CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

© Cambridge University Press & Assessment 2024

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.

© Cambridge University Press & Assessment 2024

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.

© Cambridge University Press & Assessment 2024

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.

© Cambridge University Press & Assessment 2024

This mark scheme will use the following abbreviations:

;	separates marking points
/	separates alternatives within a marking point
()	contents of brackets are not required but should be implied / the contents set the context of the answer
R	reject
A	accept (answers that are correctly cued by the question or guidance you have received)
I	ignore (mark as if this material was not present)
AW	alternative wording (where responses vary more than usual, accept other ways of expressing the same idea)
AVP	alternative valid point (where a greater than usual variety of responses is expected)
ORA	or reverse argument
underline	actual word underlined must be used by the candidate (grammatical variants excepted)
MAX	indicates the maximum number of marks that can be awarded
+	statements on both sides of the **+** are needed for that mark
OR	separates two different routes to a mark point and only one should be awarded
ECF	error carried forward (credit an operation from a previous incorrect response)

© Cambridge University Press & Assessment 2024

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>7 nm ; A a suitable range
A within the range 5 to 10 nm
unit must be shown</td><td>1</td></tr>
<tr><td>1(a)(ii)</td><td>one mark per row – name and letter must agree in row 3 – glycolipid and glycoprotein
If no rows are correct or one row is correct, mark by column to give max 2 if one or two columns are correct

<table>
<tr><th>component</th><th>function</th><th>letter on Fig.1.1</th><th></th></tr>
<tr><td>channel protein</td><td>facilitated diffusion
or
transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances
I named examples of each category</td><td>A</td><td>;</td></tr>
<tr><td>phospholipid</td><td>forms a bilayer
or
a role within bilayer
e.g. barrier to, water soluble / polar substances / ions
allows diffusion of, fat soluble / non-polar, substances
allows fluidity / provides stability / forms a hydrophobic core / AW</td><td>E</td><td>;</td></tr>
<tr><td>glycoprotein
A glycolipid</td><td>receptor for cell signalling</td><td>B
D</td><td>;</td></tr>
<tr><td>cholesterol</td><td>gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances
or
at low temperatures, maintains or increases fluidity / prevents close packing
A prevents hydrophobic ‘tails’ interacting at low temperatures
or
at high temperatures, stabilises the membrane / decreases fluidity</td><td>F</td><td>;</td></tr>
</table></td><td>4</td></tr>
</table>

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(b)(i)	*each organelle must be drawn in the cytoplasm and labelled for a mark* *max 2 if organelles are drawn correctly but not labelled or are not labelled correctly* *labels must clearly identify the organelles* **R** *any 3D drawings* mitochondrion with two membranes and at least one crista **;** rough endoplasmic reticulum with at least one cisterna (two lines close together) and ribosomes attached on the outside **;** **R** if any ribosomes completely inside the organelle smooth endoplasmic reticulum with at least one tube with no ribosomes **;** **A** RER and SER as labels **A** if RER or SER attached to nuclear envelope	**3**
1(b)(ii)	Golgi body / dictyosome **; A** Golgi, apparatus / complex *plus any **one** from:* modifies / processes, protein(s) / polypeptide(s) / lipid(s) **; A** any suitable type of modification or a description e.g. glycosylation / addition of sugars forming tertiary or quaternary structures packaging of proteins into (Golgi) vesicles **; I** transports AVP **;** e.g. forming lysosomes / cell wall enzymes assembled	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
2(a)	*any **three** from:* **1** water is a, good / universal / AW, solvent **;** **A** dissolves many substances / description of solvent action **A** solvent for / dissolves, (named) ions **and** (named) polar molecules **2** transport of one named substance for a correct reason **;** e.g. urea for excretion **3** high specific heat capacity **; A** a full description e.g. the amount of heat that must be added to, one unit of mass of the substance / 1 gram *or* 1 cm^3 of water, to increase the temperature by, one unit / 1 °C **4** so temperature of blood remains (fairly) constant / heat is dispersed throughout the body **;** *must be linked to mp**3*** **I** temperature of water is constant AVP **;** e.g. water is (di)polar	**3**
2(b)(i)	**P** - aorta **A** dorsal aorta **Q** - vena cava **; I** superior and inferior	**1**
2(b)(ii)	**1** aorta / **P**, transports / delivers / AW, oxygenated blood to the, organs / body / respiring tissues / systemic circulation **or** aorta / **P**, transports / AW, blood at high pressure to, organs / body / respiring tissues / systemic circulation **;** **2** vena cava / **Q**, transports / returns / AW, deoxygenated blood to the, right atrium / heart (from systemic circulation) **or** vena cava / **Q**, transports / AW, blood at low pressure to the, right atrium / heart **;** **A** vena cava / **Q**, collects blood from, veins / systemic circulation *alternative* **3** aorta / **P**, transports oxygenated blood and, vena cava / **Q**, transports deoxygenated blood **;** **4** blood in aorta to, organs / body / respiring tissues / systemic circulation, and blood in vena cava to, right atrium / heart **;**	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
2(b)(iii)	*closed* blood is contained within vessels **;** **A** at least three from heart, arteries / arterioles, veins / venules, capillaries *double* blood flows twice through the heart in, one / each, (complete), circuit/circulation (of the body) **;** **A** pulmonary circulation and systemic circulation **A** described	**2**
2(c)(i)	*any **two** from:* (blood at high pressure) will, burst / damage, capillaries **;** **A** cannot withstand high pressure capillaries have thin walls / capillary walls are composed of one (thin) layer of (endothelial) cells **;** **A** capillary walls are one cell thick **R** capillaries have cell walls *idea that a*t low pressure blood flows slowly to allow, exchange / diffusion, of substances (in capillaries) **;** **A** efficient exchange (of substances) AVP **;** e.g. *idea that* pressure will be low at venous end of capillaries so that tissue fluid is reabsorbed	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
2(c)(ii)	*any **three** from:* ***I** functions* *similarities* **1** (both have) endothelium / tunica intima **; A** tunica interna **2** both have) tunica media / <u>smooth</u> muscle **;** *differences* *muscular artery – accept **ora** for arteriole* **3** smaller lumen to wall thickness / ratio of wall thickness to lumen width is smaller **;** **A** thicker wall **; I** artery is 'bigger / thicker / wider', unqualified **4** wider lumen **;** **5** more <u>smooth</u> muscle (layers) / thick (layer) v thin (layer), <u>smooth</u> muscle **;** **A** thicker tunica media **6** more / presence of, elastic, fibres / tissue **;** **A** no elastic lamina **7** more / presence of, collagen (fibres) **;** **8** AVP **;** e.g. *ref. to* blood vessels in wall of artery (vasa vasorum) e.g. no vesicles in endothelium e.g. artery has, tunica externa / adventitia **A** tunica externa not (clearly) visible in arteriole	**3**
3(a)	(insect) vector / *Anopheles* / (a) mosquito **;** *Plasmodium, falciparum* / *ovale* / *malariae* / *vivax* **; A** *knowlesi* *Vibrio cholerae* **and** cholera **;** **A** other pathogens and associated diseases that are transmitted in the same way *Mycobacterium*, *tuberculosis* / *bovis* **;** airborne droplets / droplet infection / aerosol (infection) **;** **I** air droplets **I** water droplets from, coughing / sneezing **A** alternative transmission only if *Mycobacterium bovis* stated e.g. (eating) contaminated meat (from infected cattle) (drinking) contaminated milk (drinking) unpasteurised milk from contaminated, cows / cattle	**5**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
3(b)	*any **two** from:* tenofovir competes with, (activated / phosphorylated) adenine nucleotide / deoxyribose adenosine triphosphate / dATP, for active site / to prevent nucleotides being added to elongating chain **;** **A** (tenofovir acts as a) competitive inhibitor (of reverse transcriptase) tenofovir forms a phosphodiester bond to elongating DNA strand, but stops further reactions / AW **;** tenofovir has, no 3´ -OH so next nucleotide cannot form a phosphodiester bond / no (deoxy)ribose so cannot form phosphodiester bond **;** **A** pentose **R** sugar unqualified	**2**
3(c)(i)	20 (%) **; R** answers with decimal places	**1**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
3(c)(ii)	*there must be at least one statement or at least one explanation to gain max 4, otherwise mark to max 3* *any **four** from:* **1** supply, condoms / femidoms / dental dams / item(s) for protection during sex **;** **2** barrier to transmission during sexual intercourse **;** **3** *ref. to*, needle exchange schemes / other suitable support for intravenous drug (ab)users **; I** clean needles **4** decreases risk of sharing contaminated equipment / AW **;** **5** use, new needles / new syringes / sterilised equipment / AW, for medical procedures **; I** clean needles **6** decreases risk of transmission from contaminated blood **;** **7** provide testing for HIV, in high risk groups / to individuals at high risk **;** **8** for early diagnosis so newly infected people so can start drug treatment immediately **;** **8** test pregnant women for HIV / provide powdered milk to women who are HIV positive **;** **9** prevent women who are HIV positive passing HIV in breast milk **;** **10** prevent people who are HIV positive being blood donors / screen donated blood / heat-treat donated blood **;** **11** prevent people receiving blood infected with HIV, during blood transfusions / operations **;** **12** carry out contact tracing **;** **13** locate people who, are undiagnosed / may be HIV positive / should be offered test **;** **14** supply (named) drug(s) to people, living with HIV / who are HIV positive / pregnant women with HIV **;** **15** prevents HIV, spreading throughout the body / infecting more T-lymphocytes **; A** to reduce viral load **16** provide, education / information, about, HIV treatments / HIV transmission **;** **17** to raise awareness of ways to reduce infection / AW **; A** use of barrier methods during sex / safer sex **18** AVP **;** e.g. law to make it illegal to knowingly transmit the virus	**4**
4(a)(i)	**A** – ciliated epithelial (cell) **; R** ciliated epithelium **B** – goblet (cell) **;**	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
4(a)(ii)	**1** goblet cells / **B**, secrete / produce / release, mucus / mucin **;** **2** mucus, covers / AW, the (ciliated) epithelium to trap (named) particles **;** **or** *idea that* mucus prevents (named) pathogens reaching, epithelial cells / alveoli / gas exchange surface **; I** lungs **A** acts as a barrier to (named) pathogens **3** cilia / ciliated epithelial cells, move mucus (and trapped material), upwards / towards mouth / towards throat **or** pharynx / away from alveoli / away from gas exchange surface / away from lungs / out of the airways **;** **I** 'out of the lungs' / 'to be swallowed' unqualified / out of the respiratory system / out of the gas exchange system	**3**
4(b)(i)	9+2, pattern / arrangement / structure **;** composed of microtubules **;** AVP **;** e.g. *ref. to* dynein 'arms' / AW outer 9 are, pairs of microtubules / doublets, and central two are single	**2**
4(b)(ii)	*idea that* each cilium / structure **X**, is surrounded by cell (surface) membrane (so contents are inside the, cell / cytoplasm) **;**	**1**
4(c)	*must have either mp1 or mp2 or both to gain max 4, otherwise max 3* **1** (centrioles) make / organise, microtubules **; A** microtubular organising centre / MTOC **2** to form, the spindle / spindle fibres **;** **3** (during each cell cycle) each centriole, replicates / duplicates / forms two centrioles **;** **4** during, S phase / G2 phase **; A** before mitosis *mp4 is linked to mp3* **5** centriole pairs / centrioles, move to the (opposite) <u>poles</u> (of cell during prophase of mitosis) **;** **R** if incorrect phase **R** 'poles of nucleus' **6** centrioles, lengthen / shorten, the spindle fibres / microtubules **; I** 'contract'	**4**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
5(a)	*both units must be used at least once* *any **three** from:* **1** no transpiration when LVPD is 0 kPa **;** **2** (both) increase in transpiration rate until 2.5 kPa **;** **3** *H. annuus* rate remains constant between 2.5 and 3.0 kPa, *N. oleander* rate decreases slightly **;** **4** *H. annuus* has higher rate of transpiration (at all LVPDs) **; ora** for *N. oleander* **5** *H. annuus* has a higher rate of increase (between 0 and 2.5 kPa) **; A** steeper gradient **6** any comparative data quote from Fig. 5.1 **;** *must include figures and units from both axes <u>and</u> data must come from both species*	**3**
5(b)	*if a correct adaptation does not match the figure, allow ecf for the explanation Fig. 5.3* *any **four** from:* **1** three layers of thick-walled cells at, upper / lower, surface **;** **A** two layers of cells under epidermis / epidermis and (two layers of) hypodermis **2** reduces, diffusion of water vapour to atmosphere / cuticular transpiration **;** **A** increases the distance for water vapour to diffuse **3** no stomata on upper surface / stomata only on lower surface **;** **4** stomata not exposed to direct sunlight / AW **;** **5** (stomata in) pits / depressions / cavities / chambers / crypts / infoldings / grooves / AW (on lower side of leaf) **;** **6** creates humid atmosphere in, pit / AW *or* reduces the, diffusion / water potential, gradient (for water vapour) **;** **A** vapour pressure gradient **A** minimises effect of, external air currents / wind *Fig. 5.3 or Fig. 5.4* **7** thick walled epidermis **;** **8** reduces diffusion of water vapour through lower epidermis **;** **9** thick (waxy) cuticle (on epidermis / surface) **;** **10** reduces diffusion of water vapour through cuticle / reduces cuticular transpiration **; A** (waxy) cuticle is waterproof **11** (epidermal) hairs / trichomes (around stomata / fill pits) **;** **12** reduces air movement / traps still air / creates humid atmosphere / traps water vapour *or* reduces the, diffusion / water potential, gradient for water vapour **;**	**4**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
6(a)(i)	*any **two** from:* **1** (antigen-binding site / variable region) has a shape that is <u>complementary</u> to antigen **; A** tertiary / quaternary, structure **2** (antigen-binding site / variable region has) specific, sequence(s) of amino acids / primary structure(s) **;** **3** *idea that* different amino acids have different, R-groups / side chains, so give different, tertiary structures / shapes (for binding to antigens) **;** **4** AVP **;** e.g. correct *ref. to* epitope(s)	**2**
6(a)(ii)	*idea that* allows flexibility for binding (to antigens) **;** **A** at different angles for flexibility / allows variable region(s) to move	**1**
6(a)(iii)	*any **one** from:* *idea that* easier for macrophage to engulf, antibodies that have bound antigens / antibody-antigen complexes **;** facilitates / AW, destruction of pathogens 'marked' by antibodies **; A** *ref. to* opsonisation **I** stimulates phagocytosis of the pathogen, unqualified	**1**
6(b)	*any **two** from:* **1** removal of introns (from primary transcript) **;** **2** (after removal of introns) exons, are joined together, in different, sequences / combination(s) **; A** alternative splicing **3** not all the exons are used (in making the polypeptides) **; I** capping and poly-A tails	**2**

© Cambridge University Press & Assessment 2024

CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **May/June 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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

© Cambridge University Press & Assessment 2024

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.

© Cambridge University Press & Assessment 2024

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.

© Cambridge University Press & Assessment 2024

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

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(a)	*any **two** from:* **1** (by) contracts / contracting / contraction, and, relaxes / relaxing / relaxation **;** *must be in context of bronchioles* **R** if includes *ref. to* stretch / expand / recoil **R** if in context of *bronchus or trachea (then ecf in subsequent mps)* **2** diameter / lumen size, can be, controlled / changed **;** AW **A** contraction, decreases diameter (of lumen) / constricts **A** relaxation (after contraction) increases diameter (of lumen) / widens / dilates / expands **R** vasoconstriction / vasodilation **3** *idea of,* controls / regulates, flow of air / volume of air flowing **;** AW **I** statements such as 'lets air in' / 'allows inhalation and exhalation' **A** oxygen in / carbon dioxide out, *instead of air flow* **R** oxygen out and carbon dioxide **4** AVP **;** e.g. contract to, reduce air movement / prevent entry of contaminants *idea of* normally relaxed but can, contract / cause constriction, when needed *max 1 if response relates function to inhalation and exhalation* *0 marks if incorrectly stated as <u>elastic tissue or elastic fibres</u>*	**2**
1(b)(i)	stage micrometer / stage micrometer scale **;**	**1**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(b)(ii)	yes, qualified **;** e.g. 0.2 mm = 200 μm 0.2 mm / smallest student can see, is less than 0.25 mm 250 μm = 0.25 mm 250 μm / cell length, is longer than 200 μm the cell is 50 μm longer (than 0.2 mm) the cell is 0.05 mm longer (than 0.2 mm) *allow if converted to standard form* (2×10^{-4} v 2.5×10^{-4} m) *must have units* *must include numerical values*	**1**
1(c)(i)	*any **two** from:* wall, of one layer / is one cell thick **;** **I** capillary is one cell thick **A** thin wall / endothelial cells are a single layer **A** endothelium is, a single layer (of cells) / one cell thick *idea that* red blood cells transported in single file **;** *idea that* red blood cells diameter (approximately), as large / same, as capillary (lumen) **;** **A** if diameter (e.g. 7μm) stated as being similar to capillary size *idea of* diameter of capillary narrower than smooth muscle cell **;** AVP **;** e.g. no muscle and elastic layer muscle fibres / elastic fibres / collagen, not present *ref. to* different shapes of red blood cell / red blood cell showing flexibility, to pass through (narrow) capillary	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(c)(ii)	*allow tissue fluid / fluid surrounding cells, instead of (smooth muscle) cells* *allow, blood / plasma, for capillary* *allow O_2 for oxygen and CO_2 for carbon dioxide* *any **three** from:* *capillary function* **1** named, substance / type of substance, that is supplied to smooth muscle cells or is a product removed from the cells **;** e.g. (supply) oxygen / nutrients / glucose / amino acids / cell-signalling molecule e.g. (removes) carbon dioxide / lactic acid / waste **A** exchange of respiratory gases (between capillary and cells) **I** plasma proteins into tissue fluid *structure to function* **2** thin wall / AW, so short distance **;** **R** capillary is thin **3** endothelial pores / fenestrations, for more efficient passage / AW **;** **A** gaps, between / within, (endothelial) cells (of capillary wall) **A** increases, quantity / rate of supply (of substances) **A** endothelial pores for formation of tissue fluid (around cells) **R** if blood leaves to make tissue fluid **4** (endothelial) pores / AW, for passage of, phagocytes / monocytes / macrophages / neutrophils **;** **5** small (size) / narrow diameter, to reach cells / so (all) cells are close **;** **A** value in range 5–10 μm **A** small size / narrow lumen, slows (rate of) blood flow **6** detail about red blood cell and, respiratory gases / gas exchange / oxygen / carbon dioxide **;** e.g. narrow lumen slows red blood cell movement for uptake of oxygen slows red blood cell movement to increase time for exchange of gases only one red blood cell fits (at a time) so short diffusion distance red blood cells are close to (muscle) cells for gas exchange red blood cells squeeze through, (so) distance for oxygen to reach cells is minimised	**3**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(d)(i)	(a gene mutation is a) change in the sequence of base pairs in a DNA molecule **;** **A** change in the DNA, base / nucleotide, sequence **I** change in RNA base sequence **I** names of mutations codes for / may result in / results in / AW, an altered / a different / a changed, polypeptide **;** **A** protein / amino acid sequence / primary structure, *for polypeptide*	**2**
1(d)(ii)	*any **two** from:* differences owing to, RNA / gene, splicing **; A** primary transcript for RNA **A** *ref. to* alternative splicing **R** DNA splicing **R** mutation occurring during gene splicing (differences occur during) removal of, introns / non-coding sequences **;** **R** if introns described as bases / nucleotides / codons **R** different number of introns removed / some introns remain exons / coding sequences, detail **;** e.g. joined differently / in a different combination in middle (of transcript), removed / not included for repeating sequence, removed / not included (so) messenger RNA / mRNA, formed is different **;**	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(d)(iii)	*allow ref. to binding sites as plural* **I** *ref. to* active site(s) *any **one** from:* (still have) similar, tertiary structure / binding site shape **;** **A** similar 3D shape **R** same **A** *idea of* binding sites still complementary to attach to (the) proteins removed amino acids are not structural amino acids **;** removed amino acids are not part of binding site **;** **A** description R-group interactions (still) the, same / similar **;** AVP **;** e.g. idea of more than one binding site and only, one / a few, changed **A** same type of binding site, but a different number	**1**

© Cambridge University Press & Assessment 2024

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

<table>
<tr><th>cell structure</th><th>function</th></tr>
<tr><td>nucleolus ;</td><td>manufactures ribosomal subunits from proteins and ribosomal RNA</td></tr>
<tr><td>smooth endoplasmic reticulum ;
R endoplastic</td><td>synthesises triglycerides and other lipids</td></tr>
<tr><td>pair of centrioles ;
R centrosomes</td><td>organise microtubules of the cell cytoskeleton</td></tr>
</table></td><td>3</td></tr>
<tr><td>2(a)(ii)</td><td>structures should be labelled and drawn with enough detail not to be mistaken for another structure

all three correct = 2 marks
one or two correct = 1 mark
all three structures correctly drawn but no labels = 1 mark

• roughly spherical organelle within the nucleus labelled as nucleolus

• minimum of one single membrane-bound tubular sac labelled as, smooth endoplasmic reticulum / smooth ER / SER
R if dots (ribosomes) drawn and resembles RER

• two, short lines or cylinders, not parallel to each other labelled as (pair of) centrioles
R if inside the nucleus</td><td>2</td></tr>
</table>

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
2(b)(i)	*allow, M. tuberculosis / pathogens / bacteria, for bacterial cells* endocytosis occurs / described **;** e.g. (macrophage cell surface) membrane, surrounds / AW, bacterial cells pseudopodia, surrounds / form round / AW, bacterial cell (alveolar) macrophage / phagocyte / (phagocytic) cell, envelops / engulfs, bacterial cells **;** event occurring before <u>or</u> after **;** *e.g. before* *ref. to* chemotaxis / chemotactic response bacterial cells / bacteria / (bacterial) antigens, bind / attach / join / AW, to (macrophage cell surface), receptors / membrane **I** binding to, macrophage / cell *suggestion of* (in alveolar space) opsonisation of /antibody binding to, bacterial cells *e.g. after* membrane fusion / (phagocytic), vacuole pinches off / AW **A** vesicle for vacuole	**2**
2(b)(ii)	lysosomes / lysosome **;** **A** lysosomal vesicles	**1**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
2(c)	*any **four** from:* **1** cells are replicating / AW (because live vaccine) **;** **2** high / increased / AW, levels of (non-self / foreign) antigen (because live vaccine) **;** **3** (so) strong / effective / good / AW, (primary) immune response **;** **A** described e.g. (T-/B-) memory cells are formed *idea that* memory cells present when *Mycobacterium* infects / AW secondary response occurs when *Mycobacterium* infects / AW **4** provides (artificial) active immunity **;** **R** natural active immunity **5** (so) boosters not needed (to build sufficient immunity) **;** **6** vaccine does not cause, disease / TB (because, weakened / attenuated) **;** **I** doesn't show symptoms **7** easy to, transport / store / deliver (because freeze-dried) **;** **8** AVP **;;** e.g. effective against *M. tuberculosis* and *M. bovis* no / few / mild, side effects, so people not discouraged (from having vaccine) memory cells / immunity, (relatively) long-lived / long-lasting only need one dose (good immunity for most individuals) provides herd immunity *(a consequential effect)*	**4**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
3(a)	*any **three** from:* active site with a specific shape as part of a lysozyme molecule drawn and active site labelled or included in an annotation **;** complementary shaped peptidoglycan drawn <u>and</u>, peptidoglycan / **s**ubstrate, labelled or included in an annotation**;** enzyme-substrate complex drawn <u>and</u> labelled **;** lysozyme with same shaped active site and, two products / NAM and NAG drawn (formed from hydrolysed peptidoglycan) **;** AVP **;** e.g. water shown enzyme active site labelled 'lock' and substrate labelled 'key' *max 2 if no ref. to specific example e.g. label for lysozyme **or** peptidoglycan **or** murein **or** the products NAG and NAM* *max 1 no labels but otherwise clearly lock and key* ***or** by gaining the enzyme-substrate complex mark if induced fit drawn*	**3**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
3(b)	*allow murein for peptidoglycan* *must attempt similarities and differences to gain max* *any **three** from:* *similarities, both* **1** cause cell, lysis / bursting **;** **I** ref.to destroying / killing, bacteria (both) **2** detail **;** e.g. weaken / destroy / AW, cell wall act on peptidoglycan cell wall cell wall cannot withstand turgor pressure / AW *differences* *(lysozyme is, a protein / an enzyme / a catalyst, but)* **3** penicillin is, an antibiotic / an enzyme inhibitor / a beta-lactam **;** *(lysozyme hydrolyses, glycosidic bonds / peptidoglycan molecules, but)* **4** penicillin, inhibits transpeptidase(s) **;** **A** peptidase(s) **5** penicillin, prevents formation of / AW, peptide / cross, bridges / linkages **;** **R** penicillin breaks cross bridges **A** *ref. to* autolysins e.g. 'cannot repair holes made by autolysins' **6** penicillin only effective when cell is, growing / synthesising cell walls, but lysozyme effective, at all stages / AW**;** **7** AVP **;** e.g. lysozyme (much) larger molecule *ref. to* lysozyme denatured v penicillin less affected by heat *idea of* lysozyme more affected by factors affecting enzyme **A** examples lysozyme globular v penicillin contains (beta-lactam / 4-member) ring	**3**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
4(a)	*allow points from correctly labelled diagram* (monomers of) beta-glucose / β-glucose **;** **R** α-glucose / two β-glucoses *plus any **two** from:* *max 1 if no monomer stated* (joined by) 1, 4 glycosidic bonds **;** **A** 1,4 glucosidic bonds **R** 1,4 and 1,6 bonds each (β–) glucose rotated by 180° compared to adjacent (β–)glucose **;** AW linear / straight, chain / molecule**;** unbranched **;**	**3**
4(b)(i)	*any **one** from:* increases rate of translation of, enzyme / nitrate reductase **;** increases, enzyme / nitrate reductase, synthesis / concentration **;** **A** more nitrate reductase produced *idea of* more metabolically efficient **;** e.g. enzyme only produced when needed AVP **;** e.g. more nitrate is reduced to nitrite / more nitrite is formed leads to increased supply of nitrite for amino acids / amino acid synthesis	**1**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
4(b)(ii)	*any **two** from:* improves accuracy of results / results not by eye / results not subjective **;** **A** detects smallest change in, (intensity of) colour / concentration / quantity provides quantitative results **/** obtain numerical values **;** **A** described e.g. absorbance values / can measure absorbance/ gives percentage transmission / absorbance readings *idea that* different, intensities / shades of, colour / magenta / red-purple, relate to different, quantities / concentrations, of nitrites **;** **A** relate to (rates of) nitrate uptake can produce calibration curve (for quantitative results) **;** AVP **;** e.g. can detect, (very) low concentrations / faintly coloured samples	**2**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
4(c)(i)	*accept hydrogen ions / H^+, for protons* *max 3 if no ref. to amino acids* *any **four** from:* **1** protons, moved by active transport / pumped, out of (companion) cell **;** **A** using, energy / ATP *for active transport* **2** protons, moved into / enter / AW, cell wall / apoplast **;** **R** if moved out to phloem sieve tube **3** proton gradient builds up in, apoplast / cell wall **;** **A** higher concentration **A** high concentration if mp4 gained **4** protons move back (into companion cell), by facilitated diffusion / AW **;** e.g. down, electrochemical / concentration, gradient from high(er) to low(er) concentration **A** diffuse *if movement is described through a transport protein in mp5* **5** protons cotransport amino acids **or** amino acids move with protons through, a cotransporter / a cotransport protein / (amino acid) transporter **;** **6** amino acids, transported / AW, against their concentration gradient **;**	**4**
4(c)(ii)	plasmodesmata present **;** **A** movement is down the, concentration / diffusion, gradient **A** because there is a high(er) concentration in the companion cell **ora** for phloem sieve tube (sap)	**1**

© Cambridge University Press & Assessment 2024

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(d)</td><td>0.2 mmol dm^{-3} constant rate v 5.0 mmol dm^{-3}, rate not constant / described ;

0.2 mmol dm^{-3} lower rate than 5.0 mmol dm^{-3} ; ora 5.0 mmol dm^{-3} higher rate
A faster / slower, rate for higher / lower, rate
A (overall) steeper rate / less steep rate

calculated rates to support ;</td><td>2</td></tr>
<tr><td>4(e)</td><td>any four from:

1 (experiments suggest mainly) active transport / active uptake ;
A uptake, is an active process / needs energy / needs ATP
if mp8 given, allow ‘active transport and facilitated diffusion’

2 comparison of experiments with control, any one ;
<table>
<tr><th>expt</th><th>discussion point</th></tr>
<tr><td>1</td><td>oxygen required for (complete) uptake A aeration required
or
almost no /AW, uptake, with no oxygen / in anaerobic conditions</td></tr>
<tr><td>2</td><td>almost no / AW, uptake, in, low temperature / at 3°C
or
uptake, higher / AW, at 30°C / in control</td></tr>
<tr><td>3</td><td>proteins / enzymes, are, required for / involved in, uptake
or
(much) lower / AW, uptake when, proteins not synthesised / protein synthesis inhibitor present</td></tr>
<tr><td>4</td><td>slightly lower / very similar, uptake / AW, without any bacteria
or
slightly higher / very similar, uptake / AW, with bacteria (control)</td></tr>
</table>
3 one comparative result / manipulated data, with units, to support mp2 ;</td><td>4</td></tr>
</table>

© Cambridge University Press & Assessment 2024

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(e)</td><td>

<table>
<tr><th>experiment</th><th>experiment v control</th><th>or</th><th>lower by</th><td rowspan="5">only needs to state control value once somewhere in response</td></tr>
<tr><td>1</td><td>0.4 v 10.9 μmol g^{-1}</td><td rowspan="4"></td><td>10.5 μmol g^{-1}</td></tr>
<tr><td>2</td><td>0.6 v 10.9 μmol g^{-1}</td><td>10.3 μmol g^{-1}</td></tr>
<tr><td>3</td><td>1.4 v 10.9 μmol g^{-1}</td><td>9.5 μmol g^{-1}</td></tr>
<tr><td>4</td><td>10.0 v 10.9 μmol g^{-1}</td><td>0.9 μmol g^{-1}</td></tr>
</table>

discussion points

4 aerobic respiration needs oxygen **;**

5 lower temperature means lower activity of enzymes involved in respiration **;**

6 *ref. to* ATP (for active transport) **;**
e.g. (aerobic) respiration produces ATP
less respiration means less ATP produced
no ATP for, conformational change / AW (of carrier protein)

7 some (facilitated) diffusion because some uptake without oxygen **;**

8 protein synthesis needed for transport proteins **;**
A membrane / transport / carrier / channel, proteins not being synthesised
A no protein synthesis so less ATP synthase

9 effect of lower temperature on transport **; ora** for control
e.g. reduces rate of (facilitated) diffusion
affects, ATPase / carrier protein, for active transport
transport proteins less efficient at low temperature

10 bacteria will have, little / no, effect on uptake
or
(normally) bacteria (associated with roots), increase / help, nitrate uptake **;**

11 AVP **;** e.g. idea that nitrate uptake involves metabolic processes

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

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
5(a)	coiling / supercoiling / condensation / becomes more compact / AW **;** e.g. becomes shorter and fatter	**1**
5(b)	**I** *ref. to* homologous chromosomes to describe the chromosomes in Fig. 5.1 *any **four** from:* each has two, sister / (genetically) identical, chromatids **;** **R** homologous (chromatids) joined by a centromere **;** each chromatid has a (single) <u>DNA molecule</u> **;** **A** 2 chromatids and 2 DNA molecules DNA associated with, histone proteins / histones / basic proteins **;** telomeres / repeating non-coding sequences, at ends of, chromatids / chromosomes **;** AVP **;** e.g. chromosomes, highly / most, condensed	**4**

Question	Answer	Marks
6(a)	<u>human immunodeficiency virus</u> **;**	**1**
6(b)	*max 1 if no mention of benefit of ART* *any **two** from:* helps to, increase / maintain / AW, number of, T-,lymphocytes / T-helper cells **;** **A** helps to prevent death of T-lymphocytes / AW **A** T-cells maintains / improves / AW, strength of, immune system / immune response **;** increases chance of recovery from, infectious / opportunistic, disease **;** AW *idea that* decreases risk of having / helps prevent, other (opportunistic) diseases **;** AVP **;** e.g. (can) decrease viral load / reduce number of HIV	**2**
6(c)(i)	**X** is positioned <u>above</u> the join on the coronary artery on, left-hand side of Fig. 6.1 / right heart **;** **R** if placed at the junction of the vein and artery	**1**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
6(c)(ii)	can withstand high(er) blood pressure / less likely to burst **;** **R** collapse **A** *idea that* blood pressure is now higher (so) blood vessel may last longer **;** **A** otherwise unlikely to last a long time (in tunica media) more (smooth) muscle / thicker (smooth) muscle layer / more elastic fibres **;** detail **;** e.g. helps, onward movement / faster flow, of blood / AW **A** otherwise does not have enough, (smooth) muscle / elastic fibres, for onward movement / required speed of flow, of blood thicker tunica, externa / adventitia **;** **A** more collagen	**2**

© Cambridge University Press & Assessment 2024

CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

© Cambridge University Press & Assessment 2024

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.

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.

© Cambridge University Press & Assessment 2024

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

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(a)(i)	capsid **;** **A** capsomere **A** protein coat	**1**
1(a)(ii)	RNA / DNA **;** *(actual is RNA)* **I** viral **R** dsRNA / dsDNA / mRNA / tRNA / rRNA	**1**
1(b)(i)	50 (nm) **;** **A** 50 / 52.5 / 55 / 57.5 / 60 nm working showing use of correct formula, A = I / M **;** *length* **X**–**Y** */ ÷ magnification*	**2**
1(b)(ii)	ability to distinguish between two points **;** AW	**1**
1(c)	malaria is transmitted by *Anopheles* (rather than *Aedes*) **;** *plus any **two** from:* *max 1 if incorrect context stated for malarial transmission* both are transmitted by vectors **;** both are transmitted by mosquitoes **;** both, are blood-borne diseases / vectors feed on blood **;**	**3**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
1(d)(i)	*max three if no correct ref. within response to, memory cells / immunological memory* **A** T- / B-cells, for, T- / B- lymphocytes *any **three** from*: **1** proteins are, non-self / foreign, antigens **;** **2** proteins / antigens, stimulate a primary immune response **;** **3** T-lymphocyte / B-lymphocyte, binding / recognition / clonal selection / activation / described in terms of receptor **;** **4** clonal expansion / cell divides by mitosis to produce a clone / AW ; **5** formation of memory, (T- / B-) lymphocytes **;** *mps 3, 4, 5 in context of primary immune response* **6,7** further detail **;** e.g. (artificial) active immunity (T- / B-) memory cells, remain in, circulation / the body, for a long time **or** memory cells are long-lived (for secondary response) larger numbers of lymphocytes (specific to Zika virus) greater chance of encountering, Zika virus / pathogen / antigens secondary immune response is, stronger / faster (than primary immune response) faster production / higher concentration, of (specific) antibody (so) person does not have symptoms of disease when infected with (actual) Zika virus	**4**
1(d)(ii)	*any **two** from:* *ref. to* herd immunity **;** **A** a large proportion of the population is immune (to Zika virus disease) **;** detail**;** e.g. *context is less likely / less chance of / less risk of* people without immunity / unvaccinated people, less likely / unlikely, to be in contact with an infected person **ora** infected person unlikely to be in contact with a non-immune person *idea of* increased chance of breaking the transmission cycle AVP **;** e.g. can achieve a high percentage cover if R_0 high, greater percentage of population need vaccinating **ora**	**2**

Question	Answer	Marks
2(a)	*max 1 in molecule section if mps from collagen fibre included as features of a molecule* *max 1 in fibre section if mps from molecule included as features of collagen fibre* ***or*** *if polypeptide described in molecule section and all features in fibre section are descriptive for a collagen molecule* *any* ***five*** *from*: *molecule (to max 4)* **1** three, helical / AW, polypeptides / chains **I** quaternary structure **or** triple helix **;** **2** (helical chains) tightly wound **;** **3** hydrogen bonds between, polypeptides / chains **;** **4** (generally) every third amino acid (in each, polypeptide / chain) is glycine **;** *fibre (to max 4)* **5** cross links / covalent bonds , between molecules **;** **6** molecules arranged in parallel **;** **7** molecules (in fibril / fibre) are, staggered / ends not aligned **/** AW **;** **8** AVP **;** e.g. detail of H bonds collagen fibre can be composed of collagen fibrils made of (parallel) collagen molecules glycosylated (amino acids in polypeptide) / hydroxylated	**5**
2(b)(i)	α-glucose / alpha glucose **;**	**1**
2(b)(ii)	label to glycosidic bond labelled **G ;**	**1**
2(b)(iii)	$NH_2CH_2CHCH_2CH_2$ circled and labelled **R ;**	**1**
2(c)	correct named tissue or structure **;** e.g. blood vessels / cartilage / bone / ligaments / skin / tendons (is/are) weaker / deformed / easily broken / AW **;** **A** description of how function is affected	**2**

© Cambridge University Press & Assessment 2024

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>
<table>
<tr><th>feature</th><th>artery</th><th>capillary</th><th>vein</th></tr>
<tr><td>smooth muscle</td><td>✓</td><td>X</td><td>✓</td></tr>
<tr><td>endothelium</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>tunica media</td><td>✓</td><td>X</td><td>✓</td></tr>
</table>
; ; ;
one mark per correct row
if 0 or 1 mark, check columns to allow max 2</td><td>3</td></tr>
<tr><td>3(b)(i)</td><td>labelled arrows for
oxygen, leaving alveolar space / entering capillary lumen
and
carbon dioxide, leaving capillary lumen / entering alveolar space ;</td><td>1</td></tr>
<tr><td>3(b)(ii)</td><td>any four from:

1 blood arriving (in alveolar capillaries), is deoxygenated / has low(er) partial pressure of oxygen ;
A low, concentrations / levels, of oxygen or oxygen-poor

2 oxygen taken up by haemoglobin (from plasma) / formation of oxyhaemoglobin ;

3 idea that newly oxygenated blood is, constantly / continually, removed ;
A oxygenated blood passed to pulmonary vein
A oxygen that diffuses, from alveoli / into blood, is transported away (by blood flow)
4 (because of) many / large network of capillaries ; context is alveolar capillaries

5 ventilation / breathing / inhalation and exhalation / AW, qualified ;
e.g. allows (more) oxygen in (to alveolar space)
idea of constantly replaces alveolar air

6 AVP ; e.g. ventilation maintains a large concentration difference between alveolar space and capillary</td><td>4</td></tr>
<tr><td>3(c)</td><td>pulmonary vein ;

semilunar ; A aortic <u>and</u> pulmonary

coronary ;</td><td>3</td></tr>
</table>

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
4(a)	*Max 3 for suberin, max 3 for lignin* *any **four** from*: **1** lignin / suberin, is, hydrophobic / (partially) impermeable to water / AW **;** e.g. waterproof / barrier to water *suberin* **2** suberin found in, Casparian strip / endodermal cells / endodermis **;** **3** water must move from apoplast (pathway) to, symplast (pathway) / cytoplasm (at endodermis) **;** **4** allows control of solutes / AW, before entering, endodermal cells / xylem **;** **A** helps to prevent, toxins / bacteria / AW, entering xylem *in context of mp3* *lignin* **5** lignin found in, cell walls of xylem vessel elements / walls of xylem vessels **;** **A** xylem / vessel, elements **6** *idea of* lignin / lignified wall, prevents water leaving xylem **/** loss of water from xylem **;** **7** lignified walls, prevents, (inward) collapse of / compression of / AW, xylem **;** **R** bursting **8** provides strength / secondary thickening, for (structural) support (of xylem) **;** **9** AVP **;** e.g. *ref. to* lignin as part of endodermis adhesion of water molecules to hydrophilic parts of lignin prevents collapse of water column **/** AW lignification causes death of xylem vessel elements *context of producing empty xylem vessels for transport*	**4**

© Cambridge University Press & Assessment 2024

Question	Answer	Marks
4(b)	*max 4 if no reference to laccase / monolignols* *allow substrate(s) for monolignols* *any **five** from*: **1** laccase uses induced fit **;** **2** *idea that* active site shape not fully complementary to (shape of) monolignols **;** **3** active site changes shape to, fit / bind to, monolignols **;** AW **4** becomes fully <u>complementary</u> **;** **5** forming enzyme-substrate complex **;** **6** lowers, activation energy / energy of activation**;** **7** suggestion of how activation energy is lowered **;** **8** laccase returns to original shape, after product leaves active site / for re-use / AW **;** **9** AVP **;** e.g. *suggestion that,* copper ions are, cofactors / necessary for enzyme action *suggestion that* monolignols are held in place by (temporary) H bonds	**5**
5(a)	*any **two** from*: cells secrete ligands **or** transport of ligands, through blood / in circulatory system **;** ligands bind to (complementary / specific) <u>receptors</u> **;** *context of target cells* (binding) sets off reactions within the (target) cell / triggers secondary messengers / sets off an enzyme cascade **;** **A** cyclic AMP for secondary messengers	**2**
5(b)	(non-competitive inhibitor) binds to, allosteric site / site other than active site / AW **;** (binding causes) change in shape of active site **;** active site no longer complementary to the substrate / AW **;**	**2**
5(c)(i)	Palbociclib / p21Cip1 **;** (in S phase), stops DNA replication occurring / DNA replication occurs **or** identical /sister, chromatid formed in S phase **;** **A** *idea of* p21Cip1 disrupts normal DNA replication (in S phase)	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(c)(ii)</td><td><u>RO-3306</u>, qualified
1 cell cycle stops (in G_2) after mitochondria have, divided / increased in number
or
mitochondria, divide / increase in number, in (G1 and) G2 / before mitosis ;
A no, mitosis / cytokinesis, so numbers of mitochondria remain high

2 idea that DNA replication will have occurred / sister chromatids will have formed, in S phase, but the cell cannot carry out mitosis ;</td><td>2</td></tr>
<tr><td>5(d)</td><td>cell cycle is stopped before, mitosis / cytokinesis / cell division ;

idea of stops uncontrolled cell division (increasing tumour size) ;</td><td>2</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>6(a)</td><td>must have correct matching information about mRNA <u>and</u> DNA

any three correct (rows) from:
<table><tr><th>mRNA</th><th>DNA</th></tr><tr><td>one strand / single-stranded / one polynucleotide chain</td><td>two strands / double-stranded / two polynucleotide chains ;
A double helix</td></tr><tr><td>RNA, bases not paired / base pairing not present</td><td>DNA base pairing present ;</td></tr><tr><td>ribose (sugar)</td><td>deoxyribose (sugar) ;</td></tr><tr><td>uracil, (adenine, cytosine, guanine) (base(s) / nucleotide(s))</td><td>thymine, (adenine, cytosine guanine) (base(s) /nucleotide(s)) ;</td></tr><tr><td>shorter / fewer nucleotides</td><td>longer / more nucleotides ;</td></tr></table></td><td>3</td></tr>
<tr><td>6(b)(i)</td><td>P <u>and</u> B ;</td><td>1</td></tr>
<tr><td>6(b)(ii)</td><td>C <u>and</u> G ;
held together by three hydrogen bonds (same as the artificial base pairs) ;</td><td>2</td></tr>
</table>

© Cambridge University Press & Assessment 2024