



Cambridge International AS & A Level

BIOLOGY**9700/23**

Paper 2 AS Level Structured Questions

October/November 2020

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 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **20** printed pages.

PUBLISHED**Generic Marking Principles**

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

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

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

GENERIC MARKING PRINCIPLE 2:

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

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

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

GENERIC MARKING PRINCIPLE 4:

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

PUBLISHED**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.

6 Calculation specific guidance

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

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

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

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

7 Guidance for chemical equations

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

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

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
<u>underline</u>	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
I	ignore

Question	Answer	Marks															
1(a)	<p><i>one mark per row</i> A if names and labels reversed</p> <table border="1" data-bbox="338 352 1599 815"> <thead> <tr> <th data-bbox="338 352 804 448">description</th> <th data-bbox="804 352 1223 448">name of part of gas exchange system</th> <th data-bbox="1223 352 1599 448">label from Fig. 1.1</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 448 804 549">supported by incomplete (C-shaped) rings of cartilage</td> <td data-bbox="804 448 1223 549">trachea</td> <td data-bbox="1223 448 1599 549">B ;</td> </tr> <tr> <td data-bbox="338 549 804 649">lined by ciliated epithelium and supported by blocks of cartilage</td> <td data-bbox="804 549 1223 649">bronchus A bronchi</td> <td data-bbox="1223 549 1599 649">C / J ; A C and J</td> </tr> <tr> <td data-bbox="338 649 804 718">lined by squamous epithelium</td> <td data-bbox="804 649 1223 718">alveolus / alveoli</td> <td data-bbox="1223 649 1599 718">M ;</td> </tr> <tr> <td data-bbox="338 718 804 815">lined by ciliated epithelium, but not supported by cartilage</td> <td data-bbox="804 718 1223 815">bronchiole(s) I terminal / respiratory</td> <td data-bbox="1223 718 1599 815">H ;</td> </tr> </tbody> </table>	description	name of part of gas exchange system	label from Fig. 1.1	supported by incomplete (C-shaped) rings of cartilage	trachea	B ;	lined by ciliated epithelium and supported by blocks of cartilage	bronchus A bronchi	C / J ; A C and J	lined by squamous epithelium	alveolus / alveoli	M ;	lined by ciliated epithelium, but not supported by cartilage	bronchiole(s) I terminal / respiratory	H ;	4
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1(b)	<p>A mutagen(s) / carcinogen(s) ; A tar A named carcinogens B nicotine ; C carbon monoxide ; D tar ; E nicotine ;</p>	5															

Question	Answer	Marks														
2(a)	<p><i>award mp1 and mp8 anywhere in each section of the answer</i></p> <p><i>cell B - mesophyll cells</i></p> <p>mp1 photosynthesis / described ; e.g. conversion of carbon dioxide to sugars using light energy synthesis of complex organic compounds from inorganic compounds using light energy</p> <p><i>adaptation – mp2 and one from mp3 to mp7</i></p> <table border="1" data-bbox="338 552 1523 1214"> <tbody> <tr> <td data-bbox="338 552 902 651">mp2 chloroplasts / chlorophyll / chloroplast pigments</td> <td data-bbox="902 552 1523 651">to absorb light ;</td> </tr> <tr> <td colspan="2" data-bbox="338 651 1523 715">any one from:</td> </tr> <tr> <td data-bbox="338 715 902 778">mp3 large vacuole</td> <td data-bbox="902 715 1523 778">to keep chloroplasts at the periphery ;</td> </tr> <tr> <td data-bbox="338 778 902 842">mp4 starch grains</td> <td data-bbox="902 778 1523 842">as store of products of photosynthesis ;</td> </tr> <tr> <td data-bbox="338 842 902 1050">mp5 large / moist, surface / cell wall</td> <td data-bbox="902 842 1523 1050">for evaporation of water for <u>transpiration</u> (stream) ; A provides water for photosynthesis in context of water supply transpiration</td> </tr> <tr> <td data-bbox="338 1050 902 1114">mp6 thin cell wall</td> <td data-bbox="902 1050 1523 1114">gas exchange / diffusion of gases ;</td> </tr> <tr> <td data-bbox="338 1114 902 1214">mp7 isodiametric / (roughly) spherical shape</td> <td data-bbox="902 1114 1523 1214">prevents close packing / gives large air spaces ;</td> </tr> </tbody> </table> <p><i>cell C - sieve tube element</i></p> <p>mp8 transport / movement of, (named) sugars / (named) assimilates / photosynthates / organic substances ; A translocation</p>	mp2 chloroplasts / chlorophyll / chloroplast pigments	to absorb light ;	any one from:		mp3 large vacuole	to keep chloroplasts at the periphery ;	mp4 starch grains	as store of products of photosynthesis ;	mp5 large / moist, surface / cell wall	for evaporation of water for <u>transpiration</u> (stream) ; A provides water for photosynthesis in context of water supply transpiration	mp6 thin cell wall	gas exchange / diffusion of gases ;	mp7 isodiametric / (roughly) spherical shape	prevents close packing / gives large air spaces ;	5
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Question	Answer	Marks														
2(a)	<p><i>adaptation – any two from:</i></p> <table border="1" data-bbox="338 280 1464 1145"> <tbody> <tr> <td data-bbox="338 280 880 448"> mp9 peripheral / described, cytoplasm A 'at the edge' / 'thin layer' </td> <td data-bbox="880 280 1464 448"> allowing maximum, volume / space, for transport of, phloem sap / assimilates ; A less / little, resistance to flow / AW </td> </tr> <tr> <td data-bbox="338 448 880 616"> mp10 no nucleus / few organelles / little cytoplasm R 'no organelles' </td> <td data-bbox="880 448 1464 616"> allowing maximum, volume / space, for transport of, phloem sap / assimilates ; A less / little, resistance to flow / AW </td> </tr> <tr> <td data-bbox="338 616 880 715"> mp11 elongate / elongated (cells, so end to end) </td> <td data-bbox="880 616 1464 715"> to make (sieve) tubes ; </td> </tr> <tr> <td data-bbox="338 715 880 813"> mp12 plasmodesmata </td> <td data-bbox="880 715 1464 813"> (un)loading from / AW, companion cells / cell A ; I 'between cells A and C' </td> </tr> <tr> <td data-bbox="338 813 880 879"> mp13 sieve pores </td> <td data-bbox="880 813 1464 879"> A flow between sieve tube elements ; AW </td> </tr> <tr> <td data-bbox="338 879 880 978"> mp14 sieve plates </td> <td data-bbox="880 879 1464 978"> prevent, bursting / bulging ; A maintaining hydrostatic pressure </td> </tr> <tr> <td colspan="2" data-bbox="338 978 1464 1145"> mp15 AVP for C ; e.g. phloem proteins and defence against pathogens / sealing wounds e.g. cell walls with cellulose microfibrils that run around the cells and to prevent bursting </td> </tr> </tbody> </table>	mp9 peripheral / described, cytoplasm A 'at the edge' / 'thin layer'	allowing maximum, volume / space, for transport of, phloem sap / assimilates ; A less / little, resistance to flow / AW	mp10 no nucleus / few organelles / little cytoplasm R 'no organelles'	allowing maximum, volume / space, for transport of, phloem sap / assimilates ; A less / little, resistance to flow / AW	mp11 elongate / elongated (cells, so end to end)	to make (sieve) tubes ;	mp12 plasmodesmata	(un)loading from / AW, companion cells / cell A ; I 'between cells A and C'	mp13 sieve pores	A flow between sieve tube elements ; AW	mp14 sieve plates	prevent, bursting / bulging ; A maintaining hydrostatic pressure	mp15 AVP for C ; e.g. phloem proteins and defence against pathogens / sealing wounds e.g. cell walls with cellulose microfibrils that run around the cells and to prevent bursting		
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Question	Answer	Marks
2(b)	<p><i>mp1, 2, 4 and 6 needs idea of increases / more; this is not needed for mp3 and mp5</i></p> <p>any three from:</p> <p>1 increases surface area:volume <u>of cell</u> / increases surface area of (cell surface) <u>membrane</u> ;</p> <p>2 <i>idea of</i> more space for / increased area for / more, proton pumps / carrier proteins in context of moving protons ;</p> <p>3 pumping protons, from cytoplasm / into cell wall / into apoplast / AW ; A create / increase, proton / electrochemical / concentration, gradient</p> <p>4 <i>idea of</i> more space for / increased area for / more, <u>cotransporter</u> proteins / carrier proteins in context ;</p> <p>5 <u>cotransport</u> of sucrose / described, into companion cell / into transfer cell / into cell A / from mesophyll cell / from cell B ; A secondary active transport</p> <p>A <i>movement of sucrose <u>and</u> protons for cotransport</i></p> <p>6 more space for plasmodesmata (between cell A and cell C) ;</p>	3

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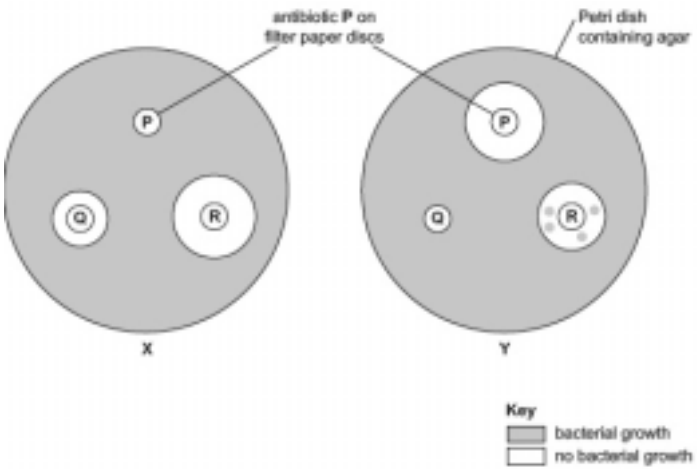
Question	Answer	Marks																
3(a)(i)	A – G1 / gap 1 ; B – S / synthesis ; A DNA replication I S1 / S2 / replication unqualified	2																
3(a)(ii)	telophase ;	1																
3(a)(iii)	<p><i>any two from:</i> increase in cytoplasm / increase in number of (named) organelle(s), <u>during interphase</u> ; A synthesis of organelles I cell growth</p> <p>(re)formation of <u>nuclear envelope</u> ; nuclear envelope, forms around each group of chromosomes ; A nuclear membrane as an ECF if used for mp2</p> <p>(movement of) organelles to be shared between two daughter cells ;</p> <p>spindle, disassembles / breaks down / degrades / disappears / AW ;</p> <p>cleavage furrow forms ; A cytoplasm / cell membrane, pinches in / constricts / infolds</p> <p>AVP ; e.g. (actin) microfilaments / microtubules, form contractile ring / AW, around equator of cell / beneath cell surface membrane A cytoskeleton for microtubules / microfilaments</p>	2																
3(a)(iv)	<p><i>one mark per row</i></p> <table border="1" data-bbox="338 1118 1308 1382"> <thead> <tr> <th></th> <th colspan="3">stages of cell cycle</th> </tr> <tr> <th></th> <th>A</th> <th>B</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>number of nuclei within the stem cell</td> <td>1</td> <td>1</td> <td>2 ;</td> </tr> <tr> <td>number of chromosomes in each nucleus</td> <td>12</td> <td>12</td> <td>12 ;</td> </tr> </tbody> </table>		stages of cell cycle				A	B	D	number of nuclei within the stem cell	1	1	2 ;	number of chromosomes in each nucleus	12	12	12 ;	2
	stages of cell cycle																	
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number of chromosomes in each nucleus	12	12	12 ;															

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Question	Answer	Marks
3(b)	<p>1 stem cells) continue to divide / divide repeatedly (by mitosis) ; A at least one daughter cell, retains ability to divide / is a stem cell / A 'repeated mitosis' / A 'to produce more stem cells'</p> <p><i>any two from mps 2-5: to produce cells</i></p> <p>2 for growth ;</p> <p>3 for repair of tissues ; R repair of cells</p> <p>4 for replacement of, worn out / old / dead, cells ; A damaged cells if repair of tissues not given</p> <p>5 to differentiate for formation of, tissues / organs ; A specialised cells for forming, tissue / organs</p> <p><i>and:</i></p> <p>6 AVP ; e.g. <i>ref. to potency of stem cells (multipotent or pluripotent)</i></p>	3

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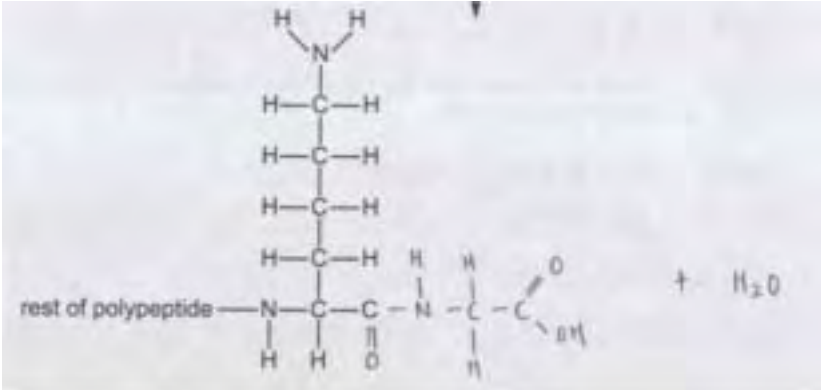
Question	Answer	Marks
4(a)(i)	<p>X – R and Y – P ;</p>	1
4(a)(ii)	<p>any two from:</p> <p>mp1 = resistance with ref. to P / Q / R Y, is resistant to Q / has no resistance to P ; A Y has some resistance to (antibiotic) R</p> <p>mp2 = antibiotics used at different concentrations (antibiotic) R may, have different concentration / be less effective, compared with P ;</p> <p>mp3 = reason for resistance ref. to gene(s) for resistance (on plasmids) or Y has, cell wall / cell membrane, that prevents entry of antibiotic Q or Y has enzyme that breaks down, Q / R ;</p> <p>mp4 = action of antibiotics idea that antibiotics have, different / specific, target(s) / AW ;</p> <p>A any example of process inhibited by antibiotic, e.g. cell wall synthesis transcription translation DNA replication cell surface membrane function synthesis of folic acid</p>	2

Question	Answer	Marks
4(a)(ii)	<p>mp5 = AVP ; e.g. <i>idea that P</i> may be bacteriocidal / (antibiotic) R is bacteriostatic e.g. <i>idea that</i> gene for resistance to antibiotic R passed by, vertical / horizontal, transmission</p>  <p>The diagram shows two Petri dishes, X and Y, containing agar. Each dish has three filter paper discs labeled P, Q, and R. In dish X, there is bacterial growth (grey shading) in the areas between the discs and around the edges, with distinct zones of inhibition (white) around each disc P, Q, and R. In dish Y, there is bacterial growth (grey shading) in the areas between the discs and around the edges, with zones of inhibition (white) around discs P and R, but no zone of inhibition around disc Q. A key below the dishes indicates that grey shading represents bacterial growth and white represents no bacterial growth. Labels include 'antibiotic P on filter paper discs' pointing to disc P in both dishes, and 'Petri dish containing agar' pointing to the agar in dish Y.</p>	

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Question	Answer				Marks
4(b)	<p>any three from: to award the MP1 to MP5 you must be able to see a difference between the two stated clearly</p>				3
	<i>vaccines</i>		<i>antibiotics</i>		
	1 (generally) are preventative / are not a treatment / are not a cure or use before a person, has an infection / is ill	v	are (generally) not preventative / are a treatment / are a cure or used when a person, has an infection / is ill ;		
	2 effective against bacteria and viruses (in context of different vaccines)	v	not effective against viruses / only effect against bacteria ;		
	3 <i>idea of indirect effect on pathogens</i>	v	<i>idea of direct effect on pathogens ;</i> A example of effect		
	4 not given as a course / give once or a few times (or with boosters)	v	given as a course / over many days / AW ;		
	5 specific for particular, pathogen	v	(most) antibiotics act on a range of pathogens ;		
	6 stimulate an <u>immune response</u>	or	do not stimulate an <u>immune response</u> ;		
	7 detail e.g. stimulate, (B- / T-) lymphocytes / production of antibodies A stimulates production of memory cells	or	do not stimulate, (B- / T-) lymphocytes / production of antibodies ; A no stimulation of memory cells		
	8 provide long-term, protection / immunity	or	do not provide long-term, protection / immunity ;		
	9 does not lead to resistance	or	may lead to resistance ;		
	10 time delay before being effective / AW	or	have effect, faster / sooner / AW ;		

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Question	Answer	Marks
5(a)(i)	<p>I presence or absence of water diagram shows bond between C (of lysine) and N (of glycine) and double bond to O shown correctly ; glycine drawn correctly ; R if R is used instead of H on glycine</p> 	2
5(a)(ii)	condensation ; A dehydration (reaction)	1
5(a)(iii)	<p>I high tensile strength any two from: allows close packing of, triple helix / three polypeptides ; A chains I tight coiling A 'binds more tightly' glycine, has smallest R group / R group of glycine is H / is smallest amino acid ; A glycine is small glycine, is <u>every third</u> amino acid in the, polypeptide / chain ;</p>	2

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Question	Answer	Marks
5(b)	<p>I collagen is insoluble / collagen is strong any four from:</p> <p>1 collagen, has high tensile strength / does not stretch / AW ; A withstands large pulling forces</p> <p>2 any ref. to use of collagen in the body ; e.g. (walls of) arteries or veins / tendons / cartilage / skin / basement membranes / around alveoli / bones / teeth I hair / R if any ref. to elastic(icity)</p> <p><i>three from</i></p> <p>3 triple helix has many hydrogen bonds between, polypeptides / chains ;</p> <p><i>mp4, 5, 6 and 7 – must be clear that answers are about molecules, but accept triple helix for molecule</i></p> <p>4 collagen molecules form, fibrils / fibres ;</p> <p>5 strong / covalent, (cross) links between molecules ;</p> <p>6 (ends of) molecules (in fibril / fibre) are staggered ;</p> <p>7 AVP ; e.g. (many) collagen molecules lie parallel</p>	4

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Question	Answer	Marks
5(c)	<p><i>induced fit</i></p> <p>1 active site changes shape ; A active site moulds round substrate A 'active site changes to fit the substrate (more closely)'</p> <p>2 (so) active site becomes (fully) <u>complementary</u> shape to collagen ;</p> <p><i>any four from</i></p> <p>3 formation of, <u>enzyme-substrate complex / ESC</u> ;</p> <p>4 lowering of activation energy ;</p> <p>5 breakage of peptide bond ;</p> <p>6 active site returns to, pre-ESC / original, shape and can be reused ;</p> <p>7 AVP ; e.g. <i>ref. to</i>, binding site / catalytic site (of active site) e.g. suggestion of how activation energy lowered, e.g. strain put on bond / alternative pathway</p>	5

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Question	Answer	Marks
5(d)	<p><i>description</i></p> <p>1 general description of effect of pH on activity ; e.g. as pH increases the activity increases and then decreases e.g. as pH increases activity reaches a peak e.g. use of data with unit for relative activity to describe increase and decrease (see next page)</p> <p>2 2 optimum pH is 7 ;</p> <p><i>explanation</i> any three from:</p> <p>3 partial denaturation in, acid and alkaline conditions / AW ; A 'starts to denature' as alternative to partial denaturation</p> <p><i>small changes either side of optimum</i></p> <p>4 (ionisable) R-groups in, active / catalytic, site affected ;</p> <p><i>large changes either side of optimum</i></p> <p>5 <u>hydrogen bonds</u> / <u>ionic bonds</u>, break / disrupted ;</p> <p>6 active site (shape) / (enzyme) tertiary structure, changes, so substrate / collagen, no longer fits into active site / fewer ESC complexes formed ; A fits less well <i>in context of partial denaturation</i></p> <p>7 AVP ; e.g. detail of R groups</p>	4

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Question	Answer	Marks
6(a)	<p><i>formula</i> (magnification =) $\frac{\text{size of image}}{\text{actual size}}$;</p> <p>A $M = I / A$ or $I = A \times M$</p> <p>A magnification triangle</p> <p>length of line X–Y = 30 mm (± 2 mm) / 30 000 μm = 3.0×10^{-2} m</p> <p>actual length = 150 μm / 0.15 mm = 150×10^{-6} m</p> <p><i>working</i></p> <p>length of the image (in m, mm or cm) divided by the actual size (A ± 2 mm) ;</p> <p>(x) 200 ; A answer in range 187 – 213</p>	3

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Question	Answer	Marks
6(b)	<p>1 endocytosis / phagocytosis ;</p> <p><i>two from</i></p> <p>2 particles / bacteria, reach end of, gullet / AW ;</p> <p>3 binding / fusion / attachment, (of bacteria / food particles) to, receptors / (cell surface) membrane ; I 'makes contact with'</p> <p>4 membrane engulfs, bacteria / food particles ;</p> <p>5 fusion of phospholipids / membrane fusion ;</p> <p>6 (phagocytic) vacuole / vesicle, pinches off from, surface / membrane ;</p>	3
6(b)(ii)	<p>I bulk transport</p> <p>1 fuse / bind, with, phagosome / food vacuole / phagocytic vacuole / phagocytic vesicle ; A food vacuole, etc. implied</p> <p>2 contain / add, hydrolytic / digestive, enzymes ; A hydrolases A description of one type of breakdown reaction catalysed by a lysosomal enzyme</p> <p>3 an example of hydrolase or enzyme ; e.g. protease / lipase / carbohydrase / nuclease / lysozyme</p>	3