Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS 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 **13** printed pages.

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Generic Marking Principles

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

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

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

GENERIC MARKING PRINCIPLE 2:

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

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

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

GENERIC MARKING PRINCIPLE 4:

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

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

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

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

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

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

7 Guidance for chemical equations

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

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

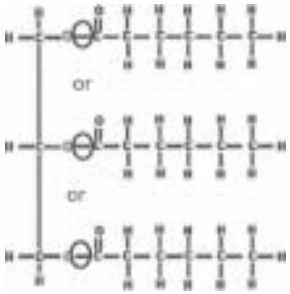
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Mark scheme abbreviations

;	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)
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
I	ignore

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Question	Answer	Marks
1(a)(i)	(sister) chromatids **;** centromere **;** histone **;**	**3**
1(a)(ii)	prophase / metaphase **;** **I** late / early **A** prometaphase	**1**
1(a)(iii)	**I** *ref. to* replication or cytokinesis *any **two** from:* provides energy **;** movement of centrioles to poles **;** spindle formation / organisation of microtubules (for spindle) **;** movement of chromosomes to the, spindle equator / AW **;** separation of, (daughter) chromosomes / (sister) chromatids, to opposite poles (of the cell) / during anaphase **;** AW AVP **;** e.g. (for) condensation / AW, of, chromatin / chromosomes	**2**
1(b)	*assume reference to binary fission unless stated otherwise* *any **two** from:* DNA replication **;** **A** *idea* of, doubling / duplicating, DNA cell, elongation / gets longer **;** **A** cell increases in size cell wall formation **;** (includes) cytokinesis / described **;** *max 1 if two ideas correct describing events that only occur in mitosis*	**2**

Question	Answer	Marks
2(a)(i)	circle around any one correct bond ; **R** if circle includes the double bond O  	**1**
2(a)(ii)	condensation ; **A** dehydration (synthesis) **A** esterification three ;	**2**
2(b)(i)	macromolecule <u>and</u> extracellular enzyme ;	**1**
2(b)(ii)	4 (hours) ;	**1**
2(b)(iii)	*any **four** from:* **1** triglyceride hydrolysis / action of lipase, produces <u>fatty acids</u> ; **2** decrease in pH / described, because of production of (fatty) acids ; **3** steepest rate of (pH) decrease at start because, substrate / triglyceride, concentration highest ; **4** rate of pH decrease / AW, slows because decrease in rate of formation of fatty acids ; **5** rate of pH decrease /AW, slows because enzymes, not at optimum / <u>begin to</u> denature ; **6** rate of pH decrease slows because, substrate / triglyceride, being used up **or** substrate concentration becomes a limiting factor / AW ; **7** *ref. to* plateau at 18 hours / at pH 6.1, enzymes are denatured ; **8** *ref. to* plateau at 18 hours / at pH 6.1, as all the, triglyceride / substrate, has been, hydrolysed / AW ; **9** optimum pH for lipase activity, is pH 8 / alkaline conditions / at the start ; **10** AVP ; e.g. *ref. to* tertiary structure of lipase	**4**

Question	Answer	Marks
2(b)(iv)	*any **two** from:* (initial) decrease in pH would be more rapid **;** plateau would be reached earlier **;** AW plateau would be at the same pH (as the previous experiment) **;**	**2**

Question	Answer	Marks
3(a)(i)	blood, travels through the heart twice for every one complete, circuit (of the body) / circulation **or** blood, travels through the heart twice and through pulmonary and systemic, circulations / systems / circuits **;** **A** description of both circulations	**1**
3(a)(ii)	chordae tendineae / tendinous cords **;** **A** tendons / 'heart strings' *any **two** from:* *idea that* (atrioventricular) valve, held in position / prevented from inverting, during ventricular, systole / contraction **;** **A** AV valve *for atrioventricular valve* connect the papillary muscle to the (atrioventricular / AV), valve **;** *ref. to* tension, in the chordae tendineae / AW, (during ventricular contraction) **;** (allows valve to) prevent backflow of blood into atrium / ensure one way blood flow (through the heart) **;** *ecf max 2 marks for function if structure A is a correctly named valve (atrioventricular / tricuspid / bicuspid)*	**3**

Question	Answer	Marks
3(b)(i)	*idea of* using both antibiotics makes sure all bacteria are killed **;** if, resistance against one antibiotic occurs then, the other antibiotic will be effective / bacteria still susceptible to the other antibiotic **or** if, some bacteria are less susceptible to one antibiotic, then, the other antibiotic will be effective / bacteria still susceptible to the other antibiotic **;** *any **one** from:* antibiotics / gentamicin and penicillin G, have different sites of action / AW **;** **A** suggestion of how the antibiotics have different ways of killing *ref. to* mutations, qualified **;** e.g. need two mutations to occur to be resistant to both antibiotics probability / AW, of these two mutations occurring in the same bacterium is very small mutations must be in different genes	**2**
3(b)(ii)	*any **three** from:* course of antibiotic is not completed **;** less susceptible bacteria survive **;** **A** not all bacteria destroyed replication / population growth, increases chance of mutation **;** *ref. to* random mutation, ref to gene / allele, for resistance to gentamicin **;** suggestion of outcome of different mutations **;** e.g. changed ribosome structure so gentamicin cannot bind enzyme to breakdown gentamicin *ref. to* transmission of allele for resistance **;** e.g. vertical transmission / described horizontal transmission / described (conjugation / transformation) e.g. frequency of allele for resistance increases in the population **;** *when antibiotic next prescribed* antibiotic in the environment is the selection pressure / resistant bacteria selected for / susceptible bacteria selected against **;**	**3**

Question	Answer	Marks
4(a)(i)	plasmodesmata **;**	**1**
4(a)(ii)	*any **two** from:* *ref. to* connecting two cells **;** *in context of connecting cytoplasm* (facilitate) movement of substances between cells **;** **A** named substances *ref. to* symplast pathway **;** cell to cell communication / passage of cell signalling molecules **;** AVP **;** e.g. removes the need to cross the partially permeable cell surface membrane (when moving between cells) increases the rate of movement of substances between cells	**2**
4(b)(i)	protein coat / capsid **;** DNA or RNA / nucleic acid **;** **A** genetic material ref. to some viruses have envelope **;**	**2**
4(b)(ii)	*allow sucrose for assimilates throughout* *any **five** from:* viruses / assimilates, enter via plasmodesmata ; movement / diffusion, of assimilates into (phloem) sieve tubes, lowers water potential / AW **;** (so) water enters, by osmosis / down water potential gradient / AW **;** hydrostatic pressure increases (at source) **;** **A** turgor pressure *for hydrostatic pressure* unloading at, sink / named sink, lowers hydrostatic pressure (at sink) **;** detail ; e.g. assimilates move out and water follows osmotically pressure gradient created / higher pressure in source (than sink) / lower pressure in sink (than source) **;** (so) mass flow**;** *term to be used in context* from source to sink **;** *allow mp if terms source and sink used in correct context within complete response* AVP **;** (viruses and assimilates travel) through sieve pores	**5**

Question	Answer	Marks
5(a)	*any **one** from :* (*when the air pressure lowers inside bronchus*) holds, bronchus / airway open **;** **A** supports, bronchus / airway **;** prevents, bronchus / airway, from collapsing **;**	**1**
5(a)(ii)	*idea that* (cartilage arranged as) incomplete / C-shaped, rings in the trachea **;** *idea of* more regular distribution (of incomplete rings) along the length of trachea **;**	**1**
5(a)(iii)	*max 1 if cilia or mucus linked to incorrect cell* (ciliated epithelial cells have) cilia, to, waft / sweep / AW, mucus, away / up the trachea / AW **;** (goblet cells that) secrete mucus to trap, dust / bacteria / pathogens **;**	**2**
5(b)(i)	the larger elephant has a smaller surface area to volume ratio **; ora**	**1**
5(b)(ii)	*any **three** from:* are multicellular / have many cells **;** need a large quantity of / enough, oxygen to supply, every cell / all parts of body **;** active so high demand for, oxygen / removal of CO_2 **;** diffusion across body surface is not fast enough (to meet needs) **;** AW long diffusion distance (so diffusion is not fast enough to meet needs) **;**	**3**
5(b)(iii)	*any **four** from:* three polypeptide chains **;** (three polypeptides) form triple helix **;** **A** coil around each other **R** *ref. to* alpha helix hydrogen bonds hold the three. polypeptides / strands. together **;** the three polypeptides, lie close together / form a tight coil / are tightly wound **;** every third amino acid (in the polypeptide chain) is glycine / many glycine-proline alanine repeats / many gly-pro-ala repeats **;** glycine is found on the inside of each, polypeptide / strand**;** AVP **;** e.g. detail hydrogen bonds, between peptide bond NH (of a glycine) and C=O group in adjacent polypeptide	**4**

Question	Answer	Marks
5(b)(iv)	*allow reference to collagen fibrils instead of collagen molecules, in correct context (collagen molecules form fibrils, which form fibres)* *any **one** from:* (many) collagen molecules lie parallel **;** *no weak points because* strong / covalent, (cross) links between molecules **;** (ends of) molecules (in, fibril / fibre), are staggered **;**	**1**

Question	Answer	Marks
6(a)(i)	*in context of mutations in genes* *any **two** from:* uncontrolled, (cell) division / mitosis ; cell cycle not regulated ; programmed cell death does not occur / cell becomes immortal ; uncontrolled growth not suppressed ; *ref. to* mass of abnormal cells ; AVP ; e.g. cell cycle checkpoints impaired proto-oncogenes become oncogenes tumour suppressor genes switched off	**2**
6(a)(ii)	*any **two** from:* *ref. to* change of a single, nucleotide / base (in sequence of DNA) **or** one base substitution (mutation) ; change in one, DNA triplet / mRNA codon ; *ref. to* tRNA with a different anticodon / tRNA brings a different amino acid ; idea that different primary structure leads to different tertiary structure ;	**2**

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Question	Answer	Marks
6(b)(i)	*any **three** from:* vaccination stimulates an immune response ; antigen presentation, qualified ; e.g. TSA engulfed by, phagocyte / named phagocyte antigen binds to, specific / complementary, receptor, on, T-lymphocyte / cytotoxic T cell / killer T cell ; clonal expansion ; **A** described e.g. divides by mitosis to form a clone (receptor on) cytotoxic T cell / killer T cell, binds to TSA on tumour cell ; release of, perforin / hydrogen peroxide (to kill tumour cell) ; **A** other named e.g. granzymes AVP ; e.g. causes lysis of the cell	**3**
6(b)(ii)	*advantage any **one** relevant e.g.* tumour cells may have more than one TSA **;** stimulate a specific immune response to each TSA **;** *idea that* TSA on patient's tumour cells has the appropriate antigen *idea that* personalised treatment so more effective *disadvantage any **one** relevant e.g.* high cost of personalised treatment **;** immune system may not recognise TSA on own body cell as, foreign / non-self , the cells in the tumour may not have the TSA in the vaccine **;** patient's tumour may not be large enough to obtain enough cells for treatment **;** patient needs surgery to obtain (large quantity of) cells **;** AVP **;** e.g. *suggestion that* tumour cell may settle in a part of the body and not be destroyed	**2**

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7 Guidance for chemical equations

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ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore

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Question	Answer	Marks
1(a)(i)	plasmodesmata **;** **I** cytoplasmic strands / cytoplasm **R** if other structures also given	**1**
1(a)(ii)	(existence of / down, a) water potential gradient **;** **I** *ref. to* solute / osmotic, potential **A** lower / more negative, water potential of (cell) **C** (than cell **B**) **A** higher / less negative, water potential of (cell) **B** (than cell **C**) **A** Ψ for water potential	**1**
1(a)(iii)	symplastic (pathway) **; I** vacuolar / vacuole, pathway **A** symplast	**1**
1(b)	*max 3 if no ref. to evaporation or water vapour and ref. only to water* *any **four** from:* **1** evaporation of water / water to water vapour **;** *must be in context of* **P** **2** **P** described as, surface / cell wall, of (spongy) mesophyll (cell) **;** **R** palisade mesophyll cell **A** film / layer, of moisture / water (for surface of cell) **3** water vapour enters (substomatal) <u>air space</u> **;** **R** <u>intra</u>cellular air space **A** other correct refs. to air space in sequence of events **4** <u>diffusion</u> of water vapour (out) through stoma / stomatal pore (to **Q**) **;** **R** through guard cells **R** diffusion by osmosis **5** (towards **Q** because) down <u>water potential gradient</u> / from high to low <u>water potential</u> / to lower <u>water potential</u> **;** **I** potential gradient alone **A** down (water) vapour pressure gradient **A** Ψ *for water potential* *context is movement out to atmosphere, <u>not</u> movement from* **P** *to air space* **6** AVP **;** e.g. stoma stated as open heat energy required for evaporation / *ref. to* latent heat of vapourisation air space described as, intercellular / saturated / substomatal	**4**

Question	Answer	Marks
1(c)	**1** correct formula **;** (magnification) = image length ÷ actual length **;** **A** rearranged formula **A** magnification triangle  **2** correct working **;** **3** correct answer for magnification **; R** if units given (×) 1440 (36 mm) / 1460 (36.5 mm) /1480 (37 mm) / 1500 (37.5 mm) 1520 (38 mm) / 1540 (38.5 mm) / 1560 (39 mm) **;** *if answer given to 2 sig. figs, look for the correct answer at the end of working* ***or*** *allow if stated by answer that this is to 2 sig. figs.* *allow ecf for incorrect conversions used in working or incorrect measured value of X–Y*	**3**
2(a)	*any* ***four*** *from:* **1** (in combination treatment) antibiotics (in Table 2.1), act at different targets / have different modes of action / AW **;** **A** comparison of any two antibiotics from Table 2.1 **A** suggestion of how two antibiotics have different ways of killing **2** *idea that* if resistance / mutation, occurs / exists, unlikely to be against all antibiotics / other antibiotics should still be effective **;** **3** (in combination treatment) if resistance / mutation, occurs / exists, all bacteria will (still) be, killed / destroyed / AW **;** **A** no bacteria remain to develop resistance / no reservoir of resistant bacteria **4** antibiotic resistance, not / less likely to be, spread to affect people because no bacteria surviving (with combination treatment) **;** AW **5** long treatment time / 6 months, with, combination treatment / AW, increases chance of killing all bacteria **or** long treatment time with a single antibiotic not effective in killing all bacteria if, resistance develops / a mutation occurs **;** **6** AVP **;** e.g. combination treatment (is likely to) eliminate bacteria more quickly (so less chance of resistance occurring) resistance to different antibiotics involves more <u>genes</u> so less chance of resistance occurring <u>gene</u> for antibiotic resistance has more chance of being passed on if using single antibiotic (and not all killed) ora if using single antibiotic (and not all killed) more chance of being passed on (to other bacteria) by horizontal / vertical / AW, transmission ora	**4**

Question	Answer	Marks
2(b)(i)	transcription **;**	**1**
2(b)(ii)	*any **three** from:* **I** stops transcription **1** alters shape of / blocks, active site **;** **R** enters / fits into, active site *as it is <u>not</u> competitive* **R** *ref. to* choice of competitive or non-competitive **A** alters shape of enzyme *only if mp2 gained* **2** substrate / nucleotides, cannot, bind to / enter, active site **;** **A** fewer / no, enzyme-substrate complexes / ESCs, form *allow ecf from mp1 if rifampicin described as, competitive / enters active site* **3** complementary (base) pairs / (complementary) base pairs, cannot form / form less easily (between DNA and RNA nucleotides) **;** **4, 5, 6** *(in context of rifampicin binding to RNA polymerase)* prevents / AW, unwinding of DNA (double helix) **;** **A** uncoiling **I** unzipping prevents / AW, attachment to DNA (strand) **A** prevents / AW, attachment to promoter prevents / AW, movement along DNA (strand) **;** prevents / AW, elongation (of polynucleotide) / formation of polynucleotide /nucleotides being joined **;** prevents / AW, phosphodiester bond formation **;** prevents / AW, proof reading **;** **7** AVP **;** e.g. prevents / AW, tRNA / rRNA, formation	**3**
2(c)(i)	Phe Tyr **;** *one mark for both correct*	**1**
2(c)(ii)	**B D F G ;** *in any order*	**1**

Question	Answer	Marks
2(c)(iii)	*resistance* **1** shape / tertiary structure, of, β-subunit / enzyme, altered / AW **;** **I** active site changes shape **A** quaternary structure of enzyme altered **2** rifampicin / antibiotic, cannot / does not, bind (as well) **;** AW **R** *if context is binding to active site* *different levels of resistances* *any **two** from:* **3** (because) other mutations are involved **;** AW **A** described from Table 2.1 e.g. **C** has 2 (other) mutations and **D** and **E** have 3 **4** mutations may result in different changes to, structure / shape of, β-subunit / enzyme, and result in different, effects / levels of resistance **;** **5** data from Table 2.2 to support mp 4 **;** *must be linked to concept of mp4* **6** AVP **;** e.g. *ref. to* different binding abilities (of rifampicin to enzyme) some (of the other) mutations may cause more of a change to binding site for rifampicin mutation(s) may make it harder to bind lower resistance = binds, more strongly / for longer time lower resistance = higher proportion of transcription events hindered e.g. idea that mutations still, produce functioning enzyme / allow catalysis to occur	**3**

Question	Answer	Marks
3(a)	irregular / plates / AW, of cartilage **;** **A** cartilage not C-shaped rings *other features* *any **two** from:* smooth muscle **;** elastic, tissue / fibres **;** mucous glands **;** thick wall / wall many layers **;** large lumen (relative to thickness of wall) **;** large size relative to surrounding alveoli **;** **I** surrounded by alveoli	**3**
3(b)	*evidence must match stated structure* blood vessel **;** *plus any **one** from:* presence of tunica media / circular layers of smooth muscle **;** three layers in wall **;** similar to structure on left, which has blood cells **;** not bronchiole, qualified **;** e.g. as no ciliated epithelium not rounded shape / no definite shape **OR** artery **;** **A** arteriole *plus any **one** from:* small lumen relative to thickness of wall **;** **A** small lumen with thick wall thick, tunica media / muscle layer **;** thick tunica externa **;** **OR** vein **;** *plus any **one** from:* no definite shape / not rounded / not oval / AW **;** large lumen relative to thickness of wall **/** large lumen and thin wall **;** thin tunica media **;**	**2**
3(c)	goblet cells, produce / secrete / AW, mucus to trap, pathogens / AW **;** **A** dust / dirt / particles etc for AW cilia, waft / moves / carries / push, mucus, to back of throat / AW **;**	**2**

Question	Answer	Marks
4(a)(i)	*any **three** from:* **I** heterochromatin / euchromatin envelope / two membranes / double membrane / inner and outer membrane **;** nuclear pores **;** **A** pores in nuclear envelope *for two marks* (outer surface of) outer membrane with ribosomes **;** *ref. to* (outer nuclear) membrane continuous with RER **;** **R** inner membrane AVP **;** e.g. perinuclear space **A** intermembranous space pore complexes	**3**
4(a)(ii)	*any **two** from:* resolution / resolving power, is, low / lower / poor / AW / 200 nm / 0.2 μm **;** (**A** range 100–300 nm) **A** electron microscope has a higher resolution further detail **;** e.g. ribosomes / ER, smaller than 200 nm can only see cell structures greater than (limit of) resolution cannot see structures smaller than 200 nm cell structures too small for the resolution (*needs ref. to resolution)* cell structures, too small to / do not, interfere with light waves **;** AW	**2**
4(b)	if letter used in more than one row, **R** these rows correct interphase knowledge G2 = **A**, S = **B**, G1= **blank ;** *cytokinesis* **blank ;** *prophase* **C ;** *anaphase* **E ;** *telophase* **D ;**	**5**
4(c)	*any **three** from:* *large numbers of B-lymphocytes / plasma cells (in primary immune response)* **1** large quantity of (specific) antibody, produced / released **or** (large quantity of) antibody to form antibody-antigen complexes / to bind antigen (for phagocytosis) / AW **;** *large numbers of memory B-lymphocytes so* **2** provide long term immunity / memory cells long-lived / provides immunological memory **;** **A** remain in, circulation (for a long time) AW **3** able to produce fast(er), secondary (immune) response **;** **A** second response will be fast(er) **A** immune response faster on second encounter (with antigen / pathogen) / AW **4** higher concentration / faster production, of antibodies (than primary response) **;** **I** 'more' alone **5** person does not have, symptoms / become ill (of / from, same disease) **;** **A** presence of same, pathogen / antigen, does not cause disease **6** AVP **;** memory cells can (divide to) produce plasma cells more plasma cells present than primary response able to form more memory cells	**3**

Question	Answer	Marks
4(d)	*any **two** from:* immune response / antibodies produced, against, self antigens **;** **I** immune system attacks self **A** autoimmunity / autoimmune disease *idea that* faulty B-lymphocytes not destroyed **;** **A** *ref. to* T-lymphocytes *if in correct context* (specific) antibody, binds to / acts on / AW, self-antigen / receptor, on the (cell surface membranes of) muscle cells / at neuromuscular junction **;** **A** antibody binds to acetylcholine receptors *ref. to* consequence to muscle cells **;** e.g.(nerve) impulse conduction impaired action of transmitter substance hindered	**2**

Question	Answer	Marks
5(a)	fructose **; I** α or β	**1**
5(b)	*any **two** from:* formation of enzyme-substrate complex / substrate fits into active site **;** **A** substrate binds to active site (so) reactants held close together (e.g. for bond formation) **;** lowers, activation energy / energy of activation **; A** Ea / Ae *can award annotated on a sketch* detail **;** e.g. transfer of electrons strain on bonds alternative pathway holds substrate in a way that the bonds needed to be broken are exposed	**2**
5(c)	**I** *ref. to* denaturation, either mp2 **or** mp10 can be awarded *any **four** from:* *immobilised* **1** higher optimum temperature **;** AW e.g. peak / max activity / 100% activity **;** **2** 74 / 75 / 76°C, v, 56 / 57 / 58 / 59°C **;** **A** one correct value and calculation e.g. 17°C lower **3** *idea that* greater range of pH with, higher activity / greater stability **;** AW *allow use of comparative data at one pH value to support if answer unclear* **4** *idea that* if pH changes, less effect on enzyme activity **;** **A** resists changes in pH **5** *ref. to* more active at, higher temperatures / temperatures above 68°C **;** **A** more thermostable / less effect on enzyme at higher temperatures **A** free enzyme not active above 70°C *allow use of comparative data at one temperature to support if answer unclear*	

Question	Answer	Marks
5(c)	**6** one advantage of immobilised **; e.g.** reusable o less / no, contamination of product (by enzyme) o easier, downstream processing / separation of enzyme from product o longer shelf-life useful if enzyme, difficult to obtain **A** *ref. to* cost effective o can use in continuous processes so more productive o suggestion that (can carry out process at) lower pH (more acid conditions and) may be more effective against microorganisms *free enzyme* **7** higher activity, at lower temperatures / between 35°C to 68°C **;** *in context of a range, quoting one temperature not enough* **8** two temperatures, comparative values for both enzymes to support mp7 **;** **9** optimum temperature lower so cheaper maintaining that temperature **;** AW **A** lower temperatures cost efficient to maintain and enzyme works well / AW **10** (values of optimum) 74 / 75 / 76°C, v, 56 / 57 / 58 / 59°C **;** **A** calculation, e.g. 17°C lower **11** lower optimum temperature still high enough to kill microorganisms **;**	
6(a)(i)	same shape <u>and</u> shift to the right **;** *must start to rise within 2 small squares of 0 and end at or near to existing curve*	**1**
6(a)(ii)	*max 2 if concept of more not mentioned in response* *any **three** from:* **1** actively respiring tissue means more carbon dioxide **;** **2** increase in, formation of carbonic acid **/** dissociation of carbonic acid / hydrogen ions, (in the red blood cell) **;** **A** from equation **3** more hydrogen ions, bind to haemoglobin / form haemoglobinic acid **;** **A** HHb **4** (causes) more oxygen (to be), unloaded / dissociated / AW (from haemoglobin)**;** **I** *ref. to* faster / quicker **I** incorrect *ref. to* affinity causing unloading, e.g. CO_2 **A** lower (percentage) saturation of haemoglobin with oxygen **A** oxygen released, more easily / readily from haemoglobin **5** haemoglobin <u>affinity</u> for oxygen decreases **;** **6** more oxygen to meet demand for (aerobic / cellular) <u>respiration</u> **;** AW **I** more oxygen for respiring tissues	**3**

Question	Answer	Marks
6(b)	CO_2 = (passive / simple) diffusion **;** HCO_3^- = facilitated diffusion **;** **I** *ref. to* size CO_2 is, non-polar / not charged / not ionic and can cross, hydrophobic core / phospholipid bilayer **;** HCO_3^- is, charged / ionic / hydrophilic and (needs to) cross, via, transport / carrier, protein **; A** channel protein *if explanation mps not gained,* allow 1 mark for CO_2 is, non-polar / not charged / not ionic and HCO_3^- is, charged / ionic / hydrophilic	**4**

Cambridge Assessment International Education

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.

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Generic Marking Principles

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

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

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

GENERIC MARKING PRINCIPLE 2:

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

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

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

GENERIC MARKING PRINCIPLE 4:

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

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	'List rule' guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

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

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

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

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

7 Guidance for chemical equations

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

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

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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)
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
I	ignore

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

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
award mp1 and mp8 anywhere in each section of the answer

cell B - mesophyll cells

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

adaptation – mp2 and one from mp3 to mp7
<table>
<tr><td>mp2 chloroplasts / chlorophyll / chloroplast pigments</td><td>to absorb light ;</td></tr>
<tr><td colspan="2">any one from:</td></tr>
<tr><td>mp3 large vacuole</td><td>to keep chloroplasts at the periphery ;</td></tr>
<tr><td>mp4 starch grains</td><td>as store of products of photosynthesis ;</td></tr>
<tr><td>mp5 large / moist, surface / cell wall</td><td>for evaporation of water for transpiration (stream) ;

A provides water for photosynthesis in context of water supply transpiration</td></tr>
<tr><td>mp6 thin cell wall</td><td>gas exchange / diffusion of gases ;</td></tr>
<tr><td>mp7 isodiametric / (roughly) spherical shape</td><td>prevents close packing / gives large air spaces ;</td></tr>
</table>
cell C - sieve tube element

mp8 transport / movement of, (named) sugars / (named) assimilates / photosynthates / organic substances ;
A translocation
</td><td>5</td></tr>
</table>

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Question	Answer	Marks
2(a)	*adaptation – any **two** from:*	

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)	*mp1, 2, 4 and 6 needs idea of increases / more; this is not needed for mp3 and mp5* *any **three** from:* **1** increases surface area:volume of cell / increases surface area of (cell surface) membrane **;** **2** *idea of* more space for / increased area for / more, proton pumps / carrier proteins in context of moving protons **;** **3** pumping protons, from cytoplasm / into cell wall / into apoplast / AW **;** **A** create / increase, proton / electrochemical / concentration, gradient **4** *idea of* more space for / increased area for / more, cotransporter proteins / carrier proteins in context **;** **5** cotransport of sucrose / described, into companion cell / into transfer cell / into cell **A** / from mesophyll cell / from cell **B** **;** **A** secondary active transport **A** *movement of sucrose and protons for cotransport* **6** more space for plasmodesmata (between cell **A** and cell **C**) **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(i)</td><td>A – G1 / gap 1 ;
B – S / synthesis ; A DNA replication I S1 / S2 / replication unqualified</td><td>2</td></tr>
<tr><td>3(a)(ii)</td><td>telophase ;</td><td>1</td></tr>
<tr><td>3(a)(iii)</td><td>any two from:
increase in cytoplasm / increase in number of (named) organelle(s), during interphase ; A synthesis of organelles
I cell growth

(re)formation of nuclear envelope ;
nuclear envelope, forms around each group of chromosomes ;
A nuclear membrane as an ECF if used for mp2

(movement of) organelles to be shared between two daughter cells ;

spindle, disassembles / breaks down / degrades / disappears / AW ;

cleavage furrow forms ;
A cytoplasm / cell membrane, pinches in / constricts / infolds

AVP ;
e.g. (actin) microfilaments / microtubules, form contractile ring / AW, around equator of cell / beneath cell surface membrane
A cytoskeleton for microtubules / microfilaments</td><td>2</td></tr>
<tr><td>3(a)(iv)</td><td>one mark per row
<table><tr><td></td><td colspan="3">stages of cell cycle</td></tr><tr><td></td><td>A</td><td>B</td><td>D</td></tr><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 ineach nucleus</td><td>12</td><td>12</td><td>12 ;</td></tr></table></td><td>2</td></tr>
</table>

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Question	Answer	Marks
3(b)	**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' *any **two** from mps 2-5:* *to produce cells* **2** for growth **;** **3** for repair of tissues **; R** repair of cells **4** for replacement of, worn out / old / dead, cells **;** **A** damaged cells if repair of tissues not given **5** to differentiate for formation of, tissues / organs **;** **A** specialised cells for forming, tissue / organs *and:* **6** AVP **;** e.g. *ref. to* potency of stem cells (multipotent or pluripotent)	**3**

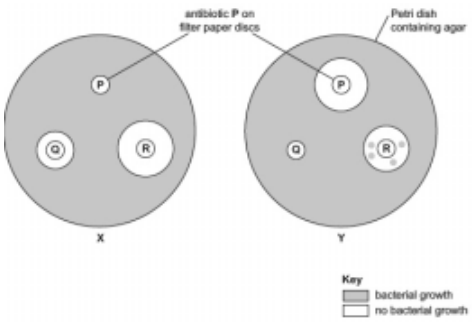
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Question	Answer	Marks
4(a)(i)	**X** – **R** *and* **Y** – **P ;**	**1**
4(a)(ii)	*any **two** from:* ***mp1** = resistance with ref. to **P** / **Q** / **R*** **Y**, is resistant to **Q** / has no resistance to **P ;** **A Y** has some resistance to (antibiotic) **R** ***mp2** = antibiotics used at different concentrations* (antibiotic) **R** may, have different concentration / be less effective, compared with **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 ;** ***mp4** = action of antibiotics* *idea that* antibiotics have, different / specific, target(s) / AW **;** **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	**2**

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Question	Answer	Marks
4(a)(ii)	***mp5*** = AVP **;** e.g. *idea that* **P** may be bacteriocidal / (antibiotic) **R** is bacteriostatic e.g. *idea that* gene for resistance to antibiotic **R** passed by, vertical / horizontal, transmission  	

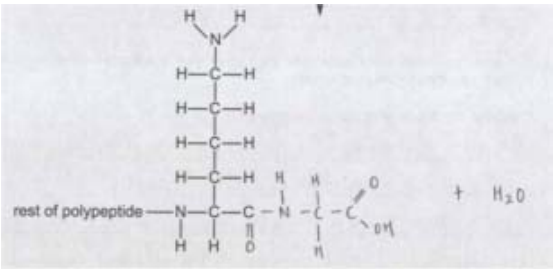
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Question	Answer	Marks
4(b)	*any **three** from:* *to award the MP1 to MP5 you **must be able to see a difference** between the two stated clearly*	**3**

	vaccines		*antibiotics*
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	*idea of* indirect effect on pathogens	**v**	*idea of* direct effect on pathogens **;** **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)	**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  	**2**
5(a)(ii)	condensation **;** **A** dehydration (reaction)	**1**
5(a)(iii)	**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 every third amino acid in the, polypeptide / chain **;**	**2**

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Question	Answer	Marks
5(b)	**I** collagen is insoluble / collagen is strong *any **four** from:* **1** collagen, has high tensile strength / does not stretch / AW **;** **A** withstands large pulling forces **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) *three from* **3** triple helix has many hydrogen bonds between, polypeptides / chains **;** *mp4, 5, 6 and 7 – must be clear that answers are about molecules, but accept triple helix for molecule* **4** collagen molecules form, fibrils / fibres **;** **5** strong / covalent, (cross) links between molecules **;** **6** (ends of) molecules (in fibril / fibre) are staggered **;** **7** AVP **;** e.g. (many) collagen molecules lie parallel	**4**

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

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Question	Answer	Marks
5(d)	*description* **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) **2** **2** optimum pH is 7 **;** *explanation* *any **three** from:* **3** partial denaturation in, acid **and** alkaline conditions / AW **;** **A** 'starts to denature' as alternative to partial denaturation *small changes either side of optimum* **4** (ionisable) R-groups in, active / catalytic, site affected **;** *large changes either side of optimum* **5** hydrogen bonds / ionic bonds, break / disrupted **;** **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 *in context of partial denaturation* **7** AVP **;** e.g. detail of R groups	**4**

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

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

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