Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

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.

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[Turn over

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.

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.

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Science-Specific Marking Principles

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

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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)	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**