Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2021**

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.

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Cambridge International is publishing the mark schemes for the May/June 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level 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.

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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)	

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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Question	Answer	Marks
1(a)	actual width = image width ÷ magnification **;** **A** A = I ÷ M M = I ÷ A I = A × M or magnification triangle working = width divided by 4275 **;** e.g. 16 000 ÷ 4275 17 000 ÷ 4275 18 000 ÷ 4275 19 000 ÷ 4275 **;** 3.7 (μm) 4.0 (μm) 4.2 (μm) 4.4 (μm) **;** **R** answer if given to more than 1 dp or whole number	**3**
1(b)(i)	DNA – **A** / **B** / **C** **;** cellulose – **E** **;** phospholipid – **A** / **C** **;** histone proteins – **A** / **B** **;**	**4**
1(b)(ii)	chloroplast / mitochondrion **;**	**1**
1(b)(iii)	nucleus **;** **A** chloroplast / mitochondrion **R** nucleolus	**1**

Question	Answer	Marks
1(c)	*any two from* **1** (section at) high <u>resolution</u> **;** **A** suggestion of a correct value of resolution for a TEM **2** any named structure visible in Fig. 1.1 that can, only be seen in a TEM / not be seen in a photomicrograph **;** e.g. internal structure of chloroplasts / thylakoid(s) / grana e.g. internal structure of mitochondria / cristae **3** high magnification / higher magnification (magnification > 1000 / higher than with light microscope) **;** *in context of higher than light microscope* **4** (very) thin **;** **5** 2D / no surface contours / no surface features / AW **; A** not 3D	**2**

Question	Answer	Marks
2(a)	*any three from* **1** (diagram shows) hydrogen bond is a weak bond **;** **2** each oxygen (atom) forms two hydrogen bonds / each hydrogen (atom) forms one hydrogen bond **;** **3** (attraction) between oxygen (atom) of one water molecule and hydrogen (atom) of another (forms a hydrogen bond) **;** **R** cohesion / adhesion – *if used for attraction* **4** water is <u>dipolar</u> **;** **5** detail **;** e.g. electrons not shared equally between oxygen and hydrogen **A** oxygen is more electronegative (than hydrogen) **A** *ref. to* (two) lone pair(s) (of electrons) on oxygen **A** uneven distribution of, electrons / charge e.g. oxygen has, <u>small</u> / <u>slight</u>, negative charge / δ^-, **and**, hydrogen has, <u>small</u> / <u>slight</u>, positive charge / δ^+ *only needs to state 'small' once*	**3**

Question	Answer	Marks
2(b)(i)	*idea that* (H-bonds) maintain / AW, (shape / structure, form of) α-helices / β-pleated sheets **;** **A** allows formation of, α-helices / β-pleated sheets **R** if bonds are between R groups	**1**
2(b)(ii)	*any two from* **1** *idea that* hydrogen bonds help to, stabilise / AW, further folding of, amylase / polypeptide / protein **;** **2** between, R groups with amine and carboxyl groups **;** **A** between R groups with -NH and, -CO / -OH **3** *idea that* may be between amino acids far apart in primary structure **;** **4** *either* helps to maintain / form / AW, globular shape / 3D shape / structure (of amylase / polypeptide / protein) ***or*** maintains / forms / AW, (specific) shape / structure, of, active site / binding site **;**	**2**
2(c)	*any three from* **1** dissolves / AW, ions / minerals / salts, <u>and</u> (named) polar molecules **;** **A** 'assimilates' as polar **I** substances / nutrients **2** transports, solute(s) / named solutes / dissolved substance, in, xylem / phloem / xylem and phloem **;** **3** storage of, solutes / named solutes, in vacuoles **;** **4** metabolic / chemical / cellular, reactions occur in water **;** **5** dissolves, carbon dioxide / oxygen, with ref to, respiration / photosynthesis**;**	**3**

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Question	Answer	Marks
3(a)	*any three from* **1** *differences in height show that* concentrations of sucrose, 0, 0.4 and 0.8 (mol dm^{-3}) *or* ⩽ / less than, 0.8 / 0.9, water moves out of Visking tubing **;** **A** one of 0, 0.4 or 0.8 **R** sucrose moving **2** concentrations of sucrose 1.2, 1.6, 2.0 (mol dm^{-3}) *or* ⩾ / more than, 0.9 /1.2, water moves into Visking tubing **;** **A** one of 1.2, 1.6 or 2.0 **R** sucrose moving **3** *ref. to* net water movement **;** *if water enters Visking tubing* – **A ora** *for water leaving* **4** external solution has higher water potential (than contents of Visking tubing) **;** **A** high water potential to low water potential **5** water moves, down, water potential / Ψ, gradient **;**	**3**

Question	Answer	Marks
3(b)	*mark whole question to a max of four marks* *descriptions* **1** at concentrations, less than / ⩽, 0.04 mol dm^{-3} all cells, burst / AW **;** **2** at concentrations between 0.04 and 0.14 mol dm^{-3} decreasing percentage of cells burst / AW **; A** use of percentages **3** at concentrations, greater than / ⩾, 0.14 mol dm^{-3} no cells, burst / AW **;** *explanations to max 3* **4** in low concentrations / ⩽ 0.04, of sodium chloride water moves into cells down water potential gradient / from high Ψ to low Ψ **;** **5** cells increase in, volume / size / internal pressure **;** **6** *either* cell membranes are not strong enough to withstand increase in volume / pressure **or** red blood cells burst because they have no cell wall **;** **7** between 0.04 and 0.14 (mol dm^{-3}) water potential gradient into cells, decreases / becomes less steep / AW **;** **8** above 0.14 (mol dm^{-3}) / in high concentrations, water potential inside cells is the same or higher than the sodium chloride solution **;** **9** at high concentration / ⩾ 0.14, water leaves cells / cells shrink / cells shrivel / cells show crenation **;**	**4**

Question	Answer	Marks
4(a)	*idea* of *shape needs to be in the answer for mp2 and mp4* **I** *'substrate changes shape'* *any three from* **1** active site is not (fully) complementary to substrate **;** **2** active site, changes shape / moulds around, to fit the substrate **;** **A** conformational change for shape change **3** <u>enzyme-substrate complex / ESC</u>, forms **;** **4** active site returns to original shape on release of product **;** **5** AVP **;** e.g. change of shape (to give complementary fit) lowers activation energy / puts strain on bonds / AW *ref. to* binding site / catalytic site (of active site)	**3**
4(b)(i)	***A** peroxidase for enzyme* *any three from* *rate of reaction increases as substrate concentration increases to 0.33 – 0.35 mmol dm^{-3}* **1** (up to 0.33 to 0.35 mmol dm^{-3}) some active sites are not occupied **;** **2** more collisions between, enzyme / active site, and substrate molecules **;** **A** more collisions lead to increase in formation of enzyme-substrate complexes *rate of reaction remains constant above 0.33–0.35 mmol dm^{-3}* **3** all active sites, occupied / saturated **;** **4** correct reference to limiting factor for slope **; A** limits / limiting e.g. at low substrate concentrations, substrate concentration limiting / enzyme concentration not limiting **5** correct reference to limiting factor for plateau **; A** limits / limiting e.g. at high substrate concentrations, enzyme concentration limiting / substrate concentration not limiting	**3**
4(b)(ii)	*idea that* determined V_{max} / maximum rate / *ref. to* 5.6 (μmol min^{-1}) **;** **A** if V_{max} shown on graph K_m is the substrate concentration at half the V_{max} **;**	**2**

Question	Answer	Marks
4(c)	*any three from* *in respiring tissue* **1** (carbonic anhydrase) catalyses the reaction between water and carbon dioxide in, red (blood) cells / erythrocytes **;** **2** to form carbonic acid, which dissociates to form HCO_3^- and H^+ **;** **A** from equation **A** use of word ion(s) **3** HCO_3^-, moves / passes / diffuses (through membrane proteins from red blood cells) into plasma **;** **4** (activity of enzyme) maintains (steep) concentration gradient for diffusion of carbon dioxide into red blood cells **;** **5** *idea that* so helps to remove large quantities of carbon dioxide **;** *in lungs* **6** (carbonic anhydrase) converts HCO_3^- back into carbon dioxide so can be, excreted / removed / exhaled **;** *if described earlier* **A** catalyses reverse reaction so carbon dioxide can be, excreted / AW	**3**

Question	Answer	Marks
5(a)	**1** vector is female *Anopheles* (mosquito) **;** **2** mosquito / (female) *Anopheles*, takes blood from infected person **; I** 'bites' alone **3** (vector / mosquito / *Anopheles*) inserts / AW, saliva / anticoagulant, with, pathogen / *Plasmodium* / parasite, into (blood of) uninfected person **;** **R** if incorrect type of pathogen	**2**
5(b)	B-lymphocytes / B-cells **;** fuse / combine / join / merge / AW **;** **R** hybridise / bind / bond hybridoma **;**	**3**

Question	Answer	Marks
5(c)	*any three from* **1** results are accurate (rely on monoclonal antibodies) **;** **2** results are obtained quickly / diagnosis is quick **;** **3** low cost / cheap **;** **4** does not need highly trained medical professional / easy to read / easy to use / AW **;** **5** does not need specialised equipment **;** **6** easily, transported / distributed (in bulk) **;** **7** can ensure appropriate treatment is given immediately malaria is confirmed **;** **8** reduces unnecessary use of antimalarial drugs (just in case) **;** **9** (a small area for S so) only a small sample of blood needed **;** **10** AVP **;** e.g. can identity different species of *Plasmodium* **I** *ref. to* line C and working correctly	**3**

Question	Answer	Marks
5(d)	***ignore*** *ref. to* sickle cell anaemia *any five from* *habitat of* Anopheles *mosquito* **1** tropical / warm and humid / AW, climate / regions **;** **A** in context of global warming (increases life span of *Anopheles*) **2** in areas where, *Anopheles* (mosquito) / vector, occurs **;** **3** *Anopheles* mosquitoes only live in humid conditions **;** **4** warm temperatures for, development / growth, of, parasite / *Plasmodium* (in vector / mosquito) **;** **5** warm temperature for, development / growth, of mosquito larvae **;** **6** mosquitoes require bodies of, still / AW, water for breeding **;** **A** ponds, puddles, lakes, swamps **7** mosquitoes require places where there is sufficient rainfall **;** **8** low altitude **;** *resistance* **9** insecticide / repellent, resistance of mosquitoes **;** **10** drug resistance of parasite **;** *prevention* **11** in countries / areas, where, prevention / control measures, are not implemented by, governments / health authorities **;** **12** further detail e.g. any example of a, prevention / control measure that is not used or not implemented fully **;** *immunity* **13** immunity to malaria in human population (limits distribution) **;** *people* **14** migration of infected people from areas (with high rates of malaria) **;** **15** high rates of HIV infection **;**	**5**

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Question	Answer	Marks
6(a)	**A** rough endoplasmic reticulum **;** **E** Golgi, body / apparatus / complex **;**	**2**
6(b)	transport from, (R)ER / ribosomes, to Golgi **; A** from **A** to **E** **A** transport from Golgi to, cell surface membrane / phagosome **A** separate, acid hydrolases / enzymes, from, rest of cell / AW	**1**
6(c)	phagocytosis / endocytosis **;**	**1**
6(d)	*any three from* **1** break down / digest / destroy, bacteria / pathogen(s) **;** **2** break down / digest / destroy, (worn out / defective / AW), organelles / named organelle (in animal cell) **; A** autophagy **3** catalyse / speed up, hydrolysis **;** **4** any **two** named substrates **;** e.g. (any named) polysaccharides / proteins / (phospho)lipids / (named) nucleic acids **5** *idea that* recycle / reuse, biological molecules within cell **;** **6** (macrophage / phagocyte) cut up to present antigen **;**	**3**
6(e)	moves / pump(s), hydrogen ions / protons, into the lysosome against concentration gradient **;** active transport / uses ATP / energy from respiration / ref to conformational change of carrier **;** **R** if a ref to facilitated diffusion	**2**

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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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A	accept
I	ignore
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Question	Answer	Marks
1(a)(i)	**E** = metaphase **;** **F** = anaphase **; I** early / mid / late **R** more than one stage given for either **E** or **F**	**2**
1(a)(ii)	*any one from* (assemble) to form / become part of / AW, spindle fibres / spindle **;** attach to, centromere **;** **A** kinetochore *for centromere* **A** form (part of) kinetochore **A** to connect, chromatid / chromosome, to, spindle / spindle fibres **I** to connect, chromosome / centromere, to centrosome example of allowing movement of, chromosomes / chromatids **;** e.g. **A** to, pull chromosomes / orientate chromosomes, at equator **A** to pull (sister) chromatids apart (at anaphase) **A** to move, (sister) chromatids / daughter chromosomes, to poles	**1**
1(a)(iii)	**must state 'plant' to gain mark** **I** vacuoles / large permanent vacuole / vague ref. to shape *any one from* cell walls present**;** uniform / regular, shape of cells **;** no, cleavage furrow / pinching in of cytoplasm (in cells at cytokinesis) **;** cell plate present (in late telophase / cytokinesis, stages) **;**	**1**

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Question	Answer	Marks
1(b)	**R** *any answers where a choice is given* **A** hydrogen **;** **B** (DNA) ligase **;** **C** DNA polymerase **;** **R** RNA polymerase **I** roman numerals, e.g. DNA polymerase I **D** telomeres **;**	**4**

Question	Answer	Marks
2(a)	*any three from* *decrease in sugar* 1 *idea that* changing / transition, from sink to source e.g. leaf becomes the source leaf no longer the sink sugars are (now) being moved away from leaf was a growing area, now translocating (sugars) 2 photosynthesis provides enough sugar / (rate of) photosynthesis increases **;** **A** leaf (now) makes enough sugar **I** makes own food *increase in water to max 2* 3 increase in size / more cells / increase in (leaf) surface area, (so proportionate increase in water) **;** 4 (more cells that need) water to, maintain turgidity / prevent flaccidity / prevent wilting, (because of transpiration) **;** 5 increased transpiration **/** greater number of stomata **;** **A** increased evaporation (greater internal leaf area) 6 water is, a reactant / needed, for photosynthesis **;** (*in context of increased photosynthesis, more water needed)* 7 AVP **;** e.g. maturing leaf growth rate slows / mature leaf no growth (more cells, so more) water needed for, cellular reactions / AW e.g. for hydrolysis of starch (more) water needed for, cell elongation / enlarging vacuoles	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)</td><td>
one mark each correct row ;;;

column mark can be used <u>instead of</u> row mark (if higher mark achieved)
<table>
<tr><th>feature</th><th>companion cells</th><th>phloem sieve tube element</th><th>xylem vessel element</th></tr>
<tr><td>cytoplasm</td><td>✓</td><td>✓</td><td>x</td></tr>
<tr><td>cell surface membrane</td><td>✓</td><td>✓</td><td>x</td></tr>
<tr><td>lignified cell wall</td><td>x</td><td>x</td><td>✓</td></tr>
<tr><td>nucleus</td><td>✓</td><td>x</td><td>x</td></tr>
</table>
</td><td>4</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(i)</td><td>accept from either column for mark and assume blood if not stated
any three from
<table>
<tr><th>blood</th><th>tissue fluid</th><th></th></tr>
<tr><td>has red blood cells</td><td>has no red blood cells</td><td>;</td></tr>
<tr><td>more, white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes
or
fewer macrophages</td><td>fewer white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes
or
more macrophages</td><td>;</td></tr>
<tr><td>has platelets</td><td>has no platelets</td><td>;</td></tr>
<tr><td>has, more protein / large proteins
or
has, plasma proteins / named example e.g albumin / fibrinogen / globulin
these are large proteins</td><td>has, fewer / no large, proteins
or
has no, plasma proteins / named example e.g. albumin / fibrinogen / globulin
only allow <u>fewer</u> plasma proteins if clear the proteins present are small enough to leave blood</td><td>;</td></tr>
<tr><td>higher, concentration / AW, oxygen
A more oxygenated</td><td>lower, concentration / AW, oxygen
A less oxygenated</td><td>;</td></tr>
<tr><td>higher, concentration / AW, glucose / amino acids / fatty acids</td><td>lower, concentration / AW, glucose / amino acids / fatty acids</td><td>;</td></tr>
<tr><td>lower, concentration / AW, carbon dioxide A urea, in liver / muscles
I waste</td><td>higher, concentration / AW, carbon dioxide A urea, in liver / muscles
I waste</td><td>;</td></tr>
<tr><td>higher pressure</td><td>lower pressure</td><td>;</td></tr>
</table></td><td>3</td></tr>
<tr><td>3(a)(ii)</td><td>lymph ; A lymphatic fluid</td><td>1</td></tr>
</table>

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Question	Answer	Marks
3(b)	*any two from:* 1 can cross / AW, hydrophobic core (of bilayer) / phospholipid bilayer **or** can pass through gaps between, fatty acid tails / phospholipids **;** 2 is, hydrophobic / lipid-soluble / non-polar / not ionic / not charged **or** not, hydrophilic / water-soluble / polar / ionic / charged **;** 3 small size **;**	**2**
3(c)	**Reject** if hormone S or receptor **R** described as an antigen or enzyme complementary (shape) to / only fits into / specificity for (binding to), **R** / receptor **;**	**1**
3(d)(i)	nuclear pore **;** **A** nuclear pores	**1**
3(d)(ii)	**B** = transcription **;** **C** = translation **;**	**2**
3(d)(iii)	(80S) ribosome **; I** 70S	**1**

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Question	Answer	Marks
3(e)	*any four from* 1 (formation of), secondary / 2° / second level, structure with, alpha-helix / α-helix / beta-pleated sheet(s) / β-pleated sheet(s) **;** **A** β-conformation for β-pleated sheet **I** incorrect detail of bonds 2 folding / coiling, to form tertiary / 3° / third level, structure **;** **A** *ref. to* 3D structure as alternative to, folding / coiling **A** secondary structure, folds / coils, to form tertiary structure **R** alpha helix / beta-pleated sheet, coils / folds 3 *two of* hydrogen bonds / ionic or electrostatic bonds / disulfide bonds or bridges / hydrophobic interactions **;** **I** peptide bonds *as part of a list that contains two correct bond types* *these must be in context of tertiary structure* 4 (formation of), quaternary / 4° / fourth level structure **;** **A** description e.g. polypeptides held together by, interactions / hydrogen bonds / ionic bonds / disulfide bonds **R** if peptide bonds included 5 (globular protein) has hydrophilic, amino acids / R-groups / side chains, to, outside / AW **;** **ora** hydrophobic, amino acids / R-groups / side chains, towards centre / AW 6 example of other post-translational modification **;** e.g. removal, methionine / met addition sugar group / glycosylation addition phosphate group / phosphorylation addition prosthetic group	**4**

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Question	Answer	Marks
4(a)	*any three from* *lung cancer to max 2* (tar) is a carcinogen **;** acts as mutagen / causes mutations **/** described **; I** mutant cells e.g. causes changes to sequence of, bases / nucleotides, in DNA detail **; I** uncontrolled mitosis e.g. tumour suppressor genes switched off protooncogenes to oncogenes / oncogenes switched on (cell cycle) checkpoints fail to function AW cell moves from, G0 / inactive state of cell cycle, to G1 phase (for mitosis) no programmed death / AW *chronic bronchitis to max 2* (tar) paralyses / destroys / damages / AW, cilia **; I** weakens cilia **A** damage to <u>ciliated</u> (epithelial) cells consequence to <u>cilia</u> action **;** *must be related to mp1* e.g. <u>cilia</u> do not, waft away / AW, mucus loss of synchronous rhythm of <u>cilia</u> (tar causes), goblet cells / mucous glands, to, increase in size / enlarge / AW **; A** (tar / accumulation of mucus, causes) inflammation more / excess, mucus produced (by, goblet / mucous gland cells) **;** **I** mucus accumulates	**3**
4(b)	*correct units for volume* cm^3 **;** *SA <u>and</u> volume calculation* (SA) = 54 (V) = 27 **;**	**2**
4(c)	**A** → **B** → **C** **;** **A** 6:1 → 3:1 → 2:1 **A** 1 → 2→ 3	**1**

Question	Answer	Marks
4(d)	*any two from (in emphysema)* alveolar walls break down / alveoli burst, to, produce one large air sac / give a lower SA:V **or** diseased, tissue / areas / alveoli, has lower SA:V (than healthy tissue) **;** removed tissue has (higher proportion of), large air sacs / diseased alveoli **;** remaining tissue has, healthy / undamaged / functional / only, alveoli **;** AW **A** volume reduced and functional surface area of lung remains the same **A** remaining tissue has higher functional surface area (than before surgery)	**2**
4(e)	*any two from* 1 only oxygenated blood passes through left side of heart **ora** **or** oxygenated blood in left side and deoxygenated blood in right side of heart **;** 2 septum in heart separates (oxygenated and deoxygenated) blood **;** 3 oxygenated blood is in pulmonary, venules / veins and deoxygenated blood is in, pulmonary arteries / arterioles **;** 4 (because mixing prevented by) double circulation / double circulatory system / pulmonary and systemic circulations **;**	**2**
5(a)	plasmodesma **;** *plus any one from* **R** if stated as apoplast 1 allows / AW, symplast, pathway / movement **;** 2 allows transport of / AW, water / sucrose / sugars / amino acids / organic substances / ions / mineral salts (**A** minerals) / lipids / assimilates / hormones / cell signalling molecules **;** *in context of* between cells **I** substance unqualified **I** osmosis of water if in a longer list where other substances are named correctly **R** osmosis of water *if this is the only item noted* 3 cell to cell / AW, communication / signalling **;** **A** cell communication	**2**

Question	Answer	Marks
5(b)(i)	*any one from* (only) polypeptides / proteins, synthesised at ribosomes **;** carbohydrates / polysaccharides, not synthesised at ribosomes **;** enzymes, for synthesis / required, not located at ribosomes **;**	**1**
5(b)(ii)	exocytosis **;**	**1**

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Question	Answer	Marks
5(c)	*accept substrate for cellulose and enzyme for cellulase* *allow use of extracted data to support a response to confirm awarding a mark* 1 correct description **;** *overall trend or more detailed break down* e.g. as, cellulose / substrate, concentration increases, rate of reaction increases **or** as, cellulose / substrate, concentration increases, steep increase in rate of reaction then, less steep increase / (begins to) plateau **I** 'rate of reaction is fast and then slows down' *needs ref. to rate of reaction, describing 'gradient of curve' is not enough* *plus any two from* 2 increasing cellulose concentration increases number of, collisions between enzyme and substrate / enzyme-substrate complexes / ESCs **;** **A** collisions between active site and substrate **A** *idea of* increased chances of cellulose binding to active site 3 at low cellulose concentrations, (many) active sites, available / not all used / not saturated **;** 4 at higher cellulose concentrations, active sites becoming saturated / most active sites occupied / most active sites not available / AW **;** **A** actives sites are, saturated / occupied 5 named limiting factor(s), qualified **;** e.g. at low(er) cellulose concentrations, cellulose concentration limiting / enzyme concentration not limiting **A** idea of, not enough cellulose / enzyme in excess as cellulose concentration increases, change from cellulose concentration limiting to enzyme concentration as limiting factor at higher cellulose concentrations, enzyme concentration limiting / cellulose concentration not limiting **A** idea of, cellulose in excess / not enough enzyme / enzyme working at its fastest rate / active sites not emptying quickly enough for substrate available	**3**

Question	Answer	Marks
5(d)(i)	*mark to max 2 if microorganisms are considered to be enzyme inhibitors* *lower K_m for pectinase, any two from* *ultrasound* increases affinity of enzyme for substrate **;** makes shape of active site more complementary **;** makes (position of) active site more accessible (to substrate) **;** **A** makes it easier for substrate to enter (active site) breaks up pectin, aggregates / AW, to expose more substrate for binding **;** *higher Vmax for xylanase, any two from* *ultrasound* increases rate of, collision between enzyme and substrate / more enzyme-substrate complexes per unit time **;** **I** more ESC form *needs idea of increased rate* increases rate of catalysis after binding **;** may change substrate for easier hydrolysis **;** may lower, more than normal, activation energy required for reaction **; A** described, e.g. increased ability to, break / form, bonds	**3**
5(d)(ii)	yes (as all have) increased, catalytic efficiency / productivity / V_{max} /K_m **;** **A** manipulated data for increased catalytic efficiency *any <u>two</u> from* pectin 24.5 / 25% cellulase 17.25 / 17% xylanase 16.8 / 17%	**1**

Question	Answer	Marks
6(a)	*any two from* 1 (MG is an) autoimmune, disease / disorder / condition **;** **A** autoimmunity **R** autoimmune system 2 (disease in which) failure to distinguish / AW, between self and, non-self **;** **A** between self and, non-self / foreign, antigens 3 (so, at neuromuscular junctions) ref. immune response occurs against / antibody produced against, self-antigens / receptors qualified (see list)**;** **A** antibodies, bind to / block / attack / AW examples of receptors cell surface muscle cell ACh / neurotransmitter neuromuscular junction postsynaptic 4 *idea that* defective lymphocytes not destroyed (during development) **;**	**2**

Question	Answer	Marks
6(b)	*max 2 if wrong context* *e.g. vaccine contains, foreign antigens / antigens of pathogen / pathogen / antibody to bind to lymphocytes* *any three from* 1 vaccine contains antigens **;** *in context of antigens of defective, T-lymphocytes and B-lymphocytes* *(accept antibody of defective B-lymphocyte as AW antigen)* 2 stimulates an immune response **;** 3 detail **;** e.g. macrophages and antigen presentation / AW *ref. to* specific lymphocytes involved clonal selection of lymphocytes recognition by / activation of, lymphocytes clonal expansion of lymphocytes production of plasma cells *in context of B-lymphocytes* production of memory cells T-helper cells produce cytokine 4 antibody produced against (defective), T-lymphocytes / B-lymphocytes / antibody (that binds ACh receptors) **;** *in context of primary or secondary response* **R** *if context is related to the vaccine containing antibody* 5 memory cells, remain / give long-lasting effect / AW **;** 6 memory cells allow secondary immune response to (defective) lymphocytes (newly produced) **;**	**3**

Question	Answer	Marks
6(c)	*any one from* antibiotic resistance, qualified **;** **A** drug for antibiotic e.g. increases risk of antibiotic resistance developing may cause / could lead to problems of, antibiotic resistance an antibiotic resistant bacterial strain may develop **R** if, immune / immunity, included **R** antibiotic resistance / mutation, in, TB / disease / people / virus mutation(s) occur in <u>bacteria</u> which, make antibiotics ineffective / prevent antibiotic action **;** **A** mutation occurs which may make bacteria resistant AVP **;** e.g. *ref. to* development of, DR-TB / MDR-TB / XDR-TB (*if latent bacteria become active)*	**1**

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Question	Answer	Marks
6(d)	*max 2 if not in context of the statistic stated (using only Fig. 6.1) mps 2 -8 only* *points are in context of people who do **not** know* *any three from* 1 9.2 million do not know that they are, living / infected with, HIV **;** **ora** 27.7 million people know *risk to themselves* 2 not accessing, ART / treatment **;** **A** only people who know will access ART **A** if tested, can access ART 3 high(er) viral, loads / levels (compared to many on ART)**; ora** *idea of no control over presence of virus in body* 4 greater risk of, developing / dying from, HIV/AIDS / HIV-related diseases **; ora** **A** AIDS for HIV / AIDS **R** HIV *context could be, no ART / higher viral loads / no treatment of HIV-related diseases* *risk to others* 5 greater risk of transmitting, virus / HIV **;** **ora** *includes placental transmission* **R** HIV/AIDS or AIDS *context could be, higher viral load / not practising prevention* 6 detail of prevention that may not be practised **; ora** e.g. are sharing contaminated needles are donating blood are breastfeeding are not, practising safe sex / using condoms / AW 7 (may develop opportunistic infection so) greater risk of spreading infectious diseases **;** *consequence for, health care / authorities*	**3**

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Question	Answer	Marks
6(d)	8 problems with increase in infection within a population **; ora** e.g. increased cost of, care / medication increased pressure on medical staff reduction in size of labour force 9 *ref. to* testing for HIV **; R** testing for HIV/AIDS e.g. indicates more, education / advertising, needed to encourage testing indicates more testing required / focusing on at risk groups 10 AVP **;** *issues for authorities other than mp 8 and 9* e.g. if people do not know status, no contact tracing can occur focus efforts on countries where a high proportion do not know HIV status authorities provide free condoms to try and reduce overall transmission	

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Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 2021**

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 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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.

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 2)	Correct, CON (of	×, (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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Question	Answer	Marks
1(a)	*structure max 2 marks* **1** RER has ribosomes **R** *if context is within lumen* **or** SER does not have ribosomes **;** **2** RER, flattened sacs / cisternae, and SER tubular **;** AW **3** RER continuous with, (external) nuclear membrane **;** **ora** **I** near to nuclear membrane **R** continuous with internal nuclear membrane **4** *ref. to* RER, more regular / layered, arrangement **or** SER more irregular / disorganised, arrangement **;** *function* **5** RER produces / transports, proteins / glycoproteins **;** **A** polypeptides **A** examples of post-translational modification **6** SER produces, lipids / cholesterol / steroids **;** **A** stores **I** produces hormones	**3**
1(b)	*any two from* *ref. to* phosphate (group) and two fatty acid, chains / tails / residues **;** **A** two hydrocarbon chains correct *ref. to* attachment, phosphate / fatty acids, to glycerol **;** AVP **;** e.g. *ref. to* ester bond *ref. to* additional group e.g. choline-containing *ref. to*, saturated / unsaturated, (fatty acid tails) *award marks from an annotated diagram*	**2**

Question	Answer	Marks
1(c)(i)	flattened sacs / cisternae **;** stack / layered / described **;** *any one from* *idea that* each cisterna in stack is, separate / not interconnected **;** smooth (outer surface) / no ribosomes **;** close to, nucleus / RER **;** single membrane **;** AVP **;** e.g. two distinct faces *ref. to* swollen ends to cisternae	**2**
1(c)(ii)	*ignore events occurring before vesicle formation* *any three from* vesicle moves to, cell surface / cell (surface) membrane **;** **A** plasma membrane movement of vesicle via, cytoskeleton / microtubules **;** vesicle fuses with (cell surface) membrane (and protein released) **;** AW e.g. vesicle makes contact with membrane and becomes part of it **I** attaches to / binds to exocytosis **;** **I** bulk transport / excreted / secreted *allow in context of release only or movement from Golgi and release*	**3**
1(c)(iii)	*any one relevant e.g.* acts as (self-)antigen / recognition site / cellular recognition / receptor / membrane stability / cell adhesion **;** **I** involved in cell signalling	**1**

Question	Answer	Marks
2(a)	**I** *ref. to* features that are absent e.g. no cellular structure *any one from* nucleic acid core **;** either DNA <u>or</u> RNA **;** **I** ref. to, single / double, stranded protein coat / capsid **;** **A** *idea of* (outer covering) made of <u>capsomeres</u>	**1**
2(b)	*(smallpox) Variola* **;** *(measles) Morbillivirus* **;**	**2**
2(c)	*allow, virus / viruses, for Morbillivirus* **I** penicillin doesn't act on viruses *any two from* **1** penicillin only acts on bacteria (and measles is caused by a virus) **;** **A** prokaryotes **2** *Morbillivirus* does not have, cell walls / murein / peptidoglycan **;** **3** *Morbillivirus* does not have, transpeptidases / the enzyme that is inhibited (by penicillin) **;** **A** *idea of* not possessing the enzyme that is acted upon by penicillin **4** *Morbillivirus* does not grow / penicillin (only) acts on growing cells / AW **;** **A** when cell wall is, growing (larger) / getting bigger **5** *Morbillivirus* does not have cellular structure / *Morbillivirus* is acellular / penicillin only acts on cells **;**	**2**
2(d)	to treat / to cure / may have / prone to / to prevent / AW, infectious diseases / infections / AW **;** e.g. bacterial / opportunistic / secondary, disease(s) / infection(s) **A** to kill bacterial pathogens **A** to treat (some) fungal diseases **R** viral disease / HIV infection *do not award if a mix of viral and bacterial diseases stated*	**1**

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Question	Answer	Marks
2(e)(i)	*allow ref. to, cheaper / low cost, related to relevant mp once only* *any four from* *did not mutate to max 2* **1** same vaccine could be used (everywhere / for many years) **;** **A** no need to manufacture different vaccines *in context of ease of, administering / planning / production* **2** (so) a person was protected for, a long time / life / each exposure (to virus) **;** AW e.g. same virus so vaccinated person did not become ill on repeated exposure **A** reduced / no, risk of vaccine becoming ineffective **A** long-lasting immunity *once only for mp2 or mp4* **I** more effective vaccine **3** no, research / trials / development, required for new vaccine(s) **;** *in context of pre-mass production* *live and closely related to max 2* **4** (closely related so) same antigens / (gives the desired) immune response / antibodies produced / memory cells produced / memory cells remain **;** **A** long-lasting immunity *once only for mp4 or mp2* **5** live virus (replicates, so), gives a strong(er) immune response **;** **A** better immunity than inactive virus **R** natural active immunity **6** no need for boosters **;** **7** *ref. to* not smallpox virus, so fewer health and safety issues (at all stages of development and use) **;** e.g. could not get ill from smallpox **A** not smallpox virus so more people willing to have vaccine	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(e)(i)</td><td>thermostable vaccine
8 longer shelf-life / doesn’t degrade easily / other advantage ;
e.g. no refrigeration needed
could be easily, stored / transported
no wastage

easy to administer
9 (using non-medical staff) increased number of people vaccinated / percentage cover / herd immunity ;
allow idea of faster delivery of vaccination programme
A idea that (makes vaccine) more accessible to people in developing countries</td><td></td></tr>
<tr><td>2(e)(ii)</td><td>one mark for correct completion of table ;

<table>
<tr><th>type of immunity</th><th>gained (✓)
not gained (x)</th></tr>
<tr><td>active immunity</td><td>✓</td></tr>
<tr><td>artificial immunity</td><td>✓</td></tr>
<tr><td>natural immunity</td><td>x</td></tr>
<tr><td>passive immunity</td><td>x</td></tr>
</table>
</td><td>1</td></tr>
</table>

Question	Answer	Marks
3(a)	*any four from* **1** mRNA, attaches to / associates with / AW, ribosome **;** **A** ribosome reads mRNA **2** two codons, exposed **/** AW **;** **A** A and P sites / first and second binding sites, (on ribosome) **3** tRNA, qualified carries an amino acid to ribosomes / each type carries a specific amino acid / first amino acid is met / tRNA with met / $tRNA^{met}$ **;** *ref. to ribosomes can be implied in mp 3 if mp1 gained* **4** anticodon (on tRNA) binds to codon (on mRNA) **;** **I** matches **A** complementary / base, pairing between codon and anticodon **A** H-bonds form between bases on codon and anticodon **R** if anticodon on mRNA **5** START (mRNA) codon / (mRNA) AUG first codon **;** **6** second tRNA with its amino acid binds next to first tRNA / (two) amino acids are held in place close to each other by tRNA binding / AW **;** **A** *ref. to* two tRNAs next to each other **7** (after peptide bond formation) first tRNA detaches / ribosome moves along one codon **or** process repeats / elongation occurs, until, STOP codon / polypeptide chain synthesised (and released from ribosome) **;** **8** tRNA molecules, reused / leave ribosome to attach to another amino acid **;** *must be in context of leaving after peptide bond formation* **9** AVP **;** e.g. peptidyl transferase for peptide bond formation *ref. to*, 99 / 100 / 101, codons, qualified **A** number of bases in length of mRNA	**4**

Question	Answer	Marks
3(b)	*any three from* *similarity* peptide bond and disulfide bond are covalent bonds **;** *differences* tertiary structure bonds are between, R groups / side chains, (of different amino acids **;** H bond / ionic bond / hydrophobic interaction, versus <u>covalent</u> peptide bond **;** **A** tertiary structure bonds apart from disulfide are not covalent peptide bond, stronger / more thermostable, than, tertiary structure bonds / two named bonds**;** peptide bond is between, carboxylic acid / <u>COOH</u>, and, amino / <u>NH_2</u>, group (of the adjacent amino acid) **;** AVP **;** detail of a tertiary structure bond e.g. hydrophobic between non-polar R groups disulfide between sulfur-containing R groups ionic between carboxyl and amino groups of R groups H bond between oxygen on —CO groups and H on either the —OH or —NH groups of R groups	**3**

Question	Answer	Marks
3(c)(i)	*any three from:* *suggestion that* **1** flap region, opens / moves, to let, substrate / polyprotein, enter **or** flap region, closes round / AW, substrate / polyprotein **I** flap region is closed **2** induced fit / HIV protease action, involves, change in shape of active site / active site moulding around substrate / AW **;** **I** *ref. to* enzyme or substrate changing shape *if mp1 and mp2 not gained allow one mark if stated that activity of flap region changes shape of active site or that flap region changes shape because it is the active site* **3** *ref. to* better fit / fully complementary / AW **;** **4** *ref. to* formation of, enzyme-substrate complex **;** **A** ESC **5** AVP **;** e.g. (induced fit) substrate / polyprotein, not (fully) complementary to (shape of) active site **A** does not (fully) fit active site / enzyme, returns to original shape on release of product change of shape (to give complementary fit), lowers activation energy / puts strain on bonds / AW	**3**
3(c)(ii)	*any two from* acts as <u>competitive inhibitor</u> **;** binds to active site, qualified **;** e.g. instead of, substrate / polyprotein to prevent, entry / binding, of, substrate / polyprotein so competes with substrate to prevent ESC formation **I** *ref. to* flap region as active site *any one from* will be permanent / non-reversible **;** causes / induces, flap region to open to bind to active site **;** no (**A** few / fewer) polyprotein products / polyprotein not cut, so viral replication prevented / AW **;** **R** polyprotein not broken down	**2**

Question	Answer	Marks
4(a)	*disaccharides* - two, monosaccharides / sugar monomers / sugar units / simple sugars **;** **R** sugar molecule *polysaccharides* - more than two / three or more / many / large number of, monosaccharides / sugar monomers / sugar units / simple sugars **;** **A** sugar molecule / carbohydrate monomer *if 'monomers' is the only term given for both allow one mark (unless contradicted e.g. amino acids are monomers)* correct *ref. to* glycosidic bond(s) **;**	**2**
4(b)(i)	*max 2 if large vacuole or nucleus drawn* **1** sieve plate drawn and labelled **;** **A** sieve pore label *must be to a gap* *doesn't need to show pores* **I** plasmodesmata *any two from* **2** cytoplasm labelled and drawn as, thin layer against wall / patches **;** *if drawing not clear, allow if label indicates peripheral cytoplasm* **3** mitochondrion / mitochondria, drawn within cytoplasm / at edge, and labelled **;** *internal details not required* **4** endoplasmic reticulum drawn within cytoplasm / at edge, and labelled **;** **A** ER **R** RER / SER *if no indication of peripheral cytoplasm, or structures located within peripheral cytoplasm / at edge, allow one mark for drawing and labels of <u>two</u> of mp2,3,4* **5** cell surface membrane drawn in (close to cell wall) and labelled **;** **A** plasma membrane **6** AVP **;** e.g p-proteins drawn as, strands / AW, and labelled plasmodesmata shown as strands of cytoplasm entering sieve tube cell from companion cell and labelled	**3**

Question	Answer	Marks
4(b)(ii)	influx / entry / AW, of sucrose / organic compounds / assimilates / photosynthates / named **;** **A** active loading *for entry* **R** active transport / cotransport / facilitated diffusion **R** incorrect cell type named as donor cell e.g. xylem / mesophyll *must have idea of entry – stating that they are present in the phloem sieve tube is not enough* water enters (from xylem), by osmosis / down water potential gradient / from high(er) to low(er) water potential / from less negative to more negative water potential **;** **A** Ψ for water potential **A** water enters, increasing volume	**2**

Question	Answer	Marks
5(a)	*allow one mark if monocyte <u>and</u> neutrophil both labelled as phagocytes and no other cell is labelled phagocyte* *allow phagocyte for either the monocyte or neutrophil if the other cell correct* red blood cell / erythrocyte ;   monocyte / macrophage; **I** white blood cell **I** leucocyte neutrophil ; **A** *polymorphonuclear leucocyte / basophil / eosinophil*   lymphocyte ; **I** B / T **I** B-cell / T-cell	**4**
5(b)	15 / 15.0 / 15.1 / 15.2 (kPa) ; 0.09 / 0.10 / 0.1 (s) ;	**2**

Question	Answer	Marks
5(c)(i)	*emphysema and chronic bronchitis do not need to be named* *any one from must be in context of COPD* less, air / oxygen, able to reach, alveoli / air sacs / gas exchange surface **;** less <u>oxygen</u> able to, diffuse to / AW, capillaries (from, alveoli / air sacs) **;** ventilation impaired / AW **;** *any two from effects of chronic bronchitis and emphysema* inflammation (of respiratory airways) **;** build up / accumulation / excess / AW, of mucus decreased lumen of, trachea / bronchus / bronchioles / respiratory tubes / airways **;** **A** airway obstruction **I** blocked **A** constriction / narrowing (loss of, elastin / elastic fibres, so) less ability (of alveoli) to recoil **;** alveoli, burst / destroyed **or** alveolar walls break down **;** large(r) air sacs (instead of alveoli) / AW **;** decreased / reduced, SA:V **;** *of, alveolar area / gas exchange surface area* AVP **;** e.g. relevant effect of pulmonary hypertension affecting gas exchange	**3**
5(c)(ii)	*any two from* decreases quantity of, <u>oxygen / O_2</u>, taken into blood / absorbed / transported (back to heart) **;** AW **A** fewer red blood cells to take up <u>oxygen</u> **A** blood less oxygenated decreases quantity of, <u>carbon dioxide / CO_2</u>, leaving blood / excreted / AW **;** **A** more carbon dioxide remains in the blood (than normal) increased, ventilation / breathing, rate **;** **R** breathes more deeply AVP **;** e.g. further increase in pulmonary hypertension	**2**

Question	Answer	Marks
6(a)	correct working **;** e.g. 14 000 000 ÷ 1400 (**A**–**B** = 13 to 15 mm) (x) 9286 / 9642 / **10 000** / 10 357 / 10 714 **;** *incorrect conversions used in working or incorrect measured value of* **A**–**B** *can be awarded the answer mark as ecf – the working must show use of dividing by 1400 (or incorrect conversions of 1400)*	**2**
6(b)	*any four from* two chromatids drawn with, non-metacentric centromere / chromosome arms unequal length **;** (sister) chromatid **;** centromere **;** *allow as a constriction* telomere **;** *must be labelled at / towards the end* AVP **;** e.g. four telomeres labelled **or** telomere sectioned off at each chromatid end and one labelled DNA and histones gene / allele *must be shown as a section*	**4**
6(c)	**R** homologous chromosomes *any one from* most condensed state **;** AW **I** chromosomes, are condensing / condense chromosomes (all) in one, plane / focus **;** **A** *idea of* all at the equator (so clearly visible) **I** line up. horizontally / vertically	**1**
6(d)	anaphase **;**	**1**