact with / AW, water **;** **I** triglycerides are hydrophobic **2** cannot form hydrogen bonds with water **;** **I** repel water **3** cannot form a bilayer **;** in water triglycerides, form micelles / form spheres / ball shaped / form globules / do not form thin films / AW **;**	**2**

Question	Answer	Marks
5(a)	(pathogen / causative organism is) transferred / passed on / AW, (from infected) to an uninfected, person / organism **;** **I** disease **I** from one person to another *unqualified* **I** spread	**1**
5(b)	*any **two** from* *information needed* **1** magnification of, image / (electron) micrograph / Fig. 5.1 **;** **A** scale bar **I** magnification of (electron) microscope **2** length of flagellum (in, image / Fig. 5.1) **;** **I** width / diameter / size **3** *formula* actual length of flagellum = measured length of flagellum divided by magnification **;** **A** A= I / M **or** magnification triangle	**2**
5(c)(i)	0.2	**1**

Question	Answer	Marks
5(c)(ii)	*large outbreaks of cholera in countries shown in Table 5.1 accept ora* *any **five** from:* **I** *ref. to* poverty, unqualified **1** civil disturbance / (civil) war **;** **2** named natural disaster **;** **I** famine / drought **3** lack of, uncontaminated / AW, drinking water **;** **A** examples e.g. no piped water supply / no bottled water / no water treatment **4** *ref. to* sewage, qualified **;** e.g. no sewage treatment **A** examples e.g. no separation of drainage from homes and water supplies / contamination of water supplies with human faeces **5** poor sanitation **;** *credit only if mp3 or mp4 are not awarded* **6** *ref. to* poor personal hygiene / described example **;** **7** eating contaminated foods **;** e.g. crops irrigated with contaminated water / seafood harvested from contaminated seawater **8** slow(er) / no / little, diagnosis **;** **9** slow(er) / no / little, treatment / healthcare / medical facilities **;** **10** <u>oral</u> rehydration, (salts / therapy), not, provided / available **;** **A** named example of oral rehydration **11** antibiotics not, provided / available **;** **12** vaccine not provided / vaccine not available / reluctance to be vaccinated / ref to anti-vaccination campaigns **;** **13** poor, understanding of / education about, prevention / treatment / precautions **;** **14** AVP **;** e.g. difficult to reach people living in, rural / remote / dangerous, areas lack of trained professionals antibiotic resistance *ref. to* people bringing in cholera from elsewhere	**5**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(a)</td><td>one mark each correct row

<table>
<tr><th>feature</th><th>mRNA</th><th>DNA</th></tr>
<tr><td>names of four bases</td><td>adenine, cytosine, guanine, uracil</td><td>adenine, cytosine, guanine, thymine ;</td></tr>
<tr><td>name of pentose sugar present</td><td>ribose</td><td>deoxyribose ;</td></tr>
<tr><td>number of strands</td><td>1 ;
I single</td><td>2 ;
I double</td></tr>
</table></td><td>3</td></tr>
<tr><td>6(b)(i)</td><td>transcription ;</td><td>1</td></tr>
<tr><td>6(b)(ii)</td><td>can award either mp1 with mp2 ,or mp3 with mp4

1 removal of introns (from primary transcript / RNA) ;
2 exons joined together ;

or

3 splicing ;
4 of, primary transcript / RNA ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
6(c)(i)	*any **four** from:* **1** *ref. to* amino acid activation / charging amino acids before attachment to tRNA / AW **;** **A** aminoacylation **2** tRNA attached to, specific amino acid / glycine **;** **R** 'picks up' **3** *idea that* anticodon / CCG, identifies specific amino acid **;** **4** tRNA transports / AW, amino acid to ribosome **;** **5** *ref. to* (tRNA) entering the A (aminoacyl) site in ribosome **;** **6** tRNA, anticodon / CCG, binds to mRNA, codon / GGC ; **A** correct ref. to, complementary pairing / base pairing / H bond formation *as AW for binding* **7** (specific) amino acid / glycine, in correct position in the polypeptide chain / AW **;** **A** helps to form / AW, primary structure of cotransporter protein **8** AVP **;** e.g. tRNA, recycled / reused forms aminoacyl tRNA / amino acid-tRNA complex tRNA-ligase / aminoacyl-tRNA synthetase	**4**
6(c)(ii)	*any **three** from:* **1** movement of sucrose with, protons / H^+ ions, into companion cells **;** **A** correct *ref. to* (other named) assimilates **2** (sucrose moved) from, apoplast / cell wall / mesophyll cell **;** **3** sucrose moves against its concentration gradient (into companion cell) **;** **4** (needs cotransporter protein because) sucrose is polar so cannot pass through membrane **;** **5** maintain concentration gradient for sucrose between companion cell and sieve tube (element) **;**	**3**

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1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
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3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
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5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
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A	accept
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AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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Examples of how to apply the list rule

State **three** reasons…. [3]

A	1 Correct	✓	**2**
	2 Correct	✓	
	3 Wrong	×	

B	1 Correct, Correct	✓, ✓	**3**
(4 responses)	2 Correct	✓	
	3 Wrong	ignore	

C	1 Correct	✓	**2**
(4 responses)	2 Correct, Wrong	✓, ×	
	3 Correct	ignore	

D	1 Correct	✓	**2**
(4 responses)	2 Correct, CON (of 2)	×, (discount 2)	
	3 Correct	✓	

E	1 Correct	✓	**3**
(4 responses)	2 Correct	✓	
	3 Correct, Wrong	✓	

F	1 Correct	✓	**2**
(4 responses)	2 Correct	✓	
	3 Correct CON (of 3)	× (discount 3)	

G	1 Correct	✓	**3**
(5 responses)	2 Correct	✓	
	3 Correct Correct CON (of 4)	✓ ignore ignore	

H	1 Correct	✓	**2**
(4 responses)	2 Correct	×	
	3 CON (of 2) Correct	(discount 2) ✓	

I	1 Correct	✓	**2**
(4 responses)	2 Correct	×	
	3 Correct CON (of 2)	✓ (discount 2)	

I

Question	Answer	Marks
1(a)	**I** *ref. to* resolution *any **one** from:* Fig. 1.1**A** is scanning (EM), qualified **;** e.g. shows, surface / contour / 3-D, views shows (only the), the outer / external, view (of microvilli) idea of good focus with different depths does not have stated feature of TEM (see mp2) Fig. 1.1**B** is transmission (EM), qualified **;** e.g. showing, 2D / flat, views (of, microvilli / mitochondria) image in one plane showing section through, mitochondria / microvilli / cell **I** thin shows, internal view of cell / contents of cell / AW does not have stated feature of SEM (see mp1) scanning (EM) stated plus feature <u>and</u> transmission (EM) stated plus feature } **;** if Fig. 1.1, **A** / **B** not identified	**1**
1(b)	*any **two** from: max 1 if stating to measure one of the sides of the figure* (for each image) measure a number of microvilli and calculate a mean **;** same units for actual and measured images / example given **;** e.g. *if microvillus measurement is in mm* convert, microvillus measured length to μm / actual length to mm **R** if extra detail given is incorrect e.g. <u>divide</u> by 1000 for mm to μm divide, microvillus / image, length by, actual length / AW / 1(μm) **;** **A** *idea that* value for, microvillus / image, length is the magnification	**2**
1(c)(i)	*any **two** from:* (movement of substances) against concentration gradient / from low(er) to high(er) concentration ; (protein has) binding site(s) **;** specific **; A** description e.g. shape complementary to shape of substance *can be in context of protein or binding site* *ref. to* (binding causes protein), conformational change / change of shape **;**	**2**

Question	Answer	Marks
1(c)(ii)	*any **two** from:* **1** glucose is moving against a (concentration) gradient **;** AW e.g. low to high **2** movement powered by inward movement of Na^+ **;** AW **3** Na^+ movement (into cell from gut lumen) down an electrochemical gradient **or** down a (Na^+), concentration / diffusion, gradient **or** by facilitated diffusion **;** **A** diffusion if response includes *ref. to* the cotransport protein / cotranporter 4 AVP **;** e.g. *idea that*, cotransport needed so that <u>all</u> glucose will be removed from gut lumen ora facilitated diffusion of glucose will only be to equilibrium / AW cotransporter has (specific) binding site for glucose **I** cotransporter has a complementary shape *idea that* there is no specific active uptake protein for glucose	**2**
1(c)(iii)	increases / larger / large, surface area (over which glucose can enter cell per unit time) **;** **A** increases / higher / high, SA:V *idea of* (so) more, transport / carrier / cotransport, proteins **A** more cotransporters **or** more proteins, located in membrane / AW **;** **R** pump proteins **A** *idea of* more space / places, where proteins can transport glucose	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(d)</td><td>

*any **four** from:*

<table>
<tr><th>suggestion max 3</th><th>explanation</th></tr>
<tr><td>1 to replace, old / dead / damaged / injured, cells
or
to, repair / replace, damaged tissue ;

I repair cells
I replace old tissues</td><td rowspan="4">6 idea of <u>function</u> in context of mp1 or 2 or 3 ;
e.g. repair allows tissues to function

specialisation / differentiation, allows, cells / tissue, to function

genetically identical so cells can function as a tissue

look for other approaches e.g.
‘replace damaged cells that no longer function’ is mp1 and mp6
……
7 detail of function (intestines) ;

e.g. absorption (of, glucose / nutrients) production of digestive enzymes

pass absorbed, nutrients / AW, to blood

I nutrition</td></tr>
<tr><td>2 cells are produced that can, differentiate / become specialised (into intestinal cells);
I multipotent / AW

R if, stated / strongly implied that, <u>all</u> cells produced by mitosis become specialised</td></tr>
<tr><td>3 produce cells that are genetically identical ;
A clones

A identical / same, DNA / genetic material / genetic information</td></tr>
<tr><td>4 growth ; R growth of cells</td></tr>
<tr><td>5 renew / replenish / restore number of / AW, stem cells ;

I increase in stem cells</td><td>8 idea of development during, infancy / childhood ;

9 for, continued production / constant supply / AW, of intestinal cells
or
so that number of stem cells doesn’t decrease ;</td></tr>
</table>

</td><td>4</td></tr>
</table>

Question	Answer	Marks
2(a)(i)	*any **two** from:* oral rehydration (salts / solution / therapy) **;** **A** ORS / ORT **A** rehydration therapy if *ref. to* 'drinking' stated within response solution of / water with, glucose and salts **;** **A** named example for salts e.g. sodium / potassium / citrate / chloride AVP **;** e.g. antibiotics / doxycycline / tetracycline / furazolidone / choramphenicol / sulfaguanidine (*standard treatment in some countries*) zinc treatment (*standard treatment for children in some countries*) *ref. to* isolation	**2**
2(a)(ii)	*any **two** from:* decreases, recovery time **; A** cured more quickly **I** helps recovery / reduces severity of disease reduces time of / stops, diarrhoea production (containing pathogen) **;** less likely to / AW, contaminate water **;** reduced transmission of pathogen **;** AW e.g. breaks transmission cycle	**2**
2(b)(i)	*allow antibody or mAb or Mab for monoclonal antibody* **I** *ref. to* receptor **I** active site **I** combines / bonds *any **two** from:* specific / different, *(Vibrio* / pathogen) antigen-binding sites ***/*** binding sites for antigen **; R** if antibody described as enzyme **A** (each) mAb binds to a, specific / particular, *(Vibrio* / pathogen) <u>antigen</u> (each mAb has) specific / different, tertiary structure / variable region(s) / primary structure / sequence of amino acids **;** binding site and <u>antigen</u> have complementary shapes **;**	**2**

Question	Answer	Marks
2(b)(ii)	*allow antibody or mAb or Mab for monoclonal antibody* *any **three** from:* **1** person **A,** has cholera O1 / is infected with *V. cholerae* O1 and person **B**, does not have cholera **;** **A** *ref. to* person **A** testing positive for cholera O1 and person **B** testing negative to cholera **2** tests are, valid / working, because, controls / bands 4, shows bands **;** *person **A,** band / colour in area 3 because* **3** anti-O1 (mobile) antibody binds (specific antigen on) *Vibrio* O1 **;** **A** antigen-antibody (complex) 01 formed **4** antigen-antibody (complex) O1 binds to immobilised antibody *ref. to* area 3 **;** **R** if stated as, band / colour, in area 2 **5** person **B** (in test area 2 and 3) no bands form / no colour / no change, because no antibody binds with antigen / no antigen-antibody complexes formed **;**	**3**
2(c)(i)	95 / 95.1 (%) **; R** 95.0%	**1**
2(c)(ii)	**I** *ref. to*, cheaper / no need for (highly) trained personnel / easier to use / easier to obtain results / accurate **R** more accurate *any **one** from:* quicker to, obtain result / to do the test **; A** less time consuming can carry out test in a greater variety of places / AW **;** e.g. can be done at home less labour intensive **;** AW e.g. only needs one person / can do it yourself easier to test more people at one time / AW **;** portable **;** AVP **;** e.g. *idea of* easier to transport or distribute (to reach more people) *ref. to*, safer / less risk, from pathogen available to more people (*consequence of cheaper*) *suggestion that* dipsticks are able to identify different, forms / strains	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>
any two from:
I ref. to two units v one unit or bigger v smaller (neutral points)
<table>
<tr><th>sucrose</th><th></th><th>fructose</th></tr>
<tr><td>disaccharide
R if incorrect monosaccharides stated</td><td>v</td><td>monosaccharide ;</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>non-reducing sugar ora</td><td>or</td><td>reducing sugar ; ora</td></tr>
<tr><td colspan="3">A described in terms of reaction with Benedict’s reagent</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>glycosidic bond present
R glucosidic</td><td>or</td><td>no glycosidic bond present ;</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>AVP ; e.g. always ring structure(s)

hydrolysed / broken down before used as, a respiratory substrate / an energy source</td><td>v

v</td><td>ring structure or straight chain form
can be used immediately as, a respiratory substrate / an energy source</td></tr>
</table>
</td><td>2</td></tr>
</table>

Question	Answer	Marks
3(b)(i)	**I** three fatty acids **A** fatty acid residue *for fatty acid* *any **three** from:* **1** glycerol **;** **2** ester, bond / linkage, qualified **;** e.g. labelled on Fig. 3.2 / three ester bonds / ester bond between (O of) glycerol and (C of carboxyl of) fatty acid **3** palmitate is <u>saturated</u> **or** oleate(s) are, <u>unsaturated</u> / <u>monounsaturated</u> **or** two fatty acid(s) are, <u>unsaturated</u> / <u>monounsaturated</u>, <u>and</u> one is <u>saturated</u> **;** **4** (each fatty acid has a) hydrocarbon chain **;** **5** AVP **;** extra detail e.g. *hydrocarbon chain* palmitate 15C <u>and</u> oleate 17C palmitate,$CH_3(CH_2)_{14}$ <u>and</u> oleate, $CH_3(CH_2)_7CH{=}CH(CH_2)_7$ palmitate 16C and oleate 18C *unsaturated fatty acid tail(s) / oleate* *ref. to*, presence of one, C=C / (carbon-carbon) double bond not the maximum number of, hydrogen atoms / hydrogens *saturated fatty acid tail(s) / palmitate* *ref. to* no, C=C / (carbon-carbon) double bond maximum number of hydrogen atoms / hydrogens	**3**

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Question	Answer	Marks
3(b)(ii)	*any **one** from:* *idea that* provides greater energy per unit volume **;** **A** higher calorific value / greater energy density **R** produces more energy less mass needed to provide same energy / low(er) mass to energy ratio **;** ora higher energy to mass ratio low(er) mass to volume ratio **;** AVP **;** e.g. glycogen can only be stored in liver and muscles glycogen is hydrated / uses water for storage, so mass increases suggestion that more, areas / adipocytes / adipose tissue, in body to store triglycerides (proportionately) more C-H bonds (to supply H for respiration) *suggestion that* triglycerides provides insulation during flight (at heights) more compact	**1**
3(c)	closed, double (circulation / circulatory system) **;**	**1**

Question	Answer	Marks
3(d)	**I** *ref. to* metabolism *any **two** from:* need more, / large quantities of, oxygen / glucose **or** more / large quantities, of, oxygen / glucose, delivered / reaches tissues / transported / AW **or** *idea of* enough, oxygen / glucose supplied to meet needs **;** *idea that* heart pumps blood (to tissues more) efficiently **;** e.g. forcefully / in greater volumes / more / with higher pressure / faster *more oxygenated blood is mp2 only* suggestion of reason for needing more oxygen or glucose **; I** migration e.g. more active fly / wing muscles search for food longer constantly moving / move for longer time generate heat to maintain body temperature, qualified **;** e.g. (generally) smaller size / larger SA:V *ref. to* need to meet demands of carbon dioxide removal (from muscle action / respiration) **;** *idea that more carbon dioxide produced (so must be removed)*	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(e)</td><td>note: only one mark for both pulmonary vessels
<table>
<tr><th>function of blood vessel</th><th>name of blood vessel</th></tr>
<tr><td>carries blood from the heart to the lungs</td><td rowspan="2">pulmonary, artery / arteries ;
pulmonary, vein / veins</td></tr>
<tr><td>carries blood to the heart from the lungs</td></tr>
<tr><td>carries blood from the heart to the rest of body</td><td><u>aorta</u> ; I artery</td></tr>
<tr><td>carries blood to the heart from the rest of body</td><td>I superior and inferior
or anterior and posterior
I vein

venae cavae / vena cava ;</td></tr>
</table></td><td>3</td></tr>
</table>

Question	Answer	Marks
4(a)	**R** if choice given and one is incorrect carbonic acid **;** hydrogencarbonate (ions) **; A** bicarbonate (ions)	**2**
4(b)	*any **one** from:* similar / same, active site **;** have the same catalytic amino acids ; similar / same, tertiary structure **; A** same quaternary structure	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(c)</td><td>
allow pre-RNA for primary transcript

either exon or intron statement required for mp2 to 7, one mark each row
any three from:
<table>
<tr><th>exons</th><th>introns</th></tr>
<tr><td colspan="2">1 both, are (nucleotide sequences that are) transcribed / form part of the primary transcript ;</td></tr>
<tr><td>2 (DNA/RNA) <u>coding</u> (sequences)
R coding genes
I exons have the genetic code</td><td>(DNA/RNA) <u>non-coding</u> (sequences)
R non-coding genes</td></tr>
<tr><td>3 (RNA exons) needed / involved / AW, in translation or for formation of, polypeptides / proteins / carbonic anhydrase</td><td>not involved in translation / AW</td></tr>
<tr><td colspan="2">if mps 2 and 3 not gained ‘exons code for proteins’ or ora 1 mark</td></tr>
<tr><td>4 not removed, from primary transcript / from RNA / during gene splicing / during RNA splicing</td><td>removed, from primary transcript / from RNA /during gene splicing / during RNA splicing</td></tr>
<tr><td>5 (join to) form mRNA / contain mRNA codons
A remain in mRNA</td><td>not part of mRNA / in primary transcript only</td></tr>
<tr><td>6 not involved in regulating activity of genes / AW</td><td>may have regulatory roles
A other suggestions for role</td></tr>
<tr><td>7 AVP e.g. (as part of mRNA) leave the nucleus / go to cytoplasm / go to ribosomes</td><td>AVP e.g. remain in nucleus</td></tr>
</table>
if <u>all</u> are differences and <u>all</u> statements are reversed (i.e. introns for exons and vice versa) max 2 marks
</td><td>3</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(d)</td><td>allow Hb or hb or Hgb for haemoglobin
two marks for points in left column or two marks for points in right column
<table>
<tr><td>cytoplasm / cytosol ;</td><td>(bound to) cell surface membrane ;</td></tr>
<tr><td>close to haemoglobin (for H^+ uptake)
R in / on / with, hb
or
idea of being dispersed within cell because haemoglobin is distributed throughout ;</td><td>close to, anion exchanger / transport protein, for (easy) exit of hydrogen carbonate (ions) ;</td></tr>
<tr><td>quick for hydrogen carbonate (ions) to be transported out of cell / AW or
H^+ (from dissociation) binds rapidly to haemoglobin or cytoplasm provides water for reaction to form carbonic acid ;</td><td>able to, hydrate / react with, carbon dioxide as it enters cell ;</td></tr>
</table>
if stated cytoplasm <u>and</u> cell surface membrane, one mark
reason can be taken from either column if correctly linked, one mark</td><td>2</td></tr>
<tr><td>4(e)</td><td>exocytosis ;</td><td>1</td></tr>
<tr><td>4(f)</td><td>any three from:
1 acetazolamide / inhibitor, binds / attaches / AW, to, allosteric site / site other than active site ; R alternative active site

2 (which) changes, shape / tertiary structure / 3-D structure, of active site ;
A active site distorted I protein structure

allow ecf for mp3 and 4 if competitive described (to max 2)
3 substrate(s) / CO_2 / HCO_3^-, cannot, enter / bind to / fit in / AW, active site ;
A active site no longer complementary to, substrate / AW
A enzyme substrate / ES, complexes cannot form
A ESCs cannot form
I ‘substrate / CO_2 / HCO_3^- / ‘cannot bind to enzyme’ without a link to active site
4 product, not formed / released ; A named product

5 ref. to acetazolamide / inhibitor, leaves, allosteric site / enzyme ;
I reversibly binds</td><td>3</td></tr>
</table>

Question	Answer	Marks
5(a)	*any **one** from:* **I** too small presence of ciia **;** **A** ciliated, cells / epithelial cells / epithelium AVP **;** e.g. *suggestion that* mucus on surface makes detail not easily seen	**1**
5(b)	epithelium has goblet cells and ciliated epithelial cells **;** **A** ciliated cells **A** two different cell types present **I** *ref. to* cell division *ref. to* staining **;** e.g. use of stains gives different, shades / colours differential staining one cell type more neutral / acidic different parts of cells stain differently *idea of* cells have different densities **;** e.g. *idea of* more structures / larger nucleus, gives greater density / AW **R** no cell structures *for lighter cell* **I** *ref. to* number of cilia (sectioning may include) more of nucleus so, affects light penetration / makes cell darker ora AVP **;** *idea of* different components in cells appearing, darker / lighter	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(c)</td><td>
any three from:
<table>
<tr><th>A</th><th></th><th>B / cartilage</th></tr>
<tr><td colspan="3">max two for structure</td></tr>
<tr><td>smooth muscle / composed of smooth muscle cells or
no chondrocytes</td><td>or</td><td>no smooth muscle cells
or
has chondrocytes ;</td></tr>
<tr><td>cells close together</td><td>or</td><td>cells, (more) isolated / in gaps / in lacunae ;</td></tr>
<tr><td>cells, spindle shaped / elongated / AW</td><td>or</td><td>cells (more) rounded / AW ;</td></tr>
<tr><td>AVP structure e.g. not surrounded by, perichondrium / AW
contains blood vessels</td><td>or</td><td>surrounded by, perichondrium / AW
no blood vessels ;</td></tr>
<tr><td colspan="3">function</td></tr>
<tr><td>contractile / contracts (and relaxes) I recoil
A bronchi walls contract
R bronchi contract</td><td>or</td><td>non-contractile ;</td></tr>
<tr><td>changes diameter of airways
A controls size of lumen</td><td>or</td><td>protective / support ;
A described e.g. prevents collapse of, bronchus or
keeps bronchus open</td></tr>
</table>
if incorrectly quotes A as the cartilage, use right hand column to allow one mark max (ecf)
</td><td>3</td></tr>
</table>

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Question	Answer	Marks
6(a)	*any **three** from:* at (phloem) source, mineral ion entry (with water), from xylem / through plasmodesmata from companion cells **;** dissolved in water / as solutes in water / in solution / in sap solution **;** *in context of entry from xylem or within phloem sap* (transport) as part of mass flow **;** *must be in context of phloem* flow down a pressure gradient / AW **;** **R** differences in pressure gradient **R** from high pressure gradient to low pressure gradient AVP **;** e.g. suggestion that mineral ions are needed for transport of some assimilates (e.g. complexed with) *idea of* reallocation of resources / arrive at (phloem) source and are moved to other parts, for use / when needed **;**	**3**
6(b)	sieve, plates / pores **;** **A** perforated end plates / end plates with pores **I** plasmodesmata periphery / edge / AW **;** companion **;** **A** transfer	**3**

Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 2022**

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **18** printed pages.

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PUBLISHED

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	'List rule' guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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Examples of how to apply the list rule
State **three** reasons…. [3]

A

1 Correct	✓	**2**
2 Correct	✓	
3 Wrong	×	

B **(4 responses)**

1 Correct, Correct	✓, ✓	**3**
2 Correct	✓	
3 Wrong	ignore	

C **(4 responses)**

1 Correct	✓	**2**
2 Correct, Wrong	✓, ×	
3 Correct	ignore	

D **(4 responses)**

1 Correct	✓	**2**
2 Correct, CON (of 2)	×, (discount 2)	
3 Correct	✓	

E **(4 responses)**

1 Correct	✓	**3**
2 Correct	✓	
3 Correct, Wrong	✓	

F **(4 responses)**

1 Correct	✓	**2**
2 Correct	✓	
3 Correct CON (of 3)	× (discount 3)	

G **(5 responses)**

1 Correct	✓	**3**
2 Correct	✓	
3 Correct Correct CON (of 4)	✓ ignore ignore	

H **(4 responses)**

1 Correct	✓	**2**
2 Correct	×	
3 CON (of 2) Correct	(discount 2) ✓	

I **(4 responses)**

1 Correct	✓	**2**
2 Correct	×	
3 Correct CON (of 2)	✓ (discount 2)	

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Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined 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

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>bronchi ; A bronchus</td><td>1</td></tr>
<tr><td>1(b)</td><td>any two from:
trachea v alveoli
<table>
<tr><td>trachea</td><td></td><td>alveoli</td></tr>
<tr><td>(carries) oxygenated blood
A (carries) blood with more oxygen</td><td>or</td><td>(carries) deoxygenated blood ;
A described
A (carries) blood with, less / little, oxygen
I no oxygen</td></tr>
<tr><td>lower concentration of carbon dioxide</td><td>or</td><td>higher concentration of carbon dioxide ;</td></tr>
<tr><td>blood at higher pressure</td><td>or</td><td>blood at lower pressure ;</td></tr>
<tr><td>(part of the) systemic circulation
or
branch from the aorta / (originates) from, left ventricle</td><td>v</td><td>(part of the) pulmonary circulation
or
pulmonary artery
or
from right ventricle (of heart) ;</td></tr>
</table></td><td>2</td></tr>
</table>

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Question	Answer	Marks
1(c)(i)	*allow from, labelled / annotated, diagrams drawn* *any **three** from:* ciliated epithelium / ciliated epithelial cells / ciliated cells / cells with cilia **;** detail (of ciliated epithelial cells) **;** e.g. columnar / description cilia, only facing the lumen / on apical lumen / lining the lumen **I** on surface of tissue goblet cells **;** AVP **;** e.g. basement membrane pseudostratified (epithelium) large nuclei **I** visible / clear, nuclei basal nuclei (in goblet cells) nucleoli visible within nuclei	**3**

Question	Answer	Marks
1(c)(ii)	blood vessel / capillary / venule **;** *plus two from:* presence of red blood cells (in the lumen) **;** endothelium / endothelial cells **;** **A** flat cells *accept for endothelial cell* **A** cells with, prominent / bulging / AW, nucleus very thin / one cell thick, walls **;** *ref. to* small size, qualified **;** e.g. narrow lumen / comparison to other tissues *alternative* endothelium / endothelial cell **;** *plus two from* flat cells **;** cells with, prominent / bulging / AW, nucleus **;** one cell thick **;**	**3**

Question	Answer	Marks
2(a)	peptidoglycan / murein **;** ribosomes **;** (permanent / large) vacuole **;**	**3**
2(b)	*any **two** from:* to prevent, lysis / bursting / AW **or** to prevent, (protoplast) shrinking / shrivelling / AW **;** **I** damaged *ref. to* no net movement / AW, of water (occurs) **;** (otherwise movement of water) by <u>osmosis</u> / down a water potential gradient / AW **;**	**2**

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Question	Answer	Marks
2(c)(i)	*max 2 if stated as a protein or includes protein features* *any **three** from:* *cellulose molecule max 2* (β-glucose(s) joined by) glycosidic / glucosidic, bonds / linkages **;** (monomers / β-glucose(s)) joined by (β) 1,4 (glycosidic) bonds **;** **R** α-1,4 bonds **R** (β)1,4 <u>and</u> 1,6 bonds adjacent, monomers / β-glucoses, rotated through 180° **;** AW straight / linear, chain **;** *cellulose microfibril max 2* parallel, molecules / chains, of cellulose **;** hydrogen bonds, between molecules / form cross bridges / between OH groups **;** *idea that* between adjacent cellulose molecules, beginnings and ends in different places / overlap between starts and ends / staggered starts and ends **;**	**3**
2(c)(ii)	*any **one** from:* hemicellulose **;** pectin **;** lignin **;** AVP **;** e.g. expansin	**1**
2(d)	spongy mesophyll / palisade mesophyll / palisade / mesophyll, (cell) **;**	**1**

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Question	Answer	Marks
3(a)	*any **three** from:* decreases / reduces, transpiration **;** **A** lower transpiration rate *accept in the correct context once only* *counts towards max two* **I** evaporation *max two for cuticle* thick (waxy) cuticle **;** increased waterproof layer **;** increased (diffusion) distance for water vapour / less water vapour lost **;** *in context of cuticular transpiration* *max two for stoma* sunken stoma **;** **A** stoma in depression / AW moist / humid, air collects in area near to external environment **;** AW decreases water potential gradient **;** *in context of between sub-stomatal air space or area above stoma and external environment* *alternative acceptable statement for the transpiration mark* reduces diffusion of water vapour (out) via the stoma **;**	**3**
3(b)(i)	*any **three** from:* (many) mitotic cell cycles / mitoses **;** AW *ref. to* division of (meri)stem cell also produces more (meri)stem cells **;** formation of rootlets by mitosis is, growth / increase in number of cells **;** *idea of producing large number of cells* **R** cell growth differentiation / specialisation **;** *in context of the new cells formed by stem cell division*	**3**

Question	Answer	Marks
3(b)(ii)	*any **three** from:* active transport occurring **;** (pumped / moved, out) against the(ir) concentration gradient **;** (move out through), carrier / pump, protein **;** **R** channel protein using, ATP / energy **;** **A** have ATPase activity AVP **;** e.g. membrane impermeable to entry of anions suggestion that move out by exocytosis *allow ATP mp if also stated*;	**3**
3(b)(iii)	*any **two** from:* increased surface area **;** (because, many / more) root hairs / root hair cells **;** increase in, carrier proteins / channel proteins (for ion uptake) **;** **A** transport proteins / aquaporins (for water) **R** channel proteins AVP **;** increase in water uptake osmotically to follow ion uptake / AW **;**	**2**

Question	Answer	Marks
4(a)	<u>image length</u> **;** **A** magnification triangle magnification 250 (nm) **;** (8 mm) **A** 220 (for 7 mm) **A** 230 (for 7.5 mm) **A** 270 (for 8.5 mm) **A** 280 (for 9 mm)	**2**
4(b)	pathogen **;**	**1**

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Question	Answer	Marks
4(c)	ingests / drinks / AW, contaminated water / water containing the pathogen / food washed in contaminated water **/** contaminated food **;** **A** examples of accidental ingestion e.g. swimming in contaminated rivers **A** faecal / oral, transmission **A** bacteria / *Vibrio* **R** if described as virus	**1**
4(d)	**A** mRNA or messenger RNA *any **three** from:* (one strand only needed) to form mRNA / mRNA is single-stranded **;** (m)RNA is, used / needed, to produce, subunit (s) / polypeptide(s) **;** (only) one strand (of DNA) is the, template / transcribed, strand **;** *idea that* (complementary) copying / transcribing, other DNA strand would not result in, desired / AW, mRNA / polypeptide **;**	**3**
4(e)(i)	*any **two** from:* **I** receptor **I** active site (mAbs) specific / different, antigen binding sites / binding sites for antigen **;** **A** (each) mAb binds to a, specific / particular, antigen **R** if antibody described as an enzyme (each mAb has) specific / different, tertiary structure / variable region(s) / primary structure / sequence of amino acids **;** binding site and antigen have complementary shapes **or** ZAC-3 complementary shape to core polysaccharide and lipid A **or** 2D6 complementary shape to O-polysaccharide **;**	**2**

Question	Answer	Marks
4(e)(ii)	*any **four** from:* *yes* *general points* *(agglutination / motility prevented, so)* bacteria less able to, penetrate mucus / attach to intestinal epithelial cells / colonise intestine / AW **;** **A** *idea that* fewer bacteria able to, attach / colonise intestine less / no, choleragen / toxin, released **;** bacteria passed out in faeces not able to cause disease in others / AW **;** *ref. to* phagocytosis more effective **;** e.g. macrophages stimulated to carry out phagocytosis *prevention / treatment* (to prevent disease) needs to be given, at early stages / before colonising (intestine) **;** passive immunity / passive vaccine **;** *must be in context of treatment or immediate protection* *idea that* in addition to immune response (so increased effect) **;** e.g. acts beside, immune system / immune system cells acts before the immune response can become effective *ref. to* quicker recovery (if a person has cholera) **;** useful when, there is antibiotic resistance / antibiotics cannot be given **;** *specific mAb* mAb ZAC-3 may be more effective for cholera caused by, wider range of *V. cholerae* / AW**;** mAb ZAC-3 may be useful if exact form of *V. cholerae* not known **;** mAb 2D6, needs to be targeted against specific *V. cholerae* forms / may not be effective against other *V. cholerae* forms **;** **A** not all forms of *V. cholerae* were tested in lab	**4**

Question	Answer	Marks
4(e)(ii)	AVP **;** e.g. (only) short-term protection / not active immunity / not long term ref. difficulty in delivering mAbs to intestine e.g. may be, digested / destroyed, as pass through gut need to find a way to get mAbs to the intestine if given intravenously need to pass through to gut lumen may be able to prevent multiplication of bacteria mAbs have been used successfully for other diseases	

Question	Answer	Marks
5(a)	*any **two** from:* *ref. to* can organise / order, enzymes / events, in pathway **;** consequence in terms of distance **;** e.g. product of one reaction is close to next enzyme (where it acts as substrate) enzyme (more likely to be) closer to substrate distance between enzymes shorter **I** short distance / less distance to travel, unqualified (so) increases chance of successful collisions between substrate and enzymes **;** increased rate of formation of final product **or** decrease time for ES complex to occur **;** *idea that* products can pass to either side of the membrane **;** all reactions, localised / occur in the same location (within the cell) **;** AVP **;** e.g. membrane provides a source of arachidonic acid **I** phospholipid	**2**
5(b)(i)	(similar shaped) curve to the right of main curve <u>and</u> reaches V_{max} **;** **A** increasing to reach V_{max}	**1**

Question	Answer	Marks
5(b)(ii)	stays the same **;** increases **;**	**2**
5(c)(i)	the gene / PTGS2, is a sequence of nucleotides, that forms part of a DNA molecule / AW / on chromosome 1 **;** **A** bases codes for (the production of) a, polypeptide / enzyme / COX-2 **;** **A** protein **I** codes for an amino acid *max one if no example used*	**2**
5(c)(ii)	*any **two** from:* more, product / compounds, produced that stimulate mitosis **;** increased, DNA replication / cell division / mitosis **;** **I** *ref. to* cancer cells replicating *idea that,* may lead to / increases chance of / AW, (other) mutations **;** mutations can result in oncogenes **;** AVP **;** e.g. *idea that* proof checking capacity impaired / increased chance of errors	**2**

Question	Answer	Marks
5(d)	*any **three** from:* phospholipids may be, used in / added to, the (cell surface) membrane **;** arachidonic acid, is unsaturated / polyunsaturated **;** has, C=C / (carbon-carbon) double bonds **;** *allow ecf if stated as saturated* unsaturated fatty acid tails, have kinks / not linear / AW **;** **A** double bonds produce, kinks / AW increased distance between, phospholipids / other fatty acid tails **;** **A** phospholipids cannot pack closely together less hydrophobic interactions between phospholipid (molecules) **;**	**3**

Question	Answer	Marks
6(a)	wall / muscle, of right atrium **;**	**1**
6(b)	atrial, systole / contraction **;**	**1**
6(c)	AVN delays impulse (from sinoatrial node / atrial muscle) **;** AW e.g. excitation wave / conduction *plus one from:* ring of non-conducting fibrous tissue prevents impulse from sinoatrial node directly passing to ventricles **;** impulse must pass through, atrioventricular node / AVN **;** (then) passes to Purkyne tissue (to ventricles for contraction) **;**	**2**
6(d)	semi-lunar (valves) **;** **A** aortic valve <u>and</u> pulmonary valve	**1**

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