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International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **October/November 2024**

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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Generic Marking Principles

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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 point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
I	ignore
( )	the word / phrase in brackets is not required, but sets the context
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
AVP	alternative valid point

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th rowspan="2">organelle</th><th colspan="3">cell type</th></tr>
<tr><th>animal cells</th><th>plant cells</th><th>prokaryotic cells</th></tr>
<tr><td>nucleus</td><td>✓</td><td>✓</td><td>×</td></tr>
<tr><td>large permanent vacuole</td><td>×</td><td>✓</td><td>× ;</td></tr>
<tr><td>rough endoplasmic reticulum</td><td>✓</td><td>✓</td><td>× ;</td></tr>
<tr><td>Golgi body</td><td>✓</td><td>✓</td><td>× ;</td></tr>
<tr><td>centrioles</td><td>✓</td><td>×</td><td>× ;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(b)(i)</td><td>microvilli ;</td><td>1</td></tr>
<tr><td>1(b)(ii)</td><td>site of aerobic respiration, so
produces / provides, ATP ;
A provides energy
R produces energy

use of ATP in context of absorption of digested food
for, active transport / (idea of) absorption against a concentration gradient
or
endocytosis / pinocytosis; A bulk transport into cell(s) ;</td><td>2</td></tr>
</table>

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Question	Answer	Marks
2(a)	arteriole/s **;** venule/s **;**	**2**
2(b)	*any **three** from:* (because) water is, polar / a polar molecule / polar / dipolar **;** **A** delta positive hydrogen atom / $H^{\delta+}$, **and,** delta negative oxygen atom / $O^{\delta-}$ *ref. to* attraction between, (negatively charged) chloride ions / Cl^-, and $H^{\delta+}$ **;** *ref. to* attraction between, (positively charged) sodium ions / Na^+ and $O^{\delta-}$ **;** *if both ideas (mp2 and mp3) stated, then this is also mp1* water molecules collect around sodium chloride (and separate ions) **;** AVP **;** e.g. ionic bond broken (between sodium and chloride atom) *ref. to* hydration shell(s) *idea that* ions are separated (and spread through the water) *If no marks gained allow one mark for idea of attraction between water and, ions / NaCl*	**3**
2(c)(i)	line drawn to the left **;** sigmoid shape of line and starting at 0, 0 **;**	**2**

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Question	Answer	Marks
2(c)(ii)	*any **three** from:* oxygen can be released (from haemoglobin to supply respiring tissues) **;** increase in H^+ ions so more, hydrogen ions bind to haemoglobin / haemoglobinic acid forms **;** haemoglobin affinity for oxygen reduces (when the pH decreases) **;** aerobic respiration in muscle cells can continue for longer **;** AVP **;** e.g. *ref. to* Bohr shift **/** curve shifts to right providing ATP for muscle contraction	**3**
2(d)	sinoatrial node **; I** SAN	**1**

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Question	Answer	Marks
3(a)	**J** cartilage **;** **K** smooth muscle **;** *difference* **I** *ref. to* other tissues *plus **one** from:* cartilage in bronchus but not the bronchioles **;** suggestion for smooth muscle tissue (*ref. to* **K**) **;** e.g. proportionally more smooth muscle in the wall of the bronchiole	**3**
3(b)(i)	*Mycobacterium tuberculosis* / *Mycobacterium bovis* **;**	**1**
3(b)(ii)	antigen binding site(s) **; A** variable region	**1**
3(b)(iii)	*any **two** from:* **A** antigen *for TB protein* **A** TB pathogen for pathogen causing TB (immobilised) monoclonal antibody has a binding site which is a complementary shape to the protein secreted by the TB pathogen **;** monoclonal antibody on the test line will only bind with protein secreted by the by the TB pathogen **;** *idea that* monoclonal antibodies with tiny gold particle are only held in place if protein secreted by the TB pathogen is present **;** AVP **;** e.g. *suggestion that* TB protein is specific to the TB pathogen	**2**

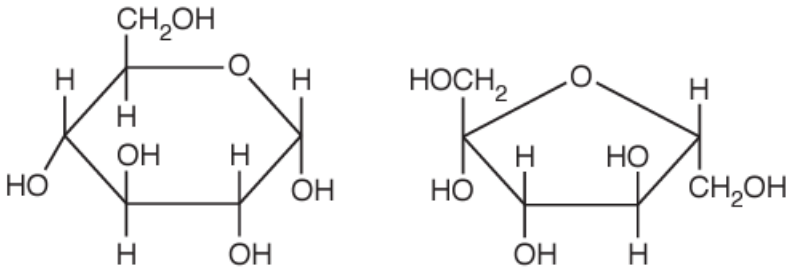
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Question	Answer	Marks
3(b)(iv)	*any **two** from:* different shaped, variable region / antigen binding site **;** *ref. to* different primary structure **;** *ref. to* a different tertiary structure **;** *ref. to* different (named) bonds holding the tertiary structure **;**	**2**
3(c)	*any **three** from:* provides (long-term) immunity **;** *context of pathogen entering the body* *ref to* secondary / fast / strong, immune response **;** because of presence of increased numbers of specific T-lymphocytes **;** memory T-lymphocytes, recognise / bind to / activated by, the foreign antigen **;** T- helper cells secrete. cytokine / interleukins **; I** cell-signalling molecules example of consequence of increased cytokine release **;** e.g. increased phagocytosis / angry macrophages increased, B-lymphocyte / humoral, response enhance T-killer cell response	**3**
3(d)(i)	endocytosis **; A** phagocytosis	**1**

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Question	Answer	Marks
3(d)(ii)	*any **three** from:* some T-lymphocytes have receptors with a complementary shape to the antigen on the tumour cell **;** antigens on the surface of the tumour cell bind to receptor / *ref. to* clonal selection **;** T-lymphocytes, divide by mitosis / *ref. to* clonal expansion **;** T-killer cells are produced that destroy the tumour cell **;** method used by T-killer cell to destroy tumour cell **;** e.g. perforin, hydrogen peroxide, granzymes **A** toxins *ref. to* B lymphocytes and antibodies **;** AVP **;** e.g. further detail of method used by T-killer cell *ref. to* phagocytosis of cancer cells	**3**

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Question	Answer	Marks
4(a)(i)	glycosidic **;**	**1**
4(a)(ii)	 *any **three** from:* label one monomer correctly **;** α-glucose with a hydroxyl group on C1 **;** fructose drawn with a hydroxyl group on C2 **;** water used in the reaction **;**	**3**
4(b)(i)	sieve plate **;**	**1**

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Question	Answer	Marks
4(b)(ii)	*any **four** from:* **1** carbohydrate is transported in (phloem) sieve tubes **;** **A** sucrose transported **A** sieve tube elements **2** as the percentage of outer stem tissue removed increases, the quantity of phloem (sieve tubes) remaining decreases **;** **3** less, mass flow / translocation **;** **4** 0 mg at 100% removal because all phloem removed / AW **;** **5** carbohydrate is not transported in xylem tissue, as there is no transport when xylem tissue is left intact **;** **6** *ref. to* movement to lower part of stem from source to sink **;** **7** AVP **;** e.g. *suggestion that* most of the (active) phloem is in the inner part of the outer stem *idea that* phloem sieve tubes are arranged in layers	**4**

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Question	Answer	Marks
4(c)	*any **four** from:* *max 3* **1** example of structural change to sucrase **;** e.g. translation stops prematurely / truncated polypeptide / AW change in the primary structure / different amino acid(s) polypeptide does not, fold into / form, (correct) tertiary structure **2** suggestion of why sucrase is non-functional **;** e.g. active site, not complementary / changed shape binding site changed shape, sucrose does not bind to active site catalytic site changed shape, glycosidic bond cannot be broken **3** polypeptide not produced as mRNA does not attach to ribosome **;** **4** polypeptide recognised as abnormal and degraded **;** *max 3* **5** deletion mutation is loss of one or more nucleotides (in the gene coding for sucrase) **;** **6** (causes a) change in the sequence of, nucleotides / bases / base pairs, (in the, gene coding for sucrase / DNA molecule) **;** **7** (causes a) change in the sequence of, nucleotides / bases, in, mRNA / an mRNA molecule **;** **8** consequence to codons **;** *(if not a deletion of, three / multiples of three)* all the codons after the deletion mutation are altered causes a frameshift *(deletion, of three / multiples of three)* one or more codons absent, then same sequence **9** mutation may, form a premature stop codon / introduce a stop codon **;**	**4**

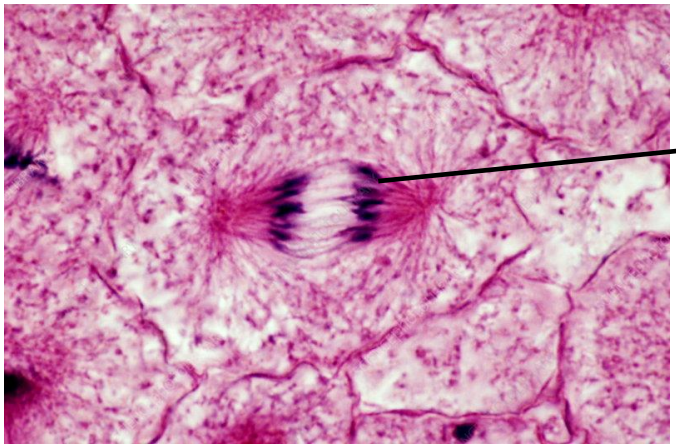
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Question	Answer	Marks
5(a)(i)	*correct answer as a whole number* 34(%) **;**	**1**
5(a)(ii)	*allow enzyme for trypsin* *allow substrate for casein* *any **five** from:* **1** at lower concentrations there are not enough, active sites / enzymes **;** **2** idea of substrate molecules cannot enter active site until product released **;** **3** as concentration increases, increased number of active sites **;** **4** idea that as concentration increases there are more successful collisions between enzyme and, substrate / casein **;** **5** (so) allows increase in (number of) enzyme-substrate complexes (formed per unit time) **;** **6** increased rate of casein breakdown as enzyme concentration increases **;** **7** *ref. to* casein reaction e.g. milk becomes transparent as solution contains amino acids **;** **8** AVP **;** e.g. depends on how many active sites available at any one time *ref. to* enzyme-substrate complex formation per unit time at high concentration substrate concentration is becoming the limiting factor when clear, total hydrolysis of casein has occurred	**5**

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Question	Answer	Marks
5(b)(i)	*any **one** from:* immobilising the enzyme may have altered the, tertiary structure of the enzyme / shape of the active site **;** *suggestion that* material may not be inert and may have an inhibitory effect at lower temperatures **;** immobilising may have covered, part of the active site / active site of some enzymes **;** *idea that* trypsin free in solution has increased chance of collision with substrate **;** immobilising changes the optimum temperature of the enzyme **;**	**1**
5(b)(ii)	*any **two** from:* immobilisation, protects / stabilises / AW, the, enzyme / trypsin **;** from (thermal) denaturation **; ora** enzyme free in solution denatured maintains shape of active site **;** immobilisation may result in lower, kinetic energy / vibration, of the enzyme molecules compared to free (so protects from denaturation) **; ora** prevents the breaking of bonds holding the tertiary structure (of immobilised enzyme molecule) **; ora** *ref. to*, hydrogen / ionic bonds **;**	**2**

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Question	Answer	Marks
6(a)	line pointing to any chromatid **;**  	**1**
6(b)	anaphase **;**	**1**
6(c)	*any **two** from:* (fully formed) spindle seen / spindle fibres, are visible **;** *idea that* chromatids are attached to, the spindle fibres / (spindle) microtubules **;** *idea that* chromosomes would have orientated at the equator (ready for anaphase) **;** sister chromatids have separated (Fig. 6.1) because, spindle fibres have contracted / microtubules have disassembled / AW **;** in anaphase so has, completed /AW, prophase / metaphase **;**	**2**

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<table>
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<tr><td>1(a)(i)</td><td>all correct for one mark ;

<table><tr><td>palmitic acid</td><td>0</td></tr><tr><td>linoleic acid</td><td>2</td></tr><tr><td>stearic acid</td><td>0</td></tr><tr><td>palmitoleic acid</td><td>1</td></tr></table></td><td>1</td></tr>
<tr><td>1(a)(ii)</td><td>circle drawn around palmitic acid <u>and</u> around stearic acid ;</td><td>1</td></tr>
<tr><td>1(a)(iii)</td><td>COOH / carboxyl (group) / carboxylic acid (group) ;
A carbonyl group and hydroxyl group
R if response includes incorrect groups</td><td>1</td></tr>
</table>

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Question	Answer	Marks
1(a)(iv)	*if no ref. to fatty acids, allow one mark for (some) triglycerides may, be saturated / have no double bonds (in hydrocarbon chain,) and (some) may, be unsaturated / have double bonds* **I** 'tails' *any **two** from:* **1** each triglyceride has three fatty acids **;** **2** fatty acids can be, saturated / with no double bonds, and, unsaturated / with double bonds **;** **A** unsaturated fatty acids can have a different number of double bonds **3** fatty acids can have different, (hydrocarbon chain) lengths / number of carbons **;** **4** detail from Table 1.1 to support mp2 or 3 **;** saturated = palmitic / stearic v unsaturated = oleic / linoleic / palmitoleic **or** 1 double bond = oleic / palmitoleic v 2 double bonds = linoleic **or** oleic / linoleic / stearic = 18C v palmitic / palmitoleic = 16C **5** *idea of* a particular fatty acid, can be located at a different position in a triglyceride / can form a bond with any one of the three (functional) hydroxyl groups **;** **6** *ref. to* different environmental conditions of plants grown in different regions **;** e.g. colder conditions and oils having (more triglycerides with) higher proportion of unsaturated fatty acids **7** *idea of* (shared triglycerides) have structures (most) suited as energy stores **;** **A** example e.g. (have fatty acids with) longest hydrocarbon chains easiest to, hydrolyse / release hydrogen atoms have greater energy value than others **8** ref. to ease of, production / synthesis **;** **9** *idea that* shared triglycerides composed of the fatty acids (present) in highest proportions **;** e.g. *using Table 1.1 to determine the most common 2 or 3 fatty acids* 'could all have the same fatty acid combination from oleic acid and / or palmitic acid and/or linoleic acid' (any two)	**2**

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Question	Answer	Marks
1(b)	*any **two** from:* **1** water is, a polar molecule / polar / dipolar **;** **A** water is a dipole **A** description e.g. the O atom (of water) has, a slightly negative / δ^-, charge, and the H atoms have a slightly positive / δ^+, charge **2** water can form, hydrogen bonds / H-bonds, with, glycerol / polar substances **;** **ora** = water cannot form H-bonds with, triglycerides / non-polar substances **3** glycerol / polar molecules / ions, interact with water (molecules) / are attracted to water (molecules) / are hydrophilic **;** **A** idea that water, attracts / collects around / AW, ions / charged substances **ora** = triglycerides / non-polar / uncharged, molecules, do not interact with water / repel water / are hydrophobic **I** 'tails'	**2**
1(c)	(phloem) sieve tube element **;** (*question asks for type of cell)* **A** sieve element	**1**

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Question	Answer	Marks
2(a)	**I** protective gear / education about transmission / contact tracing / early diagnosis / testing *any **two** from:* practising safe sex / example **;** **A** protected sex / using protection during sex **A** barrier contraceptives **I** use contraceptives screening blood, donated for / before, transfusions AW **or** not taking blood from high risk individuals / AW **;** *idea of* treating donated blood (to inactivate viruses) **;** **A** example e.g. heat / chemical treatment solvent-detergent treatment *in context of drug abusers* avoid sharing, needles / syringes / drug injecting equipment AW **or** use, new / sterile, needles / syringes / drug injecting equipment **;** **A** cookers / sterile containers to mix drugs **A** use needle-exchange schemes / AW **A** use safe injection sites / AW avoid breast feeding / use baby milk products instead of breast milk **;** pre-exposure prophylaxis / PrEP **or** post-exposure prophylaxis / PEP **;** AVP **;** e.g. using sterile equipment for, tattooing ***/*** surgery / dental procedures / body piercing	**2**
2(b)	the number of times larger an image is than actual **;** AW **I** or smaller **A** formula stated in words **A** symbolised I/A *to support a weakly worded answer* **A** *(in context of describing an image)* enlargement / making larger / making bigger / increase in size / AW	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(c)(i)</td><td>any one from:

because bacteria have cell walls (only) of, murein / peptidoglycan ;

because chitin is not found in bacterial cell walls ;

A chitin / β-D-glucans, <u>main / major / AW</u> component of fungal cell walls</td><td>1</td></tr>
<tr><td>2(c)(ii)</td><td>
<table>
<tr><th>structural feature of P. jirovecii</th><th>function</th><th>present (✓) or absent (x) in bacterial cells</th></tr>
<tr><td>ribosomes</td><td>protein synthesis</td><td>✓</td></tr>
<tr><td>smooth endoplasmic reticulum</td><td>lipid / cholesterol / steroid, synthesis / metabolism

AVP ; detoxification
I carbohydrate metabolism</td><td>x</td></tr>
<tr><td>Golgi body</td><td>modification of proteins and lipids</td><td>x</td></tr>
<tr><td>mitochondrion / mitochondria</td><td>aerobic respiration</td><td>x</td></tr>
</table>
one mark each correct column ;;;

assume a tick that has been crossed is a cross ✓✗</td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(d)(i)	*allow squamous cells or squamous epithelial cells or epithelial cells for alveolar cells* *any **two** from:* **1** *gpA* / (*P. jirovecii)* glycoprotein, <u>binds</u> to a, receptor / protein / glycoprotein on (surface of) alveolar cell **or** *gpA* <u>binds</u> to ECM, protein / glycoprotein **; I** receptor **A** idea that ECM proteins are on, surface of / interacting with, (cell surface membrane of) alveolar cells **or** receptor / protein / glycoprotein on (surface of) alveolar cell is a binding site (for gpA) **A** same idea for ECM **2** (gpA) <u>complementary shape</u> **;** *allow ecf mp1 for gpA complementary shape to receptor on ECM* **or** *idea of complementary shape to attach / bind / adhere, to, alveolar cell / ECM* **3** suggestion of adhering by, attractive charges / named bond types, between, gpA and, proteins / glycoproteins, on surface of alveolar cell / of ECM **;** **4** AVP **;** e.g. gpA acts as a <u>ligand</u>	**2**

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Question	Answer	Marks
2(d)(ii)	*any **three** from:* **1** alveolar cells / ECM, hindered / surrounded by / AW, *P. jirovecii* cells **;** **A** alveolar wall becomes, thicker / AW **2** diffusion (of oxygen), impaired / decreased / AW **;** **A** distance for diffusion increased **A** reduced surface area for diffusion **;** **3** between, alveolus / alveolar air / alveolar space, and, capillary / blood / red blood cell(s) **;** *allow mp if oxygen is clearly going in the correct direction* **4** less / AW, oxyhaemoglobin formed **;** AW e.g. **A** less oxygen, binds to / taken up by / associates with, haemoglobin **A** less oxygen forms bonds with, Fe^{2+} / iron ion / iron, (in haemoglobin) **5** *idea of* ability of elastic fibres to, stretch / recoil, impaired / AW **;** **A** *idea of* less elastic / decreased elasticity (of alveoli) **6** alveolar air not, refreshed / AW, so decreased diffusion gradient **;** **7** AVP **;** e.g. presence of macrophages hinders diffusion of oxygen *suggestion that P. jirovecii* infection, damages / AW, alveolar capillaries / venules / branches of pulmonary vein *suggestion that* oxygen used up for *P. jirovecii*, metabolism / activity / AW less ability of collagen to provide support to alveoli / AW	**3**

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Question	Answer	Marks
2(e)	*any **five** from:* caspofungin / drug, binds to site on, enzyme / glucan synthase, other than active site **;** **A** binds to allosteric site changes shape of active site **;** **A** enzyme changes, shape / tertiary structure, so active site is changed substrates cannot bind to active site / active site no longer complementary to substrates / enzyme-substrate complexes do not form **;** **A** fewer enzyme-substrate complexes form less / no, (1,3- β-D) glucans / products, synthesised / produced **;** cell wall, weakened / synthesis hindered / AW **;** **A** cell wall not formed (leads to osmotic) lysis of, *P. jirovecii* / cell / fungus **;** **A** bursting / cytolysis reduces / prevents, population growth **;** AW e.g. decrease number of *P. jirovecii* **A** decreases ability of *P. jirovecii* to colonise / AW AVP **;** e.g. *in context of lysis ref.* water entry into cell, by osmosis / down water potential gradient / AW (reduced number) increases chance of immune system eliminating the fungus	**5**

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Question	Answer	Marks
3(a)	*do not allow 'base' as AW for 'nucleotide'* *any **one** from:* *idea that* phosphodiester bond forms, between nucleotides on the same strand / between adjacent nucleotides / during polynucleotide formation / to form a sugar-phosphate backbone **;** AW *look for understanding that more than one nucleotide needs to be present on the same strand* *idea that* phosphates, shown are only bound to one (pentose) sugars / each phosphate needs to be bound to two (pentose) sugars **;**	**1**

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Question	Answer	Marks
3(b)	base / nucleotide, on left identified as guanine and, base / nucleotide, on right identified as cytosine **;** **A** guanine and cytosine *as question has DNA-RNA* **I** cytosine and guanine *unless further qualified* dotted line as hydrogen bond / annotation related to dotted lines as hydrogen bonds / there are three hydrogen bonds between the bases**; A** H-bond *circle is* phosphate **;** *pentagon / pentose, on left is* deoxyribose **;** *also AVP if 'pentose'* double ring / base on left, identified as purine **;** **A** guanine is a purine if mp1 gained single ring / base on right, identified as pyrimidine **;** **A** cytosine is a pyrimidine if mp1 gained AVP **;** e.g. label to any solid line bond as covalent bond phospho-ester bond, labelled / described pentose sugar, label to / described for, deoxyribose / ribose box drawn around one completed nucleotide and labelled 5' and 3' shown annotated ref. to antiparallel nature of base-pair	**4**

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Question	Answer	Marks
4(a)	replacing cells that are, damaged / destroyed / worn out / old **;**	**1**
4(b)	*any **two** from:* result of mutation **; A** example proto-oncogene to oncogene tumour suppressor gene inactive **I** mutation / mutated, *as a single term* short(er) / fast(er) / many / continuous, cell cycle(s) / cell divisions **;** **A** shorter interphase **A** cells do not stop dividing **I** ref. to mitosis no contact inhibition / mitosis continues beyond space available / cell formation may spread to other nearby areas / AW **;** ref. to normal (cell cycle) checkpoints not occurring **;** **A** *idea that* substances needed for error checking not, available / functioning **A** errors not checked loss of (original / normal) function **; A** example **A** non-functional (cell cycle continues because) fault in / errors in / no response to, cell signalling **;** cells do not carry out apoptosis / no programmed cell death **;** AVP **;** e.g. different cell metabolism increase in telomerase (activity) telomeres do not shorten as quickly formation / presence, of blood vessels (feature of tumour) **A** angiogenesis lack of adhesion between cells ref. metastasis / described e.g. cells travel in, blood / lymph, to form tumours elsewhere in body **I** ref. to tumour spread in blood	**2**

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Question	Answer	Marks
4(c)	*any **two** from:* *idea that* after each, cell cycle / cell division / DNA replication, telomeres shorten **;** (long telomeres means that DNA) replication can take place more times **;** **A** allows continuous (DNA) replication *context is DNA and not cell replication* *idea that* ends of chromosomes are protected **;** telomeres do not contain, genes / genetic information **;** **A** telomeres are non-coding detail **;** e.g. *idea that* after replication nucleotides at ends of DNA are lost lagging strand replication leads to unpaired nucleotides DNA polymerase cannot continue to end on lagging strand (replication) (long telomeres) allow, long life span / many divisions to occur / many mitoses **;** AVP **;** e.g. prevents chromosome ends from joining otherwise, mitosis could not occur / may lead to cell death	**2**
4(d)	*any **three** from:* differentiation has already started / AW **;** **A** they are not undifferentiated **A** GMP cells are, differentiated / specialised (compared to stem cells) no self-renewal / AW **;** **A** cannot produce a stem cell when they divide cannot form, all blood cell types / correct named **;** (only) forms (immature) neutrophils and monocytes **;**	**3**
4(e)	macrophage/s **; I** mature monocytes / granulocyte / phagocyte	**1**

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Question	Answer	Marks
4(f)	antibody / immunoglobulin **;**	**1**
4(g)	*mp2 and 3 need to see knowledge that self-antigens are on, self- / body / own, cells* *any **three** from:* **1** *idea that,* next stage / after thymus, is (T-lymphocyte) release into general circulation / blood **;** **2** (if released) exposure to / activation by, (self-antigens on body) cells **or** (on exposure to self-antigens), immune response occurs against (body) cells **;** **ora** only (T)lymphocytes that will respond only to, pathogens / foreign substances, are, left / released **3** (if released) harm to / destruction of / kills, (body) cells **;** **4** need to prevent / otherwise, formation of memory T-cells **;** **5** AVP **;** e.g. need to prevent / (if released) may cause, autoimmune, disease / response (otherwise) T-helper will release cytokines to, enhance / AW, immune response against (body) cells (if cytokine released) may lead to, phagocytosis of / antibodies produced against, (body) cells (otherwise) T-killer cell will release substance to kill cells *also mp3* (faulty T-lymphocytes) cannot bind to, foreign / non-self, antigens	**3**

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Question	Answer	Marks
5(a)	*ovale / malariae* **;** **A** knowlesi must be spelled correctly *if both given, must be correct spelling*	**1**
5(b)(i)	*any **two** from:* *details **;*** pH approx. 7.4 <u>and</u> 37 °C **A** pH7 / neutral pH **A** 36 / 38 °C pH of, plasma / blood **or** body temperature **or** use conditions occurring in, body / plasma / blood / humans **;** *idea that* oxygen uptake / haemoglobin activity / AW, affected by, temperature / pH **;**	**2**
5(b)(ii)	*any **three** from:* *in a person with malaria* **1** <u>affinity</u> of haemoglobin for oxygen, decreases / AW **;** *context is infection so* **R** *in presence of carbon dioxide* **2** lower (percentage) saturation of haemoglobin with oxygen **;** *allow ecf from mp1* **A** less oxygen binds to haemoglobin (in the lungs) **A** haemoglobin loads less oxygen AW **3** *idea that* <u>more difficult</u> to load oxygen in the lungs **; I** slower **4** (as) higher partial pressure of oxygen needed to reach same percentage saturation of, haemoglobin **;** **5** *idea that* oxygen released more readily in respiring tissues **or** in tissues, more oxygen released at any one partial pressure **;** **I** carbon dioxide **but R** if stated that carbon dioxide causes oxygen to be released more readily	**3**

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Question	Answer	Marks
5(c)	*any **four** from:* **1** (diameter / width) 6–8 μm so able to pass through (lumen of) capillaries **;** **I** small size **2** small size / small diameter / just fits in a capillary / AW, so in a line / one by one / AW, which slows blood flow / maximises time to take up oxygen / reduces diffusion distance for uptake of oxygen **;** **A** gas exchange for oxygen **3** no, nucleus / mitochondria **; A** no organelles **4** so more space for haemoglobin **;** AW *must be linked to mp3* **5** no mitochondria so oxygen is not used within cell (and can be transported) **;** **6** flexible / can squeeze through / can deform / can change shape, to pass through capillary / AW **;** *context of biconcave or property of cell surface membrane* **I** 'squeeze between' unless elsewhere there is ref. to rbc within a capillary **7** biconcave **;** **8** (biconcave, so compared to spherical) increased, surface area / SA:V, for uptake of oxygen / gas exchange / AW **;** **9** (biconcave, so) reduce distance for diffusion of oxygen to, haemoglobin / hb **;**	**4**

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Question	Answer	Marks
6(a)	*any **four** from:* **1** cell wall, pathway / route / AW **;** **R** crossing membranes / passing through vacuoles / passing through cytoplasm, *in context of passage to endodermis* **I** diffuses / osmosis / active transport **2** movement (also), through intercellular spaces / in spaces between cells **;** **R** intracellular spaces **3** named cell layer in <u>apoplast</u> pathway to endodermis **;** e.g. epidermal cells / root hair cells cells of cortex / cortical cells / parenchyma cells *must be in context of cell walls* **4** cannot cross / stops at, Casparian strip (of endodermal cells) **;** **5** detail **;** made of, suberin **or** described as a, waxy / waterproof / impermeable (layer / substance / material in cell walls) **6** (overall) movement down a water potential gradient **;** **R** ref. to osmosis / active transport *context of across root or from root to xylem (owing to overall root to, leaf / atmosphere, gradient)* **7** AVP **;** e.g. non-living pathway / does not cross membranes, until the endodermis idea that water needs to pass across a cell (surface) membrane to control substances entering xylem	**4**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(b)</td><td>
<table>
<tr><th>net movement of K^+</th><th>membrane protein needed (yes or no)</th><th>ATP used (yes or no)</th><th>name of transport mechanism</th></tr>
<tr><td>against the concentration gradient</td><td>yes</td><td>yes</td><td>active, transport / uptake</td></tr>
<tr><td>down the concentration gradient</td><td>yes</td><td>no</td><td>facilitated diffusion</td></tr>
</table>
one mark each correct column ;;;
if no marks gained, allow one mark for a correct row
</td><td>3</td></tr>
</table>

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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2024**

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 October/November 2024 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 descriptions 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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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
I	ignore
( )	the word / phrase in brackets is not required, but sets the context
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
AVP	alternative valid point

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Question	Answer	Marks
1(a)(i)	B **and** C **; Accept** A, B **and** C *if any other letters do not award the mark, ignore names*	**1**
1(a)(ii)	*any **two** from:* keeps the (named) airway(s) open / prevents collapse of airways **;** AW **R** bronchiole / alveoli e.g. to allow free flow of air into and out of, airways / lungs e.g. provides support (for the named airway(s)) **I** 'provides strength' allows flexibility **; A** described e.g. bending neck, swallowing food AVP **;** e.g. (C-shaped incomplete) rings (in, **B** / trachea) allow, lengthening / widening, during breathing in / inspiration / inhalation	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(iii)</td><td>
region
one mark for each letter – for 1.3 allow two or three letters if all are correct – ignore names

one mark for feature matched with function – feature and relationship to function must match
if find a correct feature and its function in the last column – accept
feature must be visible in Fig. 1.2 and Fig. 1.3
if gas (as in gas exchange) is not used, then answer must refer to oxygen and carbon dioxide

<table>
<tr><th>Fig.</th><th>region of the gas exchange system (A, B, C, D, E, F, G)</th><th>one visible feature</th><th>one way in which the feature relates to its function</th></tr>
<tr><td>1.2</td><td>G ;</td><td>air spaces

walls are, thin / one cell thick
A squamous epithelium
R cell wall

good blood supply / capillaries
A capillary / red blood cells

arteriole / venule
R artery / vein</td><td>large surface area for, diffusion / gas exchange ;

short distance for, diffusion / gas exchange ;

for, diffusion / gas exchange
or
maintains steep concentration gradients
or
absorption / transport, of oxygen ;

supply blood to capillaries / carry blood away from capillaries ;</td></tr>
<tr><td>1.3</td><td>B ; Accept C / A</td><td>goblet cells

(many) cilia / ciliated epithelial cells / ciliated epithelium / ciliated cells

ciliated epithelium</td><td>secrete / produce / make, mucus ;

(cilia) move / AW, mucus (towards back of throat / AW) ;

provides barrier to pathogens ;</td></tr>
</table>
</td><td>4</td></tr>
</table>

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Question	Answer	Marks
1(b)	*any **five** from:* **1** sinoatrial node, releases / generates / produces, impulses / waves of excitation / waves of depolarisation / AW **;** ***I*** 'signals' **A** SAN / SA node / pacemaker **R** nervous impulses **2** impulses / AW, spreads to / across, walls / muscle of, (right) atrium **; A** atria **3** right atrium contracts **; A** atrial systole if right atrium is given in answer, **A** pumps for contracts **4** tricuspid / (right) atrioventricular, valve opens to allow blood to flow (from right atrium) into right ventricle **;** **R** bicuspid valve / left atrioventricular valve **5** atrioventricular node sends impulses down, septum / Purkyne tissue **; A** to apex of heart / down Bundle of His **A** AVN / AV node **6** atrioventricular node is responsible for / AW, a time delay **;** **A** AVN / AV node **7** right ventricle contracts **; A** ventricular systole if right ventricle is given in answer, **A** pumps for contracts **8** semi-lunar valve opens **and** blood flows into pulmonary artery / arteries **; A** pulmonary valve **R** aorta **9** AVP **;** e.g. tricuspid / (right) atrioventricular, valve closes to stop, backflow / blood entering right atrium (only in correct context)	**5**

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Question	Answer	Marks
2(a)(i)	*any **two** from:* **I** repair cells **1** to, replace (old / worn-out / dead / short-lived) cells / repair (damaged) tissue **;** **2** stem cells divide and, differentiate / become specialised **; A** form different types of cells **3** *idea of* self-renewal e.g. stem cells divide to maintain the, pool / number, of stem cells **;** **I** increase in number of stem cells **4** AVP **;** *ref. to* movement of food through intestine / presence of pathogens, increases chance of damage cells (produced by stem cells) are genetically identical so the function of, the intestine / organs / tissues, can continue / AW *idea that* allows growth (of small intestine) during development / AW **R** growth of cells	**2**
2(a)(ii)	anaphase **;**	**1**
2(a)(iii)	cytokinesis **;**	**1**
2(b)	*any **two** from* **1** (two) sister / identical, <u>chromatids</u> attached together **; R** 'sister chromosomes' **A** holds the chromatids together after, replication / S phase **2** attach (chromatids / chromosomes) to spindle (fibres) **;** *in context of mitosis* **R** if stated in interphase **A** kinetochore *or* spindle microtubules for spindle (fibres) **3** (centromeres) divide / separate, (at the start) in anaphase **; A** end of metaphase **4** *so* daughter chromosomes can be moved to opposite poles **; A** sister / identical, chromatids *do not award MP4 unless MP3 already given*	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(c)</td><td>

look for function in explanation if not on first line
for each cell – one mark for the function and one mark for the explanation
mark each cell straight through to max 2

<table>
<tr><th>cell</th><th>function</th><th>explanation</th></tr>
<tr><td rowspan="5">P</td><td rowspan="2">absorption / uptake / movement in, of, (named) substances / nutrients

diffusion of, (named) substances / nutrients

active uptake / active transport, of (named) substances / of nutrients</td><td>microvilli, to give a large surface area / increase surface area / increase number of transport proteins (for uptake of digested food)

I cilia have large surface area A large surface area:volume ratio for microvilli</td></tr>
<tr><td>mitochondria to provide, ATP / energy, for, active transport / active uptake
R produce / make, energy R energy for cilia</td></tr>
<tr><td>breakdown of food molecules</td><td>large surface of membrane for enzymes for digestion</td></tr>
<tr><td>production / secretion, of enzymes</td><td>microvilli for membrane enzymes / RER for making enzymes / Golgi for packaging enzymes or modification of enzymes</td></tr>
<tr><td rowspan="3">Q</td><td rowspan="3">secretion / release / exocytosis / AW, of mucin / mucus
I produce and provide

if Q is secreting protein / unnamed substance allow ECF for explanation</td><td>rough endoplasmic reticulum for making protein (part of mucin / mucus)</td></tr>
<tr><td>Golgi body for, packaging / glycosylating / modification / AW, mucin
A mucus AW = adding carbohydrate / sugars</td></tr>
<tr><td>(large) vesicles / vacuoles, for storage / for containing / for transport, of mucin
A mucus</td></tr>
<tr><td rowspan="3">R</td><td rowspan="3">secretion / release / exocytosis / move ment out / AW, of (named) protein(s)
I produce and provide
A hormones / peptides / enzymes</td><td>(large quantity of) RER for, making proteins / making enzymes / translation / AW</td></tr>
<tr><td>Golgi body for packaging / modification / AW, proteins</td></tr>
<tr><td>vacuoles / vesicles, for transport to cell surface membrane / release by exocytosis / fusion with cell surface membrane</td></tr>
</table>

</td><td>6</td></tr>
</table>

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Question	Answer	Marks
3(a)(i)	pyrimidine **;** *accept phonetic or close spellings, e.g.* pyramidine / pyrimadine / pirimadine / primidine	**1**
3(a)(ii)	*any **one** from:* each nucleic acid has 4 (types of) base **; A** has 4 bases DNA has A, T, C and G **and** RNA has A, U, C and G **;** **A** full names even if misspelt unless another molecule (e.g. thiamine) *idea that* in RNA U replaces T / DNA has T but RNA has U **;**	**1**
3(b)	*any **four** from: max 2 if answer is about transcription and mRNA* *penalise polypeptide once* **1** (triphosphate) activated / free, nucleotide (with thymine) **;** **2** thymine / T, pairs with, adenine / A **; I** complementary base pairing unqualified **3** adenine / A, on <u>template</u> strand **;** **4** formation of two hydrogen bonds between T and A **; I** H bonds between C and G **5** *ref to* DNA polymerase in correct context (e.g. correct base pairing / bond formation / proof reading) **;** **6** forms phosphodiester bond (between -OH of deoxyribose and phosphate of nucleotide) **; R** if DNA ligase **7** release of, pyrophosphate / P-P / two phosphates **;** **8** nucleotide added to the 3′ end of, newly-synthesised strand / leading strand / daughter strand (of DNA) **;** **A** extension is in the 5′ to 3′ direction	**4**
3(c)	**1** strands (are parallel and) run in <u>opposite</u> directions / one strand in 5′ to 3′ direction and other strand in 3′ to 5′ direction **;** *any **two** from:* **2** elongation / synthesis / extension / AW, of strand is, in 5′ to 3′ direction / not in 3′ to 5′ direction **;** **3** DNA polymerase, moves in the 5′ to 3′ direction / can only add nucleotides to the 3′ end **;** **4** *idea that* phosphate of each nucleotide is added to C3 of last nucleotide of growing strand **;** **5** leading strand is made continuously / lagging strand is made up of Okazaki fragments **;** **6** Okazaki fragments are attached together by DNA ligase **;**	**3**

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Question	Answer	Marks
4(a)	*any **four** from:* **I** 'find optimum conditions for the enzyme mixture' **A** 'enzymes' for enzyme mixture **1** (find) suitable, raw material / crop wastes / substrate **;** *using Table 4.1* **2** (find) crop waste that has high concentration of substrate for enzyme **M ; ORA** *assume answer is about solution or mixture unless told about individual enzymes (**M**, **N** and **O**)* **3** (find), optimum pH / optimum temperature **; A** reference to, pH / temperature, for maximum activity **I** find optimum pH / temperature of each enzyme **4** (find) appropriate <u>concentrations</u> of the enzymes in the mixture **; I** 'proportions' **5** *idea of* ratio of enzyme mixture to, raw material / substrate / crop waste **;** **6** (find) the best pre-treatment of the, raw material / substrate / crop waste **;** **7** (find) if any, inhibitors / cofactors, are <u>present in the solution</u> **;** **8** (find) if any products are toxic **;** **9** identify the sugars produced **;** **10** (find) how long it takes to produce sugars / (find) rate of sugar production **;** **11** *ref to* enzyme immobilisation **;**	**4**
4(b)	*any **four** from:* **1** cellulose and, (named) protein / polypeptides, were present (in cell wall) **;** e.g. expansins **R** if collagen **2** cellulose is broken down (fully) to β-glucose / β-glucose is the monomer of cellulose **; A** 'made of' **3** protein / polypeptide / peptide, is broken down (fully) to amino acids **; A** 'made of' **4** *idea that* partial hydrolysis has occurred to form, peptides / short chains of β-glucose **;** **5** enzymes include cellulase and protease **;** **6** breakage of glycosidic and peptide bonds **; A** glucosidic **7** AVP **;** e.g. beta 1-4 glycosidic linkage / exopeptidases producing amino acids / endopeptidases producing peptides	**4**

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Question	Answer	Marks
5(a)(i)	U4 – T-helper (lymphocyte / cell) **AND** V4 – T-killer / T-cytotoxic (lymphocyte / cell) **;** **A** 'helper and killer' **I** helping and killing	**1**
5(a)(ii)	*any **four** from:* *U4 / helper* **1** secretes / produces / releases, cytokines / interleukins **; I** cell signalling molecules / cytokinins **2** to stimulate, B-lymphocytes / B cells, to, divide / develop into plasma cells **;** **A** stimulates humoral response / clonal expansion / development of memory cells **3** stimulate macrophages to, be active / carry out phagocytosis / respond (to presence of pathogens) / be 'angry' **;** **I** endocytosis *V4 / killer* **4** produces / secretes / releases, chemicals, to kill / break down, infected cells **; A** (auto)lysis / apoptosis **5** e.g. perforin / hydrogen peroxide / granzymes / proteases **; A** hydrolytic enzymes / toxins **6** detail of action of named chemical (see below) **;** **7** AVP **;** e.g. correct ref to CD4 receptors (on U4 / T-helper) / CD8 receptors on (V4 / T-killer) perforin – makes pores in cell surface membrane of infected cell for delivery of granzymes hydrogen peroxide – oxidises cell components / stimulates apoptosis granzymes / proteases – break down proteins (granzymes are serine proteases)	**4**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(b)</td><td>

*any **four** from:*

1 make vaccine free **;** **I** cheap
2 make vaccine <u>available</u>, globally / to whole population (urban and rural) **;** **I** vaccinating people
3 *ref to* herd immunity / described **;** e.g. vaccinate a high proportion of the population
4 vaccinate children as early as possible **;**
5 *ref to* provide boosters / use effective vaccine so boosters are not necessary **;** e.g. live / attenuated, virus
6 accurate record keeping of those vaccinated / find those who have not been vaccinated **;**
7 surveillance / *ref to* contact tracing / described **;** e.g. look out for any cases of the disease
8 start vaccination immediately cases are found / *ref to* ring immunity / benefits of ring immunity **;**
9 education about, effects of the disease / benefits of having the vaccine / transmission of the disease **;**
A counter, misinformation / antivaxers **A** importance of vaccination
10 make sure there is a sufficient supply of the vaccine **;**
11 provide funding for vaccine, production / distribution / delivery **;** **A** provide, cheap / easy to produce, vaccine
12 provide trained personnel **;**
13 AVP **;** e.g. quarantining people with the disease
evaluate or monitor success of vaccination programme
maintain cold chain (to ensure vaccine is effective)
use a thermostable vaccine
provide different types of the vaccine (e.g. Sabin (oral) and Salk (injected); different manufacturers for Covid)

I develop new vaccines in response to new, strains / variants / AW, of pathogen

</td><td>**4**</td></tr>
<tr><td>6(a)</td><td>

<table>
<tr><th>feature</th><th>plant cell</th><th>prokaryotic cell</th><th>virus</th></tr>
<tr><td>external structure</td><td>cell wall composed of cellulose</td><td>cell wall composed of peptidoglycan / murein **;**</td><td>capsid composed of protein / polypeptides **;**
A capsomeres</td></tr>
<tr><td>size of ribosomes</td><td>80S and 70S</td><td>70S **;**</td><td>no ribosomes</td></tr>
<tr><td>nucleic acids</td><td>DNA and RNA</td><td>DNA and RNA</td><td>DNA **or** RNA **;**
R DNA and RNA</td></tr>
</table>

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

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Question	Answer	Marks
6(b)(i)	*any **one** from:* untreated / raw, sewage **; A** poor sewage treatment / poor sewer system contaminated drinking water **;** contaminated food / crops fertilised by raw sewage / seafood contaminated by raw sewage **;** AVP **;** e.g. newly arrived people infected with, *Vibrio cholerae* / cholera pathogen (e.g. UN troops in Haiti in 2010)	**1**
6(b)(ii)	choleragen is composed of more than one polypeptide **; A** 6 / 7, polypeptides **A** amino acid chain **A** composed of, multiple / several, polypeptides	**1**
6(b)(iii)	glycolipid / glycoprotein **;**	**1**
6(b)(iv)	ATP / adenosine triphosphate **; I** adenine triphosphate	**1**
6(b)(v)	chloride ions decrease the <u>water potential</u> of, intestine lumen / outside of cells / AW **; A** low<u>er</u> water potential **A** loss of chloride ions makes the, cytoplasm / the cells, have a less negative / higher, water potential (so water, leaves cell / enters lumen) by osmosis / down water potential gradient / from high to low water potential **;**	**2**

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