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International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **October/November 2025**

MARK SCHEME

Maximum Mark: 60

Published

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Generic Marking Principles

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GENERIC MARKING PRINCIPLE 1:

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- 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
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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).
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Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> 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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The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	correct point or mark awarded
	correct awarding one mark from marking point or marking group 1. similar numbered ticks are used for marking point or marking groups 2, 3, 4 etc.
	incorrect point or mark not awarded
	working towards marking point
	information missing or insufficient for credit
	used to highlight part of an extended response
	used to highlight part of an extended response
	allow or accept
	benefit of the doubt given

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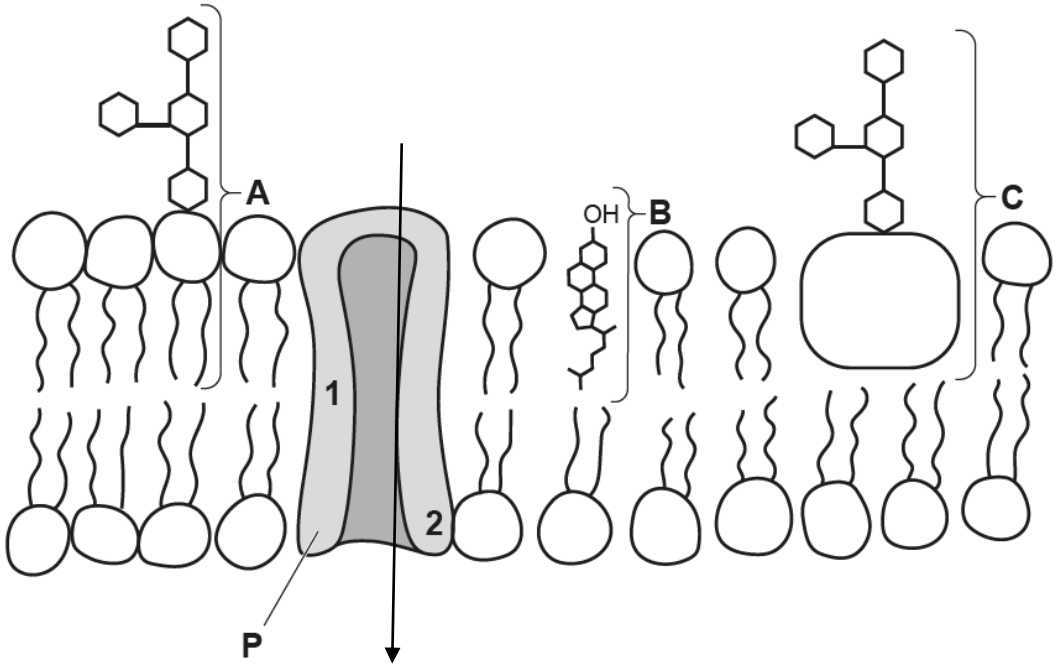
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O	or reverse argument
PAG	point already given
R	incorrect point or mark not awarded
SEEN	point has been noted, but no credit has been given or blank page seen

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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)	**A** glycolipid ; **B** cholesterol ; **C** glycoprotein ;	**3**
1(b)	 1 arrow through protein ; 2 direction of arrow correct ;	**2**

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Question	Answer	Marks
1(c)	*any **three** from:* fluidity (of membrane) increases **;** unsaturated fatty acids have double bonds **;** (double bonds) cause the fatty acid chain to, kink / bend / AW **;** unsaturated fatty acids cannot lie as close together as saturated fatty acids **A ora** **or** *ref. to* increased distance between phospholipids / AW **;** *ref. to* weakening the hydrophobic interactions between, fatty acid chains / cholesterol **;**	**3**
1(d)	*any **one** from:* position **1** has amino acids with, hydrophobic / non polar / AW, R-groups **;** position **2** has amino acids with, hydrophilic / polar / ionic / AW, R-groups**;** **A** *ref. to* amine and carboxyl groups as appropriate	**1**

Question	Answer	Marks
2(a)	*any **two** from:* (each haem contains) an, iron ion / ferrous ion / Fe^{2+} **;** **A** iron / iron atom (each haem) binds to / AW, an oxygen molecule / two oxygen atoms **;** **A** forms a bond *only if*, iron ion / ferrous ion / Fe^{2+}, stated	**2**

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Question	Answer	Marks
2(b)	*any **three** from:* less carbon dioxide diffuses into red blood cells **;** less carbon dioxide reacts with water **;** less carbonic acid is formed **;** less, dissociation of carbonic acid / formation of hydrogen ions and hydrogen carbonate ions **;** less haemoglobinic acid is formed **;** **A** description e.g. H^+ binds to haemoglobin less oxygen (released from haem) diffuses out of red blood cells (to respiring tissues) **;** *ref. to* carbaminohaemoglobin **;** AVP **;** e.g. *ref. to* change in shape of haemoglobin when H^+ binds	**3**
2(c)(i)	*idea that* blood vessel **X** carries (oxygenated blood) at high pressure (to body tissues) **;** **A** *ref. to* systemic circulation *any **two** from:* *difference* high proportion of elastic fibres (and low proportion of smooth muscle) **;** *explanation* (elastic fibres allow **X** to) expand / stretch, qualified **;** e.g. to accommodate / AW, blood from ventricular, systole / contraction with, surges / pulses, of blood leaving heart to prevent, bursting / rupture recoil of elastic fibres, detail **;** e.g.to allow surges / pulses, to continue *idea of* allowing continued flow of blood to tissues maintains, onward pressure / high pressure of blood *if no marks gained in this section allow one mark for:* *stretch and recoil with one detail* ***or*** *ref. to two correct details but stretch and recoil not stated*	**3**

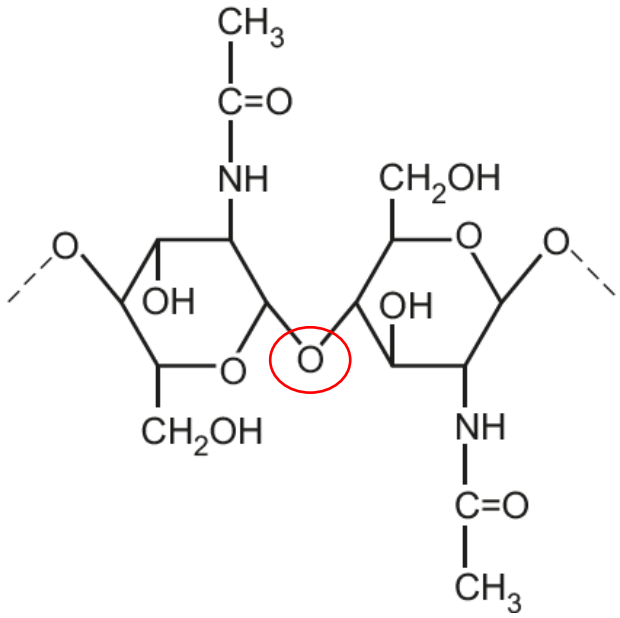
Question	Answer	Marks
2(c)(ii)	*allow, impulses / wave of excitation, for electrical impulses* **R** nerve impulses *once and allow* ***ecf*** *must attempt AVN <u>and</u> Purkyne tissue to gain max* *any* ***four*** *from:* both involved in, co-ordination / control, of, systole / contraction, of, heart / heart muscle / cardiac muscle / ventricles **;** *AVN* only pathway for impulses to travel from atria to ventricles **;** AW **A** impulses must pass through AVN for ventricular, contraction / systole allow, a delay **/** 0.1 s, for impulse to pass from atria to ventricles **;** so, ventricles contract after atria contract / ventricular systole occurs after atrial systole **;** allows atria to (fully) empty before, ventricles (begin to) contract / ventricular systole **or** allows blood to fill ventricles before ventricular, contraction / systole **;** *Purkyne tissue* carries / transmits / AW, impulse(s), (down septum), to base of ventricles / through walls of the ventricles **;** for ventricular systole / AW **;** ventricular muscles contract / AW, together / at same time / simultaneously / from the base upwards / from apex of heart **;**	**4**

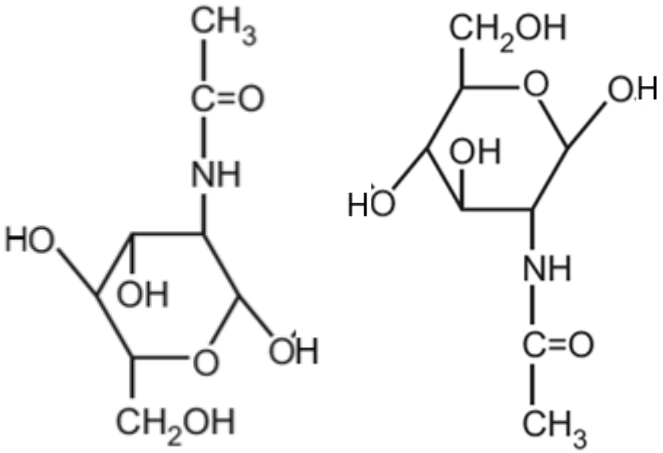
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Question	Answer	Marks
3(a)	**one** similarity **;** e.g. substrate binds to active site enzyme-substrate complex forms product leaves active site interaction does not alter enzyme for re-use lower activation energy specific to one or very similar substrate(s) interaction can be affected by, action of inhibitors / pH / AW **one** difference **;** e.g. induced-fit **ora** for lock-and-key active site not fully complementary to substrate change in, conformation / shape, of active site / AW *context of binding substrate or after product release* less specificity to substrate	**2**
3(b)(i)	orange / brown / amber **;** **A** yellow-brown, yellow-orange	**1**
3(b)(ii)	*any **three** from*: phosphorylase (in extract) catalyses addition of glucose 1-phosphate to starch added to extract **;** more starch is synthesised by phosphorylase as time progresses / AW **;** iodine solution added to mixture turns a, blue / black / blue-black, colour (in the presence of starch) **;** the more starch present in the mixture, the, darker / more intense, the, colour / shade **;** the darker the colour (of the positive result) the less light passes through, mixture / sample **;** the darker the colour / AW, the higher the absorbance (reading of the colorimeter) **;**	**3**
3(b)(iii)	*ref. to* breakdown of starch catalysed by the enzyme / reaction in Fig. 3.1 goes in the opposite direction **;** AVP **;** e.g. *ref to* equilibrium shift *ref. to* glucose 1-phosphate has run out decrease in concentration of starch, qualified with *ref. to* iodine solution	**1**

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Question	Answer	Marks
3(c)	*any **three** from:* reduction in activity of phosphorylase (at all concentrations) ; **ora** higher throughout with caffeine V_{max} not reached ; *ref. to* plateau at a (much) lower activity ; calculated K_m value with caffeine is the same as without caffeine ; use of data from the graph to support conclusion ;	**3**

Question	Answer	Marks
4(a)(i)	 correct glycosidic bond circled ;	**1**

Question	Answer	Marks
4(a)(ii)	 –OH group shown on the monomer where the glycosidic bond connected the two monomers (C1) ; –OH shown on C4 ;	**2**
4(b)	*any **four** from:* *ref. to* filtering helps prevent / AW, cholera ; filtering water removed copepods (with bacteria on surface) from water ; some bacteria were able pass through fabric / bacteria were found living free in water / some copepods were small enough to pass through fabric ; cholera transmission could be from, other sources / food ; people who filter water may have better personal hygiene ; **A** examples e.g. washing hands AVP ; e.g. differences in other water treatment methods e.g. boiling water	**4**

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Question	Answer	Marks
4(c)(i)	*any **one** from:* wash hands, qualified **;** e.g. more frequently after, urination / defecation / using the toilet **I** non-scientific terms before preparing food before handling utensils thoroughly / with soap / antibacterial gel avoid eating, crops / food, grown with faeces used as fertiliser **;** wash fruit / vegetable (in, uncontaminated / AW, water) **;** cover food to prevent flies landing / kill flies before they land on food **;** AVP **;** e.g don't share hand towels use disposable hand towels keep fingernails short	**1**
4(c)(ii)	*any **two** from:* *ref. to* active transport / *ref. to* efflux pumps **;** *in correct context* tetracycline transported out of the cell **;** AVP **;** e.g. substance pumped out combined with tetracycline (membrane) enzyme that breaks down tetracycline before entry to cell	**2**
4(c)(iii)	*any **two** from:* vaccines may contain more than one antigen (so more than one type of antibody is present) **;** multiple mutations are needed to evolve, immune evasion / described**;** vaccines given to people before infection so secondary immunity acts quickly to kill pathogen before mutations arise **;** antibiotics used when person already infected so large population **; ora** more likely to be a mutation which causes resistance **; ora** antibiotics may target only one site in a bacterial cell **;** antibiotics more likely to be misused **;** AVP **; ;**	**2**

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Question	Answer	Marks
5(a)(i)	*any **one** from:* water ; mineral ions ; **A** any named appropriate ion AVP ; e.g. plant hormone	**1**
5(a)(ii)	lignin ;	**1**
5(b)(i)	*any **three** from:* as temperature increases, rate of water vapour loss from leaf increases ; **A** transpiration for water vapour loss *idea that* more heat energy absorbed by leaf ; more (heat) energy to evaporate water molecules / increased temperature for latent heat of vaporisation ; **A** more energy to break hydrogen bonds higher rate of evaporation / AW, from, surfaces / walls, of spongy mesophyll cells ; water vapour molecules have more kinetic energy ; higher rate of diffusion of water vapour out of leaf / steeper water potential gradient ; more stomata are open at higher temperatures so more water vapour is able to diffuse out of leaf ;	**3**
5(b)(ii)	*any **one** from:* cotton leaves have fewer stomata (per unit area) ; *idea that* cotton leaves have a thicker (waxy) cuticle ; cotton leaves have trichomes ; **A** hairs for trichomes cotton leaves are curled ; **A** rolled / folded cotton leaves have, sunken stomata ; **A** other examples e.g. stomata in, grooves / crypts / chambers / pits cotton leaves have, multilayered epidermis / hypodermis / thick walled epidermis ; AVP ; e.g. suggestion that cotton leaves only have stomata on lower epidermis smaller stomatal aperture	**1**
5(c)(i)	*any **one** from:* more than one nucleus in each cell / more chromosomes ; larger cells ; more organelles ;	**1**

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Question	Answer	Marks
5(c)(ii)	any one from: nucleus will contain more chromosomes / more than 2 copies of each chromosome **;** **A** more DNA molecules / more chromatin AVP **;** e.g. *ref. to* polyploidy (proportionately) larger nuclei	**1**

Question	Answer	Marks
6(a)(i)	gene **;**	**1**
6(a)(ii)	transcribed / template, strand **;**	**1**
6(a)(iii)	ribosome **;** **I** 70S / 80S	**1**
6(a)(iv)	weakens / AW, bacterial <u>cell wall</u> **;** cell cannot maintain turgor / AW **;** leads to (osmotic) lysis / AW **;**	**2**
6(b)(i)	flattened cells / AW **;** short diffusion distance, (for gas exchange / described) **;**	**2**
6(b)(ii)	stretch / expand, on inhalation, to prevent alveoli bursting / rupturing / overstretching **;** recoil on exhalation to help expel air from the lungs **;** *if no marks gained, allow one mark for stretch and recoil*	**2**

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1(a)	*any **two** from:* *allow **oras*** **1** cilium composed of microtubules **or** microvillus, composed of microfilaments / contains actin (filaments) **;** **2** cilium 9+2 (microtubule) arrangement **;** **3** cilium has basal body **; A** has centrioles at the base **4** cilium shows synchronous, rhythm / movement **; A** whip-like / rhythmic, movement **5** cilium, moves / wafts, mucus **or** microvillus increases, surface area / SA, for, absorption / uptake / secretion **;** **A** increases SA to locate transport proteins AW **6** AVP **;** e.g. cilium has dynein (arms) cilium is, longer (10 μm) / wider (0.2 μm) **or** microvillus is, shorter (1 μm) / narrower (90 nm)	**2**
1(b)	*any **one** from*: protects (intestinal), epithelium / cells / lining **;** **A** examples of protection e.g. damage from stomach acid / digestion by enzymes **A** less likely for epithelial cells to be damaged / AW **A** traps, pathogens **or** (harmful), bacteria / microbes / microorganisms **I** dust **A** prevents, pathogens / AW, from reaching cells eases / reduces friction for, movement of, gut contents / substances (through digestive system) **;** habitat / nutrient source, for gut, microorganisms / flora **;** AW AVP **;** e.g. location for immune system cells **R** if stated as being in the gas exchange system	**1**
1(c)(i)	arteriole **; A** (small) artery	**1**

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Question	Answer	Marks
1(c)(ii)	*any **two** from:* (at arteriole end of capillary) high, <u>hydrostatic</u> / <u>blood</u>, pressure **;** **A** *ref. to* hydrostatic pressure gradient (ultra)filtration / described **;** e.g. fluid / plasma / water <u>and</u> solutes, forced / comes out of, capillaries / blood glucose / amino acids / ions, leave (blood) **or** (large / plasma) proteins remain (in blood) **;** **R** if stated, red blood cells / platelets, leave through, fenestrations / fenestrae / endothelial pores **or** pores / gaps / spaces, in, capillary wall / endothelium / between cells **;**	**2**
1(d)	*any **three** from*: *after, secreted / released, by enteroendocrine cells* transport of, peptide / GLP-1 / ligand, in, blood / circulation **;** to, <u>target cells</u> (which are cells of the, stomach / pancreas) **;** binding of, peptide / GLP-1 / ligand, to receptor **;** *context can be cell surface membrane or intracellular* *ref. to*, specificity / complementary **;** *must be in correct context of GLP-1 binding to receptor* (binding) triggers / sets off / AW, events within (target) cell (leading to the response) **;** **A** examples e.g. signal transduction / triggers enzyme cascade	**3**
1(e)(i)	prophase metaphase anaphase telophase } **;** **R** if interphase or cytokinesis stated	**1**

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Question	Answer	Marks
1(e)(ii)	*any **three** from*: *ref. to nucleus / nucleolus, is neutral* presence of, vesicles / vacuoles, qualified **;** e.g. many / secretory / Golgi **A** storage vesicles correct *ref. to* exocytosis **;** **A** fusion of, vesicle / vacuole, with cell surface membrane much / high proportion of / a lot of / AW, rough endoplasmic reticulum **;** **I** ER / RER / rough ER **A** many ribosomes rough endoplasmic reticulum / ribosomes, site of, peptide / polypeptide / protein / enzyme, synthesis **;** **ecf** *for abbreviating rough endoplasmic reticulum previously* AVP **;** e.g. presence of mitochondria to provide, ATP / energy, for, protein synthesis / movement of vesicle to cell surface membrane / exocytosis *mp2 can also be awarded here **only** if ref. has been made within response to vesicles / vacuoles*	**3**
1(e)(iii)	Paneth cell is, differentiated / specialised (for, secretion / its function) **or** stem cells are, undifferentiated / not differentiation / not specialised **;**	**1**
2(a)	*Vibrio cholerae* **;** *must be spelled correctly*	**1**

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Question	Answer	Marks
2(b)	*any **four** from*: *within general response, in correct context* **1** *ref. to*, contamination / contaminated **;** **A** presence of, pathogen / *V. cholerae* / bacterium *in correct context (can look for **ora**)* **2** *ref. to* breaking the transmission cycle **;** *providing access to safe drinking water* **3** cholera is transmitted by faecal-oral route **;** **A** described e.g. *ref. to* (contaminated) faeces and ref. to, food washed in contaminated water **or** drinking (contaminated) water **or** eating (contaminated) food *practise personal hygiene* **4** *ref. to* using method to make sure faeces do not enter drinking water **;** e.g. use of, toilets / latrines **A** do not defaecate in or near, rivers / reservoirs / lakes AW *accept* urinate **I** non-scientific terms for, defaecation / urination **5** washing hands **;** **6** detail **;** e.g. use, soap / antibacterial gel / AW after, urination / defaecation **A** after going to the toilet before handling foods*context is preparation or eating a meal* scrub under fingernails cafes, restaurants / AW, provide places for washing hands do not share towels / use disposable towels / AW **7** AVP **;** e.g. water, is / should be, chlorinated / boiled / bottled / filtered to remove pathogens / UV-treated / other water, is / should be, kept separate from sewage / piped direct from water treatment plant keep fingernails short safe disposal of vomit	**4**

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

antigen is a standalone mark then move to rows 3,4,5

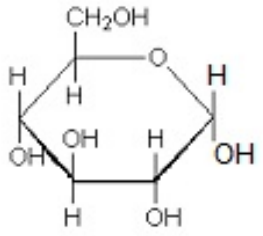
if no marks gained from rows 3,4,5, check for correct answers in these rows going <u>down</u> the column to award 1 mark

<table>
<tr><th>row</th><th>feature</th><th>oral cholera vaccine</th><th>passive immunisation for cholera</th></tr>
<tr><td>1</td><td>component causing the desired response</td><td><u>antigen(s)</u> ; I weak / weakened / toxin
A toxoid / inactivated toxin
R dead antigen
A weakened / attenuated / dead, pathogen / V. cholerae</td><td>antibody</td></tr>
<tr><td>2</td><td>type of immunity gained</td><td>artificial active</td><td>artificial passive</td></tr>
<tr><td>3</td><td>stimulates production of memory lymphocytes</td><td>(yes) / no</td><td>yes / (no);</td></tr>
<tr><td>4</td><td>length of time needed to have an effect</td><td>shorter
same
(longer)</td><td>longer
same
(shorter);</td></tr>
<tr><td>5</td><td>duration of immunity</td><td>shorter
same
(longer)</td><td>longer
same
(shorter);</td></tr>
</table>

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

Question	Answer	Marks
2(c)(ii)	B-lymphocyte / plasma cell / splenocyte, <u>and</u>, myeloma / tumour, cell **;** **A** B-cell *for B-lymphocyte* **A** cancer cell *for myeloma cell* *plus **two** from:* (B-lymphocyte) synthesises (specific / desired) / AW, antibody **;** **I** has the antibody (B-lymphocyte) cannot survive (for long) / dies, in culture **;** (myeloma cell) can divide / can carry out mitosis / long-lived **;** **I** rapidly / fast **A** <u>plasma cell</u> cannot divide **R** (hybridoma cell) divides uncontrollably	**3**

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Question	Answer	Marks
3(a)	*any **three** from:* different sequence of, (DNA) nucleotides / bases **;R** RNA nucleotides code for / result in, different, polypeptides / proteins **;** **A** result in different sequences of amino acids **A** *LCT*, codes for / AW, lactase / enzyme, and, *MCM6*, codes for a different protein / involved in regulation have different numbers of, introns / exons **;** different, lengths / number of nucleotides / number of bases **;** *context is DNA* AVP **;** e.g. one may be continually expressed, the other switched on and off *MCM6* associated with different regulatory sequences	**3**
3(b)	statement showing relationship between transcribed strand and primary transcript **;** e.g. (transcribed strand is the) DNA (strand) / template (strand), used to form the primary transcript primary transcript is RNA (molecule first) formed from transcription of transcribed strand primary transcript is a complementary copy of the transcribed strand (but uracil replaces thymine) statement showing relationship between primary transcript and mRNA **;** e.g. primary transcript undergoes, gene / RNA, splicing, to form mRNA primary transcript undergoes modification to produce mRNA mRNA formed by removal of introns from primary transcript mRNA formed only from exons of primary transcript *one mark for a response that has correct ideas but does not show a direct relationship*	**2**
3(c)	base substitution / substitution (mutation) **;** **I** missense	**1**
3(d)	 *all correct for one mark – if deciding to leave out the H, then this must be for all C1 to C5 hydrogens – leaving out only the C5 H is zero marks*	**1**

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Question	Answer	Marks
3(e)(i)	*any **two** from:* *idea of* can, detect increase in / distinguish between, the intensity of colour (as products form) **;** can obtain quantitative results (for coloured product of ONPG) **;** **A** can provide numerical, values / readings / results / measurements **R** if stated that the results are wavelengths *ref. to* not subjective / AW **;** *idea of* not by-eye judgments / difficulty in describing different colour shades can obtain accurate, results / readings / values **;** **A** *idea of* greater accuracy in obtaining results *vague references to accuracy should be considered for ideas linked to 'not subjective'* can construct numerical graphs of results to compare curves of each (lactase) concentration **;** AW AVP **;** e.g. more sensitive to small colour changes at the beginning of the experiment not able to see initial reaction proceeding by eye *ref. to* use of a (prepared) calibration, curve / graph (to compare rates / product concentrations)	**2**

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Question	Answer	Marks
3(e)(ii)	*any **four** from:* *accept activity for percentage of maximum activity* **1** immobilised (overall) greater, productivity / yield / hydrolysis (of lactose in milk) **; I** activity **2** (process / immobilised) more tolerant to, temperature / pH, fluctuations / changes **;** AW **A** *idea that* can be used in processes covering a wide range of, temperature / pH **3** detail immobilised vs free lactase from Fig. 3.2 **;** e.g. (at temperatures) above optimum / higher than 38 / 39 °C, (immobilised) has a higher activity AW above optimum / higher than 38 / 39 °C, (partial / extent of) denaturation (for immobilised) is less at each temperature AW **A** higher than 40 °C *if accompanying context is correct* **R** if optimum stated as 35 °C **4** data from Fig. 3.2 to support **;** *any one comparison (units only for temperature required)* **5** detail immobilised vs free lactase from Fig. 3.3 **;** e.g. higher activity at all pHs except pH 6.5 and pH 7.0 higher activity, below pH 6.5 / above pH 7.0 free not active at pH 5.5 but immobilised active, at all pHs / for a wider pH range **6** data From Fig. 3.3 to support **;** **7** AVP **;;** e.g. can use a lower temperature / cheaper, for same quantity of product **8** more, heat stable / thermostable / stable at high temperatures **I** longer shelf-life **R** thermostatic better in alkaline pHs	**4**

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Question	Answer	Marks
4(a)	*any **three** from:* *max 2 for similarities, max 2 for differences* *similarities, both have* phospholipids **;** channel / transport, protein **; A** intrinsic / integral / transmembrane, protein **R** carrier / pump, protein a bilayer / two layers **;** *differences* *do not need to have 'outer membrane' 'bacterial' if context is clear* (bacterial outer membrane) has lipopolysaccharides **; ora** (cell surface membrane / eukaryote) has, phospholipid bilayer / both layers with phospholipids **; ora** *if ora also given (bacterial) only has outer layer of (outer) membrane with phospholipids, can also award mp1* AVP **;;** e.g. cell surface membrane has, glycocalyx / glycolipids / glycoproteins cell surface membrane has cholesterol outer membrane does not have extrinsic proteins	**3**
4(b)(i)	*any **one** from:* *formation of O-IMV* involves a more complex process **;** e.g. greater variety of, contents / cell structures **R** organelles *ref. to* needing to make a vesicle with two 'membranes' / AW **A** 'layers' peptidoglycan, chains / layer / bonds, need to be broken **; A** peptidoglycan wall needs to be broken causes, (temporary) weakness in cell wall / risk of lysis **;** *idea that* more resources required to form vesicle **or** too great a loss of important cell, components / structures *ref. to* take more time to produce **;** uses (more) energy to, break wall / repair wall / make the vesicle **;I** *ref. to* organelles AVP **;** e.g. suggestion that periplasmic proteins need to be released in greater numbers so more OMVs formed	**1**
4(b)(ii)	*any **one** suggestion that:* *must be in context of a fully formed O-IMV* function of O-IMVs require, energy / ATP **;** **A** suggested function e.g. DNA transcription / metabolic reactions / for active transport **I** cell processes O-IMV (formation) has cytoplasm, which contains ATP **;** OMVs formed only from periplasm, which has no ATP **;** **A** no ATP in outer membrane space AVP **;** e.g. no / few, ATP transporters / transport proteins, for exit of ATP into periplasm (in area where OMV forms)	**1**

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Question	Answer	Marks
4(b)(iii)	*ref. to* DNA in O-IMVs being passed on to other bacteria **;** e.g. O-IMVs may, fuse with / be taken up by / AW, plasmids / DNA, in (degraded) O-IMVs may enter other bacteria qualified *ref. to* O-IMV DNA and antibiotic resistance **;** e.g. O-IMVs have, alleles / genes / plasmid, that, give / confer / AW, antibiotic resistance DNA may mutate to give (a, gene / allele, for) antibiotic resistance DNA, codes for / expresses / AW, a protein involved in antibiotic resistance example of gene conferring resistance e.g. enzyme to breakdown antibiotic change to ribosome structure (to prevent antibiotic attachment) efflux pump for / membrane protein to pump out, antibiotic	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>A = (waxy) cuticle ;
B = spongy mesophyll (layer / tissue) ; R spongy mesophyll cell I parenchyma</td><td>2</td></tr>
<tr><td>5(b)</td><td>one mark each correct row <u>and</u> each example must be different
<table>
<tr><th>structural feature in Fig. 5.1</th><th>one example of xerophytic adaptation</th></tr>
<tr><td>structure A</td><td>thick / thicker, (waxy cuticle) ;
A reflective layer / AW</td></tr>
<tr><td>upper epidermis</td><td>multi-layered / more than one cell layer / hypodermis
or
thick walled / thick cell walls / sclerenchyma
or
presence of, trichomes ;</td></tr>
<tr><td>lower epidermis</td><td>sunken stomata
or
stomata in, pits / grooves / crypts / chambers
or
presence of, trichomes
or
thick / thicker, (waxy) cuticle
or
few(er) stomata (per unit area) R no / fewer
or
stoma / stomata, with smaller, aperture / pore ;</td></tr>
</table></td><td>3</td></tr>
</table>

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Question	Answer	Marks
6(a)	• *consider <u>all</u> mps to award if response clearly addresses events in the left side* ○ *mps 1,2,6,7,8 must be in the context of the left side of the heart* • *otherwise allow mp 3, 4, and 5 to max 3 – these mark points are inset to the right* *any **five** from:* **1** blood enters (heart) via / in, pulmonary vein(s) **;** **2** blood exits heart to aorta **;** **R** arota **3** blood flows from atrium to ventricle **;** **4** atrial, systole / contraction, then, ventricular, systole / contraction **;** **A** atrium contracts then ventricle contracts **5** pressure in ventricle, increases / gets higher **;** **I** high pressure unclear attempts / mixed right and left sides **6** bicuspid / (left) atrioventricular valve closes **; A** mitral valve **R** *if in context of events in the atrium* **7** semilunar / aortic, valve opens **; ecf** *from arota in mp 2* **R** *if in context of events in the atrium* **8** bicuspid / (left) atrioventricular, valve closes when (blood) pressure in ventricle higher than atrium **or** semilunar / aortic, valve opens when (blood) pressure in ventricle higher than aorta **; A** aortic valve	**5**

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Question	Answer	Marks
6(b)(i)	*if no marks gained allow one mark for four, polypeptides / polypeptide chains* two, (identical) alpha / α, chains / globins, and two, (identical) beta / β, chains / globins **;** **A** subunits / polypeptides, for chains **R** beta-pleated sheets / globulin *plus **one** from;* each, chain / globin / polypeptide, incorporates / contains / AW, a haem (group) **;** **A** four haem groups **A** molecule for polypeptide if mp1 gained **A** ferrous ion / Fe^{2+} / iron (ion / atom), within porphyrin (ring) for haem group **A** prosthetic group with, ferrous ion / Fe^{2+} / iron (ion / atom) hydrogen bonds / hydrophobic interactions / ionic bonds, between, chains / polypeptides / globins **;** *context is interactions between chains* **R** if disulfide bond also stated	**2**
6(b)(ii)	oxygen binds to, iron ion / ferrous ion / Fe^{2+} **;** **A** oxygen bonds / oxygen forms a bond, *only if*, iron ion / ferrous ion / Fe^{2+} stated **A** oxygen binds to, iron / iron atom / haem (group) **R** if more than one oxygen molecule binds to one iron ion detail of saturated **;** e.g. total of 4 oxygen molecules / 8 oxygen atoms (bind per haemoglobin molecule) each, chain / globin / polypeptide, binds one oxygen molecule **R** bonds *ref. to* cooperative binding / allostery **A** description *ref. to* (fully saturated molecule is) in, high partial pressures of oxygen / high concentration of oxygen **;** *ref. to* T / tense, state to, R / relaxed, state	**2**

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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2025**

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 2025 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	<u>'List rule' guidance</u> 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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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	correct point or mark awarded
	correct awarding one mark from marking point or marking group 1. similar numbered ticks are used for marking point or marking groups 2, 3, 4, etc.
	incorrect point or mark not awarded
	working towards marking point
	information missing or insufficient for credit
	used to highlight part of an extended response
	used to highlight part of an extended response
	allow or accept
	benefit of the doubt given

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Annotation	Meaning
CON	contradiction in response, mark not awarded
ECF	error carried forward applied
I	incorrect or insufficient point ignored while marking the rest of the response
IRRL	irrelevant material that does not answer the question
O	or reverse argument
PAG	point already given
R	incorrect point or mark not awarded
SEEN	point has been noted, but no credit has been given or blank page seen

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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)	*letter **A**: example of substance* = carbon dioxide / oxygen **;** *letter **D**: type of movement* = active transport **;** *letter **D**: part of membrane involved* = carrier / pump, protein and *example of a substance* = sodium ions **;** **R** sodium-potassium pump **A** potassium ions / chloride / amino acids **A** sodium pump (if sodium is example) **A** glucose *if not given for letter **C*** *letter **C**:example of a substance* = glucose **;** **A** amino acids / chloride (ions) / potassium ions / sodium ions *part of membrane involved*: *for **B*** = channel protein and *for **C*** = carrier protein **;**	**5**
1(b)	*any **two** from* *viruses travel through* symplast pathway **;** **I** apoplast pathway *if described correctly* **R** symplast and apoplast pathways *if no further detail of apoplast given* plasmodesmata / cytoplasmic connections between cells **;** **A** strands of cytoplasm because viruses are small enough (to pass through plasmodesmata) **;** AVP **;** **A** any *ref. to* actual size (width of plasmodesmata ~ 50 nm, width of Tobacco Mosaic Virus 18 nm)	**2**

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Question	Answer	Marks
2(a)(i)	*any **two** from* each polypeptide is a (left-handed), helix / helical shape **;** **R** alpha helix (three) polypeptides are tightly, coiled / wound (around each other) / AW **;** (three polypeptides form a) triple helix **;** **I** bonding	**2**
2(a)(ii)	*any **three** from* *collagen molecules arranged* **1** in parallel **;** **2** staggered / ends are not aligned / AW **;** *molecules held together by – max 2* **3** covalent, bonds / links **; I** hydrogen bonds **R** if part of a list that includes other bonds in proteins **4** between R-groups of amino acids on different molecules **; A** side chains **5** AVP **;** e.g. covalent bonds between lysine / hydroxylysine (residues)	**3**
2(b)(i)	provides (high tensile) strength to, help keep trachea open / support trachea **;** **A** provides strength to prevent trachea collapsing allows flexibility for, breathing / change of diameter of trachea / bending of trachea / AW **;**	**2**
2(b)(ii)	*any **one** from:* (inhalation) allow, stretching / expansion, without, rupture / AW **; A** prevent overstretching elastic fibres recoil to help, expel air / exhalation / expiration **; R** to empty	**1**
2(c)(i)	(gly)-pro-met-gly-pro-arg-gly-pro-pro-gly ;	**1**

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Question	Answer	Marks
2(c)(ii)	*any **three** from:* *allow gly for glycine* **1** glycine is every third amino acid **;** **2** glycine, allows tight folding for the polypeptides / makes it easy for polypeptides to fit closely together / AW **;** **A** compactness **A** glycine allows the turning points (of the polypeptide) **3** glycine has smallest R-group **;** **A** glycine is the smallest (amino acid) / glycine has H as R-group *or* side chain **4** NH in glycine can form hydrogen bonds (with carboxyl group on another amino acid residue) **5** (so) allows many hydrogen bonds between polypeptide**s ;** **6** AVP **;** ala / pro, also has a small R-group / AW	**3**
2(c)(iii)	**P** *deletion of first nucleotide pair* changes the, sequence / order, of amino acids (in primary structure) **; I** shorter **A** (GTC CAA TGG GTC CCC GAG GTC CCC CAG GT_) val gln trp val pro glu val pro gln (val) **Q** *substitution in first triplet* (GGT to TGT in non-transcribed strand) cys (instead of gly) is first amino acid, and no change to the rest (of, sequence / order, of amino acids) **;** **A** only first amino acid is different	**2**

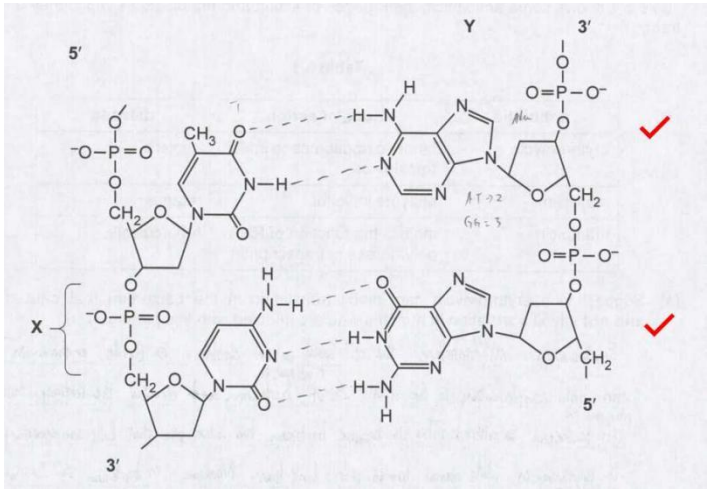
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Question	Answer	Marks
3(a)	*any **three** from:* *to award MPs 2, 3 and 6 there must be reference to shape or conformation at least once in the answer* *if no reference to shape or conformation in the answer mark to max 2* *if lock and key described mark to max 2 from MP4 onwards* **1** *idea that* active site (of inactive enzyme) and substrate are, (only) partially / not, complementary **;** **2** as substrate enters active site there is a, change in shape / conformational change, (of active site / enzyme) **;** **A** active site moulds around substrate **R** substrate changes shape / substrate active site **3** so shape of active site becomes complementary to substrate **;** **A** *idea that* there is a good fit between active site and substrate **4** enzyme-substrate complex forms **;** **5** lowers activation energy **;** **6** product(s) leave and, enzyme / active site, returns to original, shape / conformation **;** **7** AVP **;** e.g. catalytic sites move to be in correct position e.g. detail of lowering activation energy – putting strain on substrate / stress on bonds	**3**
3(b)(i)	*allow enzyme or subtilisin for immobilised subtilisin A* *allow attachment for attachment of larvae* **I** comparisons between controls *any **four** from:* **1** effective because (much) lower percentage attachment with, the enzyme / AW, compared with the control(s) / AW **;** **ora** for (both) controls **2** any comparison between 24 and 48 hrs in the same experimental tank (1 to 4) **;** e.g. tank 2 only one showing decrease at 48 hours **3** any comparison between any two different tanks (1 to 4 or any experimental with control) at either 24 or 48 hours **;** e.g. less attachment in tank 2 than in the others at 48 hours **4** 48 hours is a short period of time / may not be effective after a few days **;** **5** not 100% effective **;** **6** (generally) becomes less effective at 48 hours (with exception of tank 2) **;** **7** immobilised enzyme, not stable / detached from surface **;** **8** *ref. to* no trend with increasing subtilisin concentration **;** **9** no repeats so data may not be valid / AW **;** **10** AVP **;**	**4**

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Question	Answer	Marks
3(b)(ii)	***I*** *ref. to cost* *any* ***two*** *from:* **1** density / concentration of, enzyme / subtilisin A / polymer **;** **A** way of attaching enzyme to polymer **2** type of polymer **;** **3** check that all organisms are removed from ships before applying, enzyme / polymer **;** **4** way to fix polymer to surfaces of ships / material used to make surface of ships **;** **5** number of larvae put into tanks / experiment carried out at time of year when larvae are in sea water **;** **A** *idea that* different places have different numbers of larvae **6** length of time before taking measurements **;** **7** length of time, enzyme / anti-fouling agent, remains active **;** **A** *ref. to* stability of immobilised enzyme **8** *idea of* any interaction with other, fouling / marine, organisms **; A** 'affect' as an interaction e.g. that could, graze / decompose, subtilisin A / polymer that could compete with *A. amphitrite* for attachment sites effectiveness against fouling organisms other than, *A. amphitrite* / barnacles subtilisin A / product of enzyme, may be, toxic / harmful, to marine organisms **9** effect of immersion in sea water on, enzyme / polymer (not in artificial sea water) **;** **10** effect of different types of sea water, e.g. salt content / mineral content / roughness **;** **A** different, concentrations of sea water / salinities **11** effect of marine pollutants / something in sea water, as enzyme inhibitors **;** **12** AVP **;** e.g. *ref. to* surface area of ship exposed to sea water types of antifouling agents present in the seawater	**2**

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Question	Answer	Marks
4(a)(i)	repeating, units / sub-units / molecules / nucleotides (used to make a, polymer / polynucleotide / strand (of DNA)) ;	1
4(a)(ii)	*any **one** from:* (pentose / sugar is) ribose (not deoxyribose) ; C2 on the, pentose / sugar, is -OH not -H ;	1
4(a)(iii)	respiration ;	1
4(b)(i)	two hydrogen bonds drawn correctly between A and T ; three hydrogen bonds drawn correctly between C and G ; *for positioning of H bonds on C-G, **A** from either H on amine group on C to link with oxygen on G*  *if no marks gained but A-T has two lines and C-G has three lines between bases award 1 mark*	2
4(b)(ii)	phosphodiester ;	1

Question	Answer	Marks
5(a)	*any **two** from:* **1** bacteria, have 70S ribosomes and humans have 80S ribosomes / only have 70S ribosomes **;** **2** antibiotic, cannot bind to 80S / human ribosomes **or** can only bind to 70S / bacterial ribosomes **;** **3** antibiotic, binding site / target site, not present on 80S ribosomes / only present on 70S ribosomes **;** **A** *ref. to* complementary / specfic – alternative to second part of the MP **4** antibiotic cannot enter mitochondria to reach 70S ribosomes (in humans) **;** **5** AVP **;** different combinations of proteins in ribosomes / different rRNAs in ribosomes	**2**
5(b)	*any **one** from:* **1** penicillin acts on cell walls and human cells have no, peptidoglycans / cell walls / enzyme(s) that make cell walls**;** **A** murein *penicillin* **2** prevents formation of peptide / cross, bridges / linkages, (between peptidoglycans) in (bacterial) cell wall **;** **3** prevents repair of, gaps / holes / AW, in (bacterial) cell walls caused by autolysins **;** **I** *ref. to* penicillinase	**1**
5(c)	*any **one** from:* *rifampicin* **1** blocks / fits into / binds to / competes for, the active site of, RNA polymerase / enzyme **;** **2** binds, to allosteric site / site away from active site, to, change shape of active site / prevent it forming phosphodiester bonds **;** **3** attaches to DNA template blocking RNA polymerase moving along it **;** **4** can be incorporated into RNA but no nucleotide can be added to it **;** **5** AVP **;** e.g. attaches to the promoter to stop RNA polymerase, binding to DNA / moving along DNA / AW	**1**

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Question	Answer	Marks
6(a)	*any **two** of these pairs, feature and explanation* **1** thick wall of (left) ventricle **; R** if right **2** pumps blood at high pressure to, reach (all of) systemic circulation / overcome resistance in systemic circulation / over a long distance / AW **;** **A** if thick wall unqualified **A** generate high force **R** 'withstands high pressure' **3** thin wall of (left) atrium **;** **4** pumps blood at low pressure, into ventricle / over a short distance **;** **either** **5** (named) valves **; R** tricuspid / pulmonary **6** prevent, backflow of blood / maintains one-way flow of blood (through heart) **;** **ecf** if right atrioventricular / tricuspid **or** **5** (left) atrioventricular / mitral / bicuspid, valve **; R** right **6** prevents, backflow of blood / blood flowing from ventricle to atrium **;** **A** maintains one-way flow of blood (through heart) **or** **5** (left) semi-lunar, valve **;** **6** prevents, backflow of blood / blood flowing from, aorta / artery, to ventricle **;** **A** maintains one-way flow of blood (through heart) **7** chordae tendinae / tendons / tendinous cords / AW **; I** ligaments **8** hold the valve in position, during systole / when ventricle contracts / AW **;** **A** prevents blowback / turning inside out **I** high tensile strength unqualified **9**,**10** AVP **;;** e.g papillary muscle **;** contracts to hold, tendons / valve, when heart contracts / during systole **; ora**	**4**

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Question	Answer	Marks
6(b)	*any **four** from:* *if AVN used penalise once and then use ECF* **1** sinoatrial node releases, waves of excitation / waves of depolarisation / (electrical) impulses / action potential(s) **;** AW **2** impulses / AW, stimulate, (both) atria to contract / atrial systole **;** **3** impulses / AW, prevented from reaching ventricles by, fibrous ring / non-conducting tissue / insulating tissue / (between atria and ventricles) **;** **A** annulus fibrosus **4** atrioventricular node, delays impulse (by 0.1 s) **;** **5** atrioventricular node, sends impulse to, Purkyne tissue (in septum) **;** **A** bundle of His *allow **ecf** for abbreviating AVN* **6** Purkyne tissue conducts impulse to, base of ventricles / apex of heart, so they contract **;**	**4**
6(c)(i)	*any **two** from: if transport is used in MP2 to MP8, penalise once and mark to a max of 1 for those MPs* *provides, aqueous / watery, (external) environment / surroundings, for cells* **1** to maintain correct water potential to prevent, cell dehydration / excessive water loss from cells **;** *idea that provides medium for exchange of substances* **2** supply of oxygen / oxygen diffuses from blood into tissue fluid **;** **3** removal of carbon dioxide / carbon dioxide diffuses from tissue fluid into blood **;** **A** exchange of (respiratory) gases as alternative to MP2 and MP3 **4** supply of named nutrient e.g. glucose, amino acids, (named) ion(s) **;** **5** removal of, metabolic / toxic, waste **or** urea **;** **6** location / movement, of (tissue) macrophages / neutrophils / phagocytes (for defence) **;** **I** white blood cell **7** allows movement of / medium for passage of, (named) cell signalling molecules / hormones / ligands **;** **A** *ref. to* cells signalling nearby cells / paracrine signalling **8** AVP **;** e.g. contributes to formation of lymph / contains antibodies e.g. allows movement of lymphocytes into lymph	**2**

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Question	Answer	Marks
6(c)(ii)	*any **three** from:* **1** (at arteriole end of capillary) high, hydrostatic / blood, pressure **;** **2** (ultra)filtration / described **;** e.g. fluid / plasma / water and solutes, forced / comes, out of, capillaries / blood **3** glucose / amino acids / ions, leave blood **R** if stated, red blood cells / platelets, leave ***or*** (large) plasma proteins remain in blood **;** **4** through, fenestrations / fenestrae / endothelial pores **or** through, pores / gaps / spaces, in, capillary wall / endothelium / between cells **;** **5** AVP **;** e.g. *ref. to* hydrostatic pressure gradient hydrostatic pressure of blood is greater than hydrostatic pressure of tissue fluid	**3**
6(d)(i)	**I** pathogen **A** epitope for antigen *any **two** from:* some (T-lymphocyte) have (T-cell) receptors, specific / complementary, to a particular antigen **; ora** antigen (in vaccine) binds to these T-lymphocytes **;** *idea that* only these T-lymphocytes are, activated / stimulated / selected **; I** respond AVP **;** e.g. some T-lymphocytes do not become exposed to limited quantity of antigen in vaccine	**2**

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Question	Answer	Marks
6(d)(ii)	*max four if no correct ref. within response to, memory cells / immunological memory* *any **five** from:* *context of primary immune response* **1** antigen presentation by macrophages **;** **2** (T- / B-) lymphocyte, binding / recognition / clonal selection / activation / described in terms of receptor **;** **3** clonal expansion / cell divides by mitosis many times (to produce a clone) / AW **;** **4** cytokines released by T-helper, cells / lymphocytes **;** **5** (stimulate) formation of memory, (T- / B-) lymphocytes / cells **;** **6** (memory cells) remain in, circulation / body, for a long time / AW **; A** remain in lymph nodes **or** memory cells are long-lived **;** *context of secondary immune response* **7** large numbers of (specific), memory cells / lymphocytes **; I** more memory cells **A** memory cells have a higher chance of encountering antigen	**5**

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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/24**

Paper 2 AS Level Structured Questions **October/November 2025**

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 2025 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	<u>'List rule' guidance</u> 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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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standard isation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	correct point or mark awarded
	correct awarding one mark from marking point or marking group 1. similar numbered ticks are used for marking point or marking groups 2, 3, 4 etc.
	incorrect point or mark not awarded
	working towards marking point
	information missing or insufficient for credit
	used to highlight part of an extended response
	used to highlight part of an extended response
	allow or accept
	benefit of the doubt given

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Annotation	Meaning
CON	contradiction in response, mark not awarded
ECF	error carried forward applied
I	incorrect or insufficient point ignored while marking the rest of the response
IRRL	irrelevant material that does not answer the question
O	or reverse argument
PAG	point already given
R	incorrect point or mark not awarded
SEEN	point has been noted, but no credit has been given or blank page seen

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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)	*explanation* semi-conservative replication / DNA replication / S phase, has occurred **;** **R** if replication stated to occur in, G_1 / G_2 **I** chromatin replicates *difference between chromatin in G1 and G2:* *(allow ecf from mp1 if stated replication occurs in G2)* *Any **one** from:* double the / doubling in, quantity / number / amount, of, chromatin / DNA **;** **A** chromatin has doubled sister / two identical, chromatids (formed, instead of one structure) **;** **A** two chromatids joined at the centromere (in G2) (each) chromosome with 1 DNA molecule (in G1) has 2 DNA molecules (in G2) **;** *allow double, helix/ helices for molecule(s)* *treat as neutral ref. to chromatin / chromosome, state / behaviour* *e.g. decondensed / diffuse*	**2**

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Question	Answer	Marks
1(a)(ii)	*any **three** from*: *check diagram to see if points can be awarded* description of nucleus as having any **two** listed structures **;** two from: nuclear envelope, nuclear pore(s), nucleolus, nucleoplasm *correct spelling* detail of nuclear envelope **;** e.g. two membranes / double membrane *accept from diagram* encloses / protects, chromatin / DNA / chromosomes / genetic information / genetic material outer membrane continuous with rough endoplasmic reticulum outer membrane with ribosomes (on outer surface) controls exit and entry of substances *if nuclear envelope not stated,* **A** the nucleus is surrounded by a double membrane **or** a double membrane encloses, chromatin / AW **or** (it is) double-membrane bound / bound by a double membrane detail of nuclear pore(s) **;** e.g. allows (m)RNA to, pass through / leave / AW (nucleus) allows ribosomal subunits to leave (nucleus) allows entry of proteins prevents exit of DNA (small) channel / passage, through the nuclear envelope *can be shown on a diagram, with a label* detail of nucleolus **;** e.g. spherical *can be shown as circle on diagram, labelled nucleolus* one / can be more than one synthesis of, rRNA / ribosomal subunits **A** ribosomes densely staining / dense region / condensed region *allow shaded in on a diagram, labelled nucleolus* AVP **;** e.g. nucleoplasm is fluid surrounding chromatin	**3**

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Question	Answer	Marks
1(b)(i)	**R** *the mp if feature of cellulose stated and, is incorrect / is not neutral* *for mps 1, 3, 4 can accept 'cellulose does not have ..'* *any* ***four*** *from*: *starch has* **1** (monomer of) alpha glucose / α-glucose / α-1,4 (glycosidic) bond **;** **I** glucose / glycosidic bond / 1, 4 bond *(all shared with cellulose)* **2** monomers / glucose, orientated the same way / AW **;** **ora** for cellulose i.e. monomers rotated 180° to each other **I** cellulose / cellulose molecule, rotates 180° **3** made of, two different polysaccharides / two different polymers / amylose and amylopectin **;** **4** amylopectin / starch, has (α-1,4 and) α-1,6 (glycosidic) bonds **;** **A** 1-6 *if alpha noted elsewhere* **A** link / linkage, for bonds **R** 'can have α-1,4 or α-1,6 bonds' **5** amylose, helical / coiled **R** α-helix **or** amylopectin branched **;** *if both are stated, allow mp3 as well* **A** starch, is branched / has branching (v cellulose, not branched / linear) **R** 'starch can be helical or branched' **6** no, hydrogen / H, bonds, to hold together / between / AW, molecules / polysaccharides **;** **A** cellulose has ……. **7** AVP **;** e.g. forms, starch, grains / granules **A** 'cellulose does not have ..' does not have microfibrils / fibrils / fibres **A** 'cellulose has..'	**4**

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Question	Answer	Marks
1(b)(ii)	**1** (different) mAbs have, different / specific, antigen binding sites / variable regions **; I** active site **2** (each) mAb has complementary shape for, binding / AW, antigen (combining with / attaching to) **or** mAbs are / a mAB is, specific / complementary, to particular, antigen(s) **;** **3** *idea that* a (particular) pectin / RG-I , has different, shapes / conformations / antigens, in its structure **;** **4** *idea of* (using) different / specific, (sets / combinations, of) mAbs to, recognise / identify / locate / use for, different pectins / types of RG-I / a particular RG-I **;** **5** *ref. to* studying development e.g **;** changes occurring / side chains added, during development need different mAbs some mAbs may be specific to side chains not yet added can help to show when modifications occur **6** AVP **;** e.g. reason to use more than one mAB • some mAbs may bind to more than one type of pectin • other cell wall components, may have, similar structures / same side chains • some areas of RG-I may be out of reach for a specific mAb • can, obtain information about / investigate, shape / structure of the particular pectin	**3**

Question	Answer	Marks
2(a)	cholera = prokaryotic and malaria = eukaryotic and TB = prokaryotic **;**	**1**
2(b)	pathogen **;**	**1**

Question	Answer	Marks
2(c)(i)	*magnification* (x) 12 000 **;;** *for line X-Y measuring 24 mm* **A** *calculated values for line X-Y measured between 23 to 25 mm* *for one mark:* • *correct calculation for 23.5 or 24.5 but not to 3 sig. figs = 1 mark* • *incorrect answer e.g. conversion factor incorrect, but* – *shows correct measurement for image* – *uses correct formula for calculation* – *answer to 3 sig. figs* • *measurement 22 mm or 26 mm* – *correct answer for their measurement* – *uses correct formula for calculation* – *answer to 3 sig. figs*	**2**
2(c)(ii)	*any **three** from:* **1** by a vector / carrier / mosquito / insect / (female) *Anopheles* **;** **2** takes, blood meal / sucks blood / feeds on blood **;** *context is transmission from infected to uninfected* **3** *Plasmodium* / pathogen / parasite, is in blood **;** *in correct context* **4** injects *Plasmodium* / AW, together with, anticoagulant / saliva **;** **5** AVP **;** e.g. *Plasmodium* / AW, migrates, after ingestion / from insect gut / AW, to salivary glands *if another mode of transmission stated, e.g. transfusion, allow mp1 and mp3 and a relevant AVP*	**3**

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Question	Answer	Marks
2(d)(i)	*any **two** from:* (phagocyte) has (specific) receptors (for PS) **;** **R** antigens **A** named e.g. macrophage / monocyte / Kupffer cell / neutrophil PS binds to (phagocyte / cell surface) receptor (to stimulates a response) **;** **A** phagocyte has a binding site for PS / PS binds to a binding site *ref. to* (PS presence / change in membrane) causes chemotaxis / attracts phagocyte (to red blood cell) *treat as neutral suggested chemicals that trigger chemotaxis* AVP **;** e.g. PS acts as an antigen	**2**
2(d)(ii)	*any **one** from:* *why uninfected red blood cells are destroyed* (some) PS is present in outer layer so can be, recognised / detected **;** AW *why only some red blood cells are destroyed* only a few PS in outer layer so lower chance of being recognised **;** parts of, parasite / pathogen / *Plasmodium* (in circulation), may become attached to, surface / cell surface membrane **;** (cell) displays, a foreign antigen / a non-self, antigen **;** displays an antibody (attached to antigen) **;** damaged (by other means) / at end of life-span / non-functioning, (so need destroying) **;**	**1**
2(e)(i)	**R** if context is, red blood cell / entry into red blood cell by pathogen any ***one*** from: *context is Plasmodium* for, cell membrane(s) / cell surface membrane **;** maintain / regulate, stability / fluidity, of membrane **;** **I** affects / changes, *if not qualified* **A** phospholipid bilayer *for membrane* to, convert / AW, to other products needed **;** to (breakdown and) use as an energy source **;** cannot / does not have gene to, synthesise cholesterol **;** AVP **;** e.g. to form, vesicle / vacuole (to contain replicated cells)	**1**

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Question	Answer	Marks
2(e)(ii)	**I** *ref. to* temperature *any **two** from:* **1** make more fluid / increase fluidity **;** **2** decrease / reduces, membrane stability **;** **3** increases, entry / exit, of, polar molecules / ions / water **;** **A** increases, permeability / described **4** allow increased (lateral) movement of cell components within bilayer **;** **5** reduced interaction with fatty acid tails **;** **6** AVP **;** e.g. decreased interaction with proteins, so affecting their function may affect ability to distort shape when passing through capillaries *if no marks gained, allow one compensation mark for* • *changes two of: fluidity / stability / permeability* • ***ecf** from 'decreases fluidity'*	**2**
2(f)(i)	*any **one** from*: active / energy-requiring, process **;** **A** need energy, for the process / to move phospholipids moving, phospholipids / named, against the concentration gradient / to area with higher quantity / AW **;** to allow conformational change (of enzyme) **;** **I** active transport but **R** if described as movement across the membrane	**1**
2(f)(ii)	*any **one** from*: actively transport / pump, Ca^{2+} / calcium ions, out of cell (once entered) **;** transports Ca^{2+} / calcium ions, (out) against the concentration gradient **;** cell surface membrane impermeable to, Ca^{2+} / calcium ions **;** no / very few, transport / pump / carrier / channel, (membrane) proteins **;** *context is for entry of calcium ions*	**1**

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Question	Answer	Marks
2(f)(iii)	*any **three** from:* **1** scramblase, activated / becomes active / begins functioning / AW **;** *context is, increase in Ca^{2+} / when Ca^{2+} binds* **A** Ca^{2+} increases, more scramblase binds to Ca^{2+} **ora** scramblase, suppressed / inactive (only), in low Ca^{2+} concentration **2** scramblase moves, PC from outer to inner layer **or** PE / PS, from inner to outer layer **;** **I** scramblase randomly moves, PC / PE / PS **3** described effect on, distribution / organisation / asymmetry / AW (of phospholipids in cell surface membrane) **;** e.g. becomes, disrupted / disorganised / more random is uncontrolled / not regulated becomes more, symmetrical / even / evenly balanced higher proportion of, PC in inner layer higher proportion of, PE / PS, in outer layer (than normal) *(idea that the phospholipids are in the incorrect location)* **4** scramblase activity higher than activity of, flippase / floppase **or** *idea that,* flippase / floppase, action cannot counteract effect of scramblase **;** **5** ATP runs out, qualified **;** e.g. to maintain asymmetry for (increased), flippase / floppase, activity to move phospholipids (against their gradient) **6** AVP **;** e.g. Ca^{2+} is, a cofactor / needed for scramblase function	**3**

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Question	Answer	Marks
3(a)(i)	*if DNA or thymine stated within response, allow <u>only</u> H-bond mark (**ecf**)* *any **two** from:* (paired section) contains, complementary nucleotides / complementary bases / base pairs **;** adenine-uracil <u>and</u> guanine/cytosine **; A** A/U and G/C (paired by) hydrogen / H, bonds **; I** strong (bonds) **ecf** from mp1 **R** if another bond also named **I** phosphodiester bonds between, adjacent / AW, nucleotides	**2**
3(a)(ii)	*any **two** from:* (enzyme / Drosha / Dicer) active site is specific (to site on dsRNA) **;** *can apply in context of specific shaped active site or active site specific to a particular location* detail of different active sites of Drosha and Dicer **;** site to be cleaved / AW, (only), fits into / can bind with / is complementary to (the specific) active site forms enzyme-substrate complex at a particular site Drosha and Dicer require different, conditions / cell locations, to function **;** AVP **;** e.g. *suggestion that* Dicer too large to enter nucleus Drosha exposed to degradation in cytoplasm	**2**

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Question	Answer	Marks
3(b)	*any **two** from:* mRNA is single-stranded <u>and</u> siRNA is double-stranded **;** **A** polynucleotide / chain, for strand siRNA has paired and unpaired nucleotides **or** mRNA has, only unpaired nucleotides / no base pairing **;** mRNA codes for a, sequence of amino acids / protein **; ora** for siRNA mRNA has a longer sequence of nucleotides **;** **A** mRNA, is longer / has more nucleotides AVP **;** e.g. *ref. to* siRNA antiparallel / mRNA only 5' to 3' mRNA has no H bonds	**2**
3(c)(i)	*any **one** from:* RISC must, align with / attach to / form H bonds with, (target) mRNA **;** (passenger strand needs to be, separated / released) to allow guide strand to, be exposed / bind to mRNA **;** AW **ora** e.g. (otherwise) guide strand cannot bind to mRNA passenger strand prevents guide strand binding guide strand has complementary sequence to target sequence of mRNA **;** **ora** passenger strand does not ….	**1**

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Question	Answer	Marks
3(c)(ii)	*allow protein for polypeptide* *points need the correct context of cleaved mRNA* *any **three** from:* *no protein formed* **1** *idea that* mRNA may be degraded in cell before attaching to ribosome **;** **2** mRNA may not (be able to) attach to ribosome so no, polypeptide formed / translation **;** **3** cleaved mRNA results in loss of start, sequence / codon **;** *abnormal polypeptide formed* **4** polypeptide chain is not released from ribosome **;** **A** cleaved mRNA results in loss of stop codon **5** polypeptide chain degraded within cytoplasm / AW **;** **6** cleaved mRNA results in short(er) (polypeptide) chain being produced **;** **7** polypeptide does not, fold up / form correct tertiary structure / form correct 3D shape **; I** tertiary structure changes **8,9** AVP **;** e.g. (results in) different R-group interactions / change in number of bonds that can form active site / site of activity, changed / lost	**3**

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Question	Answer	Marks
4(a)	bronchus **;**	**1**
4(b)(i)	alveolus **;** **A** alveolar sac / alveolar duct	**1**
4(b)(ii)	<u>smooth muscle</u> (cell) **;**	**1**
4(b)(iii)	*any **three** from:* no cartilage **;** **A** no, cartilage rings / C-shaped cartilage **A** no, irregular cartilage / cartilage plates few / no, goblet cells **; ora** trachea / bronchus, have (more) goblet cells thin layer / patches / areas, of smooth muscle **; ecf** from (b)(ii) **A** idea of quantity of smooth muscle less (than in, trachea / bronchus) thin(ner) wall **;** (more) convoluted / wavy, lumen lining **;** AW e.g. folded / curvy **A** lumen lining not smooth less, elastic, tissue / fibres, (than, trachea / bronchus) **;** AVP **;** e.g. ciliated epithelium not, pseudostratified / layered appearance *in context of the trachea / larger bronchi* no mucous glands present	**3**

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Question	Answer	Marks
4(c)	*any **two** from:* *allow O_2 for oxygen and CO_2 for carbon dioxide* systemic circulation (needed) to bring, oxygen / glucose, and pulmonary circulation brings deoxygenated blood **;** *idea that* lungs are location, of gas exchange (surface) / where absorption of oxygen occurs / where excretion of carbon dioxide occurs **or** pulmonary circulation for, oxygen uptake / carbon dioxide excretion **;** cells need, oxygen / glucose, for (aerobic) respiration / for cell metabolism / AW **;** **R** body cells	**2**

Question	Answer	Marks
5(a)(i)	microtubules **;**	**1**
5(a)(ii)	*any **two** from:* *ref. to* (daughter) chromosomes at poles **;** **R** move to poles **I** ends **A** (sister) chromatids at poles **A** two separate groups of (daughter) chromosomes **A** two nuclei form (enclosing chromosomes) **I** there are two nuclei **R** if in context of cell dividing *in context of at each pole, so* **R** *if context implies only a single nucleus* nuclear envelope, reassembles / (re-)forms / AW (around chromosomes) **;** **A** nuclear membranes reassemble nucleolus / nucleoli, reappear(s) / re-form(s) **;** (daughter) chromosomes, become diffuse / become long and thin / decondense / uncoil **;** **A** become chromatin **I** chromosomes disappear spindle, disassembles / AW **;** **A** spindle breaks down *accept ref. to microtubules in a correct context*	**2**

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Question	Answer	Marks
5(b)	*any **three** from:* two structural features named **;** valves *do not count as a feature if described as semilunar* tunica, externa / adventitia **A** outer layer with collagen tunica media **A** middle layer with smooth muscle and elastic tissue thin wall large lumen (relative to wall thickness) *feature matched to function* *valve **I** semilunar* to, prevent backflow / help blood move back towards the heart / help move blood in one direction **;** *tunica, externa / adventitia* contains collagen / thick(est) layer / outer layer, to protect / prevents collapse (from external forces) / helps to maintain shape **;** AW *tunica media* smooth muscle, for (mechanical) support / to change diameter of lumen / to help move (low / zero, pressure) blood back towards heart **;** elastic fibres to accommodate changes in, blood volume / lumen diameter **;** **A** allows, vein / blood vessel, to, stretch / recoil **R** stretch and recoil to prevent bursting *thin walls with large lumen* holds large(r), volume / quantity / amount, of (low / zero, pressure) blood **I** more blood **or** (large lumen) *ref. to* minimises / reduces, resistance (from walls) **;**	**3**

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Question	Answer	Marks
6(a)	*any two features for sink = 1 mark* leaf is a sink when it is growing it is, immature / young / developing / new **A** before it is mature it is not (yet) photosynthesising / cannot make its own sugars / cannot make its own organic compounds / named receives, assimilates / photosynthates / organic compounds / named it needs energy(-containing compounds) *any two features for source = 1 mark* leaf is a source when it is mature / not young / developed photosynthesising / synthesising assimilates / AW translocating assimilates / described e.g. provides assimilates / named, to, other parts of the plant / sinks **I** starch if other correct named, otherwise **R** *one mark if only 1 correct feature for sink and 1 correct feature for source*	**2**
6(b)	**B** = 2 **;** **C** = 4 **;** **D** = 3 **;** **E** = 1 **; A** 2 **A** 1 and 2	**4**

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