Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

Paper 2 AS Level Structured questions **October/November 2021**

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 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level 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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Examples of how to apply the list rule: State three reasons … [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B

(4 responses)

1. Correct, Correct	✓ ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C

(4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓ ×	
3. Correct	ignore	

D

(4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	× (discount 2)	
3. Correct	✓	

E

(4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F

(4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G

(5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H

(4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I

(4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

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;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined 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

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>one mark max for each feature
<table>
<tr><th>feature common to bacterial and plant cells</th><th>bacterial cell</th><th>plant cell</th></tr>
<tr><td>cell surface membrane</td><td>contain hopanoids</td><td>contains cholesterol</td></tr>
<tr><td>ribosome</td><td>70S / smaller / 18-20nm
I no 80S ribosomes</td><td>80S / larger / 22-30nm ;
A and 70S</td></tr>
<tr><td rowspan="3">DNA
max 1 mark
must be across the dotted rows</td><td>circular / closed loop
I ref. to plasmids</td><td>linear ; AW</td></tr>
<tr><td>naked A no histones</td><td>(complexed) with, histones / (basic) proteins ;</td></tr>
<tr><td>free in, cytoplasm / cytosol
A not enclosed / AW, by nuclear envelope
A found in nucleoid region</td><td>enclosed by / AW, nuclear envelope ;

A in a nucleus</td></tr>
<tr><td>cell wall</td><td>(mainly composed of) peptidoglycan / murein</td><td>(mainly composed of) cellulose ;</td></tr>
</table></td><td>3</td></tr>
</table>

Question	Answer	Marks
1(b)	*any **three** from:* **A** particles *for substances* **I** *ref. to* size **1** for transport of ions <u>and</u>, hydrophilic / polar, molecules / substances AW **or** for transport of substances that cannot pass (directly) across the (phospholipid) bilayer / hydrophobic core **;** AW **R** if implied that all substances cannot cross the bilayer **I** substances, bypass / do not need, to cross the bilayer **2** carrier proteins for active transport and facilitated diffusion <u>and</u> channel proteins for facilitated diffusion **;** **3** further detail carrier protein **; I** water-filled / hydrophilic interior e.g. have specific binding sites are specific in, molecule / ion / named example, transported AW carry out conformational change (following binding) / AW use, ATP / energy active transport) moves substances against the concentration gradient / AW (active transport) moves substances down the concentration gradient / AW (facilitated diffusion) *accept once in mp3 or 4* **I** moves substances by diffusion **4** further detail channel protein **;** e.g. hydrophilic / water-filled, pore / channel **A** hydrophilic lining some, ion channels / proteins channels for ions, are selective (for size and charge) (most) channel proteins are not selective aquaporins for passage of (larger quantities of) water some, are gated / voltage-gated moves substances down the concentration gradient / AW	**3**

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Question	Answer	Marks
1(c)	**I** *ref. to* light absorption *any **one** from:* *chloroplasts at periphery because* pushed by vacuole **;** vacuole is, turgid / filled with cell sap **;** (large permanent) vacuole is in the centre (of the cell) **;**	**1**
1(d)	metaphase label to metaphase cell **;** prophase label to one of the prophase cells **;**	**2**

Question	Answer	Marks
2(a)	too large / large size **; A** not small enough cannot pass through endothelial, pores / gaps **I** holes **A** fenestrations / AW **or** cannot, pass across / cross the membranes of, endothelial cells **;** **A** epithelial cells *in context of entering an endothelial cell and exiting to the tissue fluid*	**2**
2(b)	biuret (solution / reagent) **;** **A** copper sulfate solution and, sodium / potassium, hydroxide (change from light) blue to, lilac / purple / violet / mauve **;**	**2**

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Question	Answer	Marks
2(c)	*accept Hb / hb for haemoglobin* *any **three** from:* **1** (at altitude) lower, partial pressure of oxygen / pO_2 (in, atmosphere / inhaled air / inspired air / alveolar air) **;** **I** low pO_2 in blood **R** if stated as high $ppCO_2$ and low pp O_2 **R** low, volume / saturation, of oxygen **2** percentage saturation of haemoglobin (with oxygen), lower / decreased **;** **A** haemoglobin is less saturated **A** fewer molecules of / less, oxygen, combine / associate, with haemoglobin **I** absorbed / taken up by **R** if in context of Bohr effect but then allow ecf for overall **max 2** **3** (as) haemoglobin has lower affinity for oxygen (than at sea level) **;** **4** more haemoglobin (synthesised / required / provided) **;** **5** compensation / described **;** e.g. helps to transport the same quantity of oxygen as at sea level **6** AVP **;** e.g. *idea of* more rbc through pulmonary capillaries per unit time *ref. to* EPO / erythropoietin (secreted to increase red blood cell production)	**3**

Question	Answer	Marks
2(d)	*any **three** from:* **A** Ψ for water potential **A** plasma for blood *mp1 and mp2 = consequence in blood of lower blood albumin than normal* **1** *idea that* low blood albumin means, less / AW, solute **;** **2** (so) higher water potential (in blood)**;** *must be in context of blood context can be anywhere along the capillary* **A** high water potential *if ref. to low albumin is made* **A** steeper water potential gradient (than normally, at arterial end) *mp3 and mp4 = return of water to blood from tissue fluid (capillary venous end)* **3** less steep water potential gradient (than normal) / little difference in water potentials **;** **4** less / little, water returns to, blood / capillary (from tissue fluid) **;** **A** (tissue) fluid *for water* **R** plasma *for water* *additional ideas* **5** *idea that* more, water / plasma / fluid, enters tissue fluid (than normal) **R** tissue fluid *for fluid* **A** more, water / fluid, enters tissue fluid than exits (to the capillary or lymph system) **;** *(compared to normal)* **6** AVP **;** e.g. water can enter tissue fluid for a longer time than normal less albumin than normal to act as an osmotic force for return of water / AW too much excess, water / fluid / tissue fluid, to be taken up into lymph, capillaries / vessels / system	**3**
2(e)	(cell surface) receptor(s) **;**	**1**

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Question	Answer	Marks
3(a)	*any **two** from:* *infectious* (baculovirus) is a pathogen / causative organism (of disease) **;** (baculovirus) is transmitted (from one insect host to another) / transmissible **;** *allow a description of transmission, e.g. transfer of, virus / pathogen, from, insect to insect / organism to organism* **I** spread **R** person to person / plant to plant *disease* *idea of* causing ill-effect on insect, e.g. causes, harm / damage / loss of functioning / ill health / death **; A** illness	**2**
3(b)	*any **two** from:* (highly) alkaline / acidic (conditions) **; A** (very) low / high, pH disruption of, hydrogen / ionic, bonds, of (polyhedron) proteins / polyhedrins **;** (presence of) digestive enzymes / hydrolytic enzymes / hydrolases **;** **R** if stated as within lysosomes *but allow detail of enzyme action ecf* detail **;** e.g. extracellular enzymes / proteases / peptidases peptide bonds broken **A** amide bond for peptide bond optimum pH **;** *must be in context of enzyme presence*	**2**

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Question	Answer	Marks
3(c)	if detail is linked to incorrect level of structure or levels of structure not named, **max 3** **1** primary structure detail **;** e.g. sequence of amino acids / ref. to sequence in Fig 3.1 (many) amino acids joined by peptide bonds **2** secondary structure detail **;** e.g. has, α / alpha, helices has β / beta, pleated sheets **A** β / beta, pleats has areas of random coils / AW **3** tertiary structure detail **;** e.g. interactions between, side chains / R groups (R group interactions are) H bonds, ionic bonds, hydrophobic interactions, disulfide bridges *any two* folding and coiling *in context of polypeptide chain* **4** quaternary structure detail**;** e.g. <u>three</u> (identical) polypeptide chains ref. to interaction of polypeptide chains **A** polypeptides *for polypeptide chains*	**4**
3(d)	*any **three** from:* *ref. to* <u>genetic code</u> **;** *in correct context* amino acids coded for by more than one codon / two or more codons for (most) amino acids **;** **A** triplet (of, bases / nucleotides) 64 codons and 20 amino acids **;** third base in codon can be different / only first two bases in codon are same **;** AVP **;** *idea that* amino acid sequence is only the result of exons / gives information only about introns only sure of sequence for, two amino acids / met and trp <u>degenerate</u> code / degeneracy of code **R** degenerative *ref. to* control sequences STOP codons (also) have more than one triplet (of bases) STOP codons do not specify amino acids	**3**

Question	Answer	Marks
4(a)	cohesion **;** adhesion **;**	**2**
4(b)(i)	*any **two** from:* **1** higher rate of transpiration during the day / lower rate of transpiration during the night / AW **;** **A** flow of xylem sap *for transpiration* **2** stomata are open during the day **; ora** *must be in context of transpiration* *if mp1 and mp2 not gained, allow one mark for idea that results are related to pattern of, light / daylight / day, and, dark / night (use an ordinary tick)* **3** *idea that* all three vines were kept in the same conditions so a changed condition that affects transpiration will affect all three **;** **A** all three vines have the same external factors acting that affect transpiration **4** AVP **;** e.g. (during daylight) stomata open, to obtain carbon dioxide / for photosynthesis *idea that,* increasing / decreasing, rate is related to degree of opening of stomata varying with light intensity	**2**

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Question	Answer	Marks
4(b)(ii)	*allow (xylem sap) flow rate for rate of transpiration* *any **two** from:* **1** the greater the (total) area of leaf, the higher the rate of transpiration **; ora** **A** grapevine 1 has largest leaf area and highest rate of transpiration *accept other comparisons* **R** *ref. to* SA:V but allow ecf in mp2 **2** the greater the (total) area of leaf, the more stomata are present **;** AW **A** more leaves means more stomata **3** detail of any one grapevine **;** e.g. grapevine 1 = highest transpiration rate and, highest number of / most, stomata grapevine 3 = lowest transpiration rate and, lowest number of / least, stomata *allow use of comparative data to support mp* *(if detail includes ref. to (total) leaf area then check to see if mp2 can also be awarded)* **4** *ref. to* relationship between (total) internal surface area and (total) leaf area **;** e.g. larger leaf surface area means internal surface area increased **5** *ref. to* relationship between internal surface areas and rates of evaporation **;** **6** AVP **;** higher rate of flow of xylem sap for largest leaf area as (overall) more water used in metabolism AW **ora** (greater area so) more leaves so more xylem vessels **ora**	**2**
4(b)(iii)	overcast / cloudy / rain / shade / AW **;** **A** lower wind speed / temperature **A** higher humidity **R** if described as stomata close (transpiration is still occurring)	**1**

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Question	Answer	Marks
4(b)(iv)	*valid method e.g.* draw around / place, leaf on, squared paper / graph paper / grids **;** **A** square ruler count number of (full) squares **; R** multiply by two / do it on other side method for part squares **;** e.g. add up all part squares and divide by 2 match a larger part square with a smaller and count as one square use graph paper with larger and smaller squares **or** photocopy leaves, cut out and weigh (cut out) **;** divide mass by mass of 1 cm^3 of same paper **;** **or** *ref. to* using an App **;** further detail **;** e.g. place leaf, flat / on white surface **;** take photo of single leaf with smart phone / AW	**2**

Question	Answer	Marks
5(a)	*ignore single letters for the bases* **A** *purines* = adenine and guanine **;** *in either order* *pyrimidines* = cytosine and uracil **;** *in either order* **B** phosphodiester (bond) **;** **C** ribose **;**	**4**
5(b)	*any **three** from: penalise once if incorrect, pathogen / type of organism* aerosol infection / droplet infection / ref. to airborne droplets **;** *in context of droplets containing, pathogen / virus* infected person, exhales / expires / breathes out / coughs / sneezes / AW, (airborne droplets) **;** (airborne droplets) breathed in / AW, by, uninfected / healthy, person**;** *idea of* transmitted when uninfected person touches an infected surface and puts fingers into, mouth / nose **;** **R** contact *without qualification*	**3**

Question	Answer	Marks
5(c)(i)	trachea bronchus / bronchi bronchiole / bronchioles **;** **A** types of bronchiole	**1**
5(c)(ii)	**A** CO *for carbon monoxide* **A** Hb / hb, *for haemoglobin* *any **two** from* **1** forms carboxyhaemoglobin **;** **A** binds to haemoglobin (permanently) **2** less haemoglobin available to bind oxygen / haemoglobin has higher affinity for carbon monoxide (than for oxygen) **;** **3** reduces, percentage saturation of haemoglobin (with oxygen) / AW **;** **A** less, oxygen binds to haemoglobin / oxyhaemoglobin forms **I** prevents oxygen binding *if mp2 and mp3 not gained allow one mark for statements such as* *reduces capacity for binding of oxygen to hb / less oxygen carried by hb / decreases the oxygen carrying capacity of hb* **4** decreased quantity of oxygen transported / AW **;** **5** damages, endothelium / tunica intima / lining of blood vessels **;**	**2**
5(d)(i)	(steady) increase in number of (estimated) deaths (from measles, over time / from 2000 to 2017) **;** **A** (relatively) constant then (steady) increase in number of (estimated deaths over time)	**1**

Question	Answer	Marks
5(d)(ii)	*any **three** from*: **I** ref. to cost or mutations **1** as (global) population increased, higher, number / proportion, of unvaccinated **; ora** **2** *ref. to* HIV link to measles **;** e.g. increase in number of people living with HIV increases spread of measles increase in cases of HIV / AIDS, measles can be an opportunistic disease **R** spread of HIV / AIDS weakened immune system in people with HIV / AIDS so measles more likely to occur (in unvaccinated) **3** less / no, herd immunity (so increased chance of getting measles) **;** **A** *ref. to* larger, number / proportion, unvaccinated will increase risk of spreading disease *context is community* **4** one example of a difference between unvaccinated versus vaccinated **;** e.g. risk of <u>death</u> from measles is higher in unvaccinated unvaccinated do not have, (artificial active) immunity / memory cells *context is individuals* **5** suggestion as to why fewer people are vaccinated **;** e.g. reluctance, of parents to get child vaccinated reluctance because of, cultural / religious, beliefs difficulty in obtaining vaccine *in context of remote communities* collapse of vaccination programmes in some countries / AW lack of, trained trained professionals / health facilities, to deliver vaccine lack of education about benefits of vaccine / AW **6** suggestion as to why measles cases (and so deaths) may increase **;** e.g. (greater proportion of people) malnourished / lack vitamin A (greater proportion of people) living in, overcrowded / poor, conditions **I** overcrowded countries measles is easily spread (with increase in population) **A** very infectious measles is more easily spread in overcrowded conditions	**3**

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Question	Answer	Marks
5(d)(ii)	**7** example of spread (of measles) owing to movement of people between countries **;** e.g. (unvaccinated) people with measles arriving to a country and spreading disease unvaccinated people travelling to countries with the disease, catching measles and taking it back home people arriving with measles to countries with low vaccination rates **8** AVP **;** e.g. ref. to, no / any specific difficulty for, contact tracing lack of, isolation / quarantining poor epidemiological records so authorities cannot react to outbreaks improved, recording / reporting, of deaths over the time period	
5(e)	*any **two** from:* (high count owing to), cancerous / uncontrolled mitosis of, white blood cells **;** **A** malignant cells **A** uncontrolled division white blood cells (in child with leukaemia) cannot, function (in immunity) / protect / example of function **;** **A** undifferentiated / unspecialised (so) weakened immune system (and more likely of developing measles) **;** AW vaccination is, less effective / not effective / gives weak immune response **;** secondary immune response, does not occur / too slow (after vaccination) **;** AVP **;** has memory cells but clonal expansion, does not occur / is faulty	**2**

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Question	Answer	Marks
6(a)	**1** (open top tap and) keep bottom tap closed / close bottom tap for a longer time (and then open bottom tap to collect product) **A** close bottom tap for complete hydrolysis to occur **or** run starch solution through column, collect product, repeat (a number of times) / AW **or** only allow a small quantity of starch solution through at a time / AW **;** *if a different idea suggested to set-up in Fig. 6.1, method must be related to an increase in contact time between beads and starch to award mp1* *any **two** from:* **2** suggestion of modification to experimental set-up in Fig. 6.1 **;** e.g. use smaller beads use more, beads / enzyme in beads **I** use more immobilised enzyme use of visking tubing attached to end of column (so only reducing sugar passes out) use longer, narrower column **I** *ref. to* filtering with filter paper / adding buffers to control pH **3** test (sample of) product with iodine solution, qualified **;** **A** iodine in potassium iodide solution / I in KI solution e.g. to confirm no starch present stays orange (colour) does not change to blue-black (colour) to confirm no starch present **4** ref. to using optimum temperature (for amylase) **; A** e.g. 35 °C temperature	**3**

Question	Answer	Marks
6(b)	*any **one** from:* surface area to volume ratio / SA:V, decreases with increasing size / increases with decreasing size **;** SA:V ratio is different, with consequence **;** e.g. smaller beads means increased contact of substrate with enzyme (in same conditions) *idea that overall,* larger surface area exposed using smaller beads **; ora** *(for the same experimental set up)* larger beads, slows rate of diffusion into beads / increases diffusion time to reach enzyme **; ora** larger beads will increase rate of flow through column **; ora**	**1**

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