Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 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 May/June 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 2)	Correct, CON (of	×, (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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Mark scheme abbreviations:

;	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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Question	Answer	Marks
1(a)	*structure max 2 marks* **1** RER has ribosomes **R** *if context is within lumen* **or** SER does not have ribosomes **;** **2** RER, flattened sacs / cisternae, and SER tubular **;** AW **3** RER continuous with, (external) nuclear membrane **;** **ora** **I** near to nuclear membrane **R** continuous with internal nuclear membrane **4** *ref. to* RER, more regular / layered, arrangement **or** SER more irregular / disorganised, arrangement **;** *function* **5** RER produces / transports, proteins / glycoproteins **;** **A** polypeptides **A** examples of post-translational modification **6** SER produces, lipids / cholesterol / steroids **;** **A** stores **I** produces hormones	**3**
1(b)	*any two from* *ref. to* phosphate (group) and two fatty acid, chains / tails / residues **;** **A** two hydrocarbon chains correct *ref. to* attachment, phosphate / fatty acids, to glycerol **;** AVP **;** e.g. *ref. to* ester bond *ref. to* additional group e.g. choline-containing *ref. to*, saturated / unsaturated, (fatty acid tails) *award marks from an annotated diagram*	**2**

Question	Answer	Marks
1(c)(i)	flattened sacs / cisternae **;** stack / layered / described **;** *any one from* *idea that* each cisterna in stack is, separate / not interconnected **;** smooth (outer surface) / no ribosomes **;** close to, nucleus / RER **;** single membrane **;** AVP **;** e.g. two distinct faces *ref. to* swollen ends to cisternae	**2**
1(c)(ii)	*ignore events occurring before vesicle formation* *any three from* vesicle moves to, cell surface / cell (surface) membrane **;** **A** plasma membrane movement of vesicle via, cytoskeleton / microtubules **;** vesicle fuses with (cell surface) membrane (and protein released) **;** AW e.g. vesicle makes contact with membrane and becomes part of it **I** attaches to / binds to exocytosis **;** **I** bulk transport / excreted / secreted *allow in context of release only or movement from Golgi and release*	**3**
1(c)(iii)	*any one relevant e.g.* acts as (self-)antigen / recognition site / cellular recognition / receptor / membrane stability / cell adhesion **;** **I** involved in cell signalling	**1**

Question	Answer	Marks
2(a)	**I** *ref. to* features that are absent e.g. no cellular structure *any one from* nucleic acid core **;** either DNA <u>or</u> RNA **;** **I** ref. to, single / double, stranded protein coat / capsid **;** **A** *idea of* (outer covering) made of <u>capsomeres</u>	**1**
2(b)	*(smallpox) Variola* **;** *(measles) Morbillivirus* **;**	**2**
2(c)	*allow, virus / viruses, for Morbillivirus* **I** penicillin doesn't act on viruses *any two from* **1** penicillin only acts on bacteria (and measles is caused by a virus) **;** **A** prokaryotes **2** *Morbillivirus* does not have, cell walls / murein / peptidoglycan **;** **3** *Morbillivirus* does not have, transpeptidases / the enzyme that is inhibited (by penicillin) **;** **A** *idea of* not possessing the enzyme that is acted upon by penicillin **4** *Morbillivirus* does not grow / penicillin (only) acts on growing cells / AW **;** **A** when cell wall is, growing (larger) / getting bigger **5** *Morbillivirus* does not have cellular structure / *Morbillivirus* is acellular / penicillin only acts on cells **;**	**2**
2(d)	to treat / to cure / may have / prone to / to prevent / AW, infectious diseases / infections / AW **;** e.g. bacterial / opportunistic / secondary, disease(s) / infection(s) **A** to kill bacterial pathogens **A** to treat (some) fungal diseases **R** viral disease / HIV infection *do not award if a mix of viral and bacterial diseases stated*	**1**

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Question	Answer	Marks
2(e)(i)	*allow ref. to, cheaper / low cost, related to relevant mp once only* *any four from* *did not mutate to max 2* **1** same vaccine could be used (everywhere / for many years) **;** **A** no need to manufacture different vaccines *in context of ease of, administering / planning / production* **2** (so) a person was protected for, a long time / life / each exposure (to virus) **;** AW e.g. same virus so vaccinated person did not become ill on repeated exposure **A** reduced / no, risk of vaccine becoming ineffective **A** long-lasting immunity *once only for mp2 or mp4* **I** more effective vaccine **3** no, research / trials / development, required for new vaccine(s) **;** *in context of pre-mass production* *live and closely related to max 2* **4** (closely related so) same antigens / (gives the desired) immune response / antibodies produced / memory cells produced / memory cells remain **;** **A** long-lasting immunity *once only for mp4 or mp2* **5** live virus (replicates, so), gives a strong(er) immune response **;** **A** better immunity than inactive virus **R** natural active immunity **6** no need for boosters **;** **7** *ref. to* not smallpox virus, so fewer health and safety issues (at all stages of development and use) **;** e.g. could not get ill from smallpox **A** not smallpox virus so more people willing to have vaccine	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(e)(i)</td><td>thermostable vaccine
8 longer shelf-life / doesn’t degrade easily / other advantage ;
e.g. no refrigeration needed
could be easily, stored / transported
no wastage

easy to administer
9 (using non-medical staff) increased number of people vaccinated / percentage cover / herd immunity ;
allow idea of faster delivery of vaccination programme
A idea that (makes vaccine) more accessible to people in developing countries</td><td></td></tr>
<tr><td>2(e)(ii)</td><td>one mark for correct completion of table ;

<table>
<tr><th>type of immunity</th><th>gained (✓)
not gained (x)</th></tr>
<tr><td>active immunity</td><td>✓</td></tr>
<tr><td>artificial immunity</td><td>✓</td></tr>
<tr><td>natural immunity</td><td>x</td></tr>
<tr><td>passive immunity</td><td>x</td></tr>
</table>
</td><td>1</td></tr>
</table>

Question	Answer	Marks
3(a)	*any four from* **1** mRNA, attaches to / associates with / AW, ribosome **;** **A** ribosome reads mRNA **2** two codons, exposed **/** AW **;** **A** A and P sites / first and second binding sites, (on ribosome) **3** tRNA, qualified carries an amino acid to ribosomes / each type carries a specific amino acid / first amino acid is met / tRNA with met / $tRNA^{met}$ **;** *ref. to ribosomes can be implied in mp 3 if mp1 gained* **4** anticodon (on tRNA) binds to codon (on mRNA) **;** **I** matches **A** complementary / base, pairing between codon and anticodon **A** H-bonds form between bases on codon and anticodon **R** if anticodon on mRNA **5** START (mRNA) codon / (mRNA) AUG first codon **;** **6** second tRNA with its amino acid binds next to first tRNA / (two) amino acids are held in place close to each other by tRNA binding / AW **;** **A** *ref. to* two tRNAs next to each other **7** (after peptide bond formation) first tRNA detaches / ribosome moves along one codon **or** process repeats / elongation occurs, until, STOP codon / polypeptide chain synthesised (and released from ribosome) **;** **8** tRNA molecules, reused / leave ribosome to attach to another amino acid **;** *must be in context of leaving after peptide bond formation* **9** AVP **;** e.g. peptidyl transferase for peptide bond formation *ref. to*, 99 / 100 / 101, codons, qualified **A** number of bases in length of mRNA	**4**

Question	Answer	Marks
3(b)	*any three from* *similarity* peptide bond and disulfide bond are covalent bonds **;** *differences* tertiary structure bonds are between, R groups / side chains, (of different amino acids **;** H bond / ionic bond / hydrophobic interaction, versus <u>covalent</u> peptide bond **;** **A** tertiary structure bonds apart from disulfide are not covalent peptide bond, stronger / more thermostable, than, tertiary structure bonds / two named bonds**;** peptide bond is between, carboxylic acid / <u>COOH</u>, and, amino / <u>NH_2</u>, group (of the adjacent amino acid) **;** AVP **;** detail of a tertiary structure bond e.g. hydrophobic between non-polar R groups disulfide between sulfur-containing R groups ionic between carboxyl and amino groups of R groups H bond between oxygen on —CO groups and H on either the —OH or —NH groups of R groups	**3**

Question	Answer	Marks
3(c)(i)	*any three from:* *suggestion that* **1** flap region, opens / moves, to let, substrate / polyprotein, enter **or** flap region, closes round / AW, substrate / polyprotein **I** flap region is closed **2** induced fit / HIV protease action, involves, change in shape of active site / active site moulding around substrate / AW **;** **I** *ref. to* enzyme or substrate changing shape *if mp1 and mp2 not gained allow one mark if stated that activity of flap region changes shape of active site or that flap region changes shape because it is the active site* **3** *ref. to* better fit / fully complementary / AW **;** **4** *ref. to* formation of, enzyme-substrate complex **;** **A** ESC **5** AVP **;** e.g. (induced fit) substrate / polyprotein, not (fully) complementary to (shape of) active site **A** does not (fully) fit active site / enzyme, returns to original shape on release of product change of shape (to give complementary fit), lowers activation energy / puts strain on bonds / AW	**3**
3(c)(ii)	*any two from* acts as <u>competitive inhibitor</u> **;** binds to active site, qualified **;** e.g. instead of, substrate / polyprotein to prevent, entry / binding, of, substrate / polyprotein so competes with substrate to prevent ESC formation **I** *ref. to* flap region as active site *any one from* will be permanent / non-reversible **;** causes / induces, flap region to open to bind to active site **;** no (**A** few / fewer) polyprotein products / polyprotein not cut, so viral replication prevented / AW **;** **R** polyprotein not broken down	**2**

Question	Answer	Marks
4(a)	*disaccharides* - two, monosaccharides / sugar monomers / sugar units / simple sugars **;** **R** sugar molecule *polysaccharides* - more than two / three or more / many / large number of, monosaccharides / sugar monomers / sugar units / simple sugars **;** **A** sugar molecule / carbohydrate monomer *if 'monomers' is the only term given for both allow one mark (unless contradicted e.g. amino acids are monomers)* correct *ref. to* glycosidic bond(s) **;**	**2**
4(b)(i)	*max 2 if large vacuole or nucleus drawn* **1** sieve plate drawn and labelled **;** **A** sieve pore label *must be to a gap* *doesn't need to show pores* **I** plasmodesmata *any two from* **2** cytoplasm labelled and drawn as, thin layer against wall / patches **;** *if drawing not clear, allow if label indicates peripheral cytoplasm* **3** mitochondrion / mitochondria, drawn within cytoplasm / at edge, and labelled **;** *internal details not required* **4** endoplasmic reticulum drawn within cytoplasm / at edge, and labelled **;** **A** ER **R** RER / SER *if no indication of peripheral cytoplasm, or structures located within peripheral cytoplasm / at edge, allow one mark for drawing and labels of <u>two</u> of mp2,3,4* **5** cell surface membrane drawn in (close to cell wall) and labelled **;** **A** plasma membrane **6** AVP **;** e.g p-proteins drawn as, strands / AW, and labelled plasmodesmata shown as strands of cytoplasm entering sieve tube cell from companion cell and labelled	**3**

Question	Answer	Marks
4(b)(ii)	influx / entry / AW, of sucrose / organic compounds / assimilates / photosynthates / named **;** **A** active loading *for entry* **R** active transport / cotransport / facilitated diffusion **R** incorrect cell type named as donor cell e.g. xylem / mesophyll *must have idea of entry – stating that they are present in the phloem sieve tube is not enough* water enters (from xylem), by osmosis / down water potential gradient / from high(er) to low(er) water potential / from less negative to more negative water potential **;** **A** Ψ for water potential **A** water enters, increasing volume	**2**

Question	Answer	Marks
5(a)	*allow one mark if monocyte <u>and</u> neutrophil both labelled as phagocytes and no other cell is labelled phagocyte* *allow phagocyte for either the monocyte or neutrophil if the other cell correct* red blood cell / erythrocyte ;   monocyte / macrophage; **I** white blood cell **I** leucocyte neutrophil ; **A** *polymorphonuclear leucocyte / basophil / eosinophil*   lymphocyte ; **I** B / T **I** B-cell / T-cell	**4**
5(b)	15 / 15.0 / 15.1 / 15.2 (kPa) ; 0.09 / 0.10 / 0.1 (s) ;	**2**

Question	Answer	Marks
5(c)(i)	*emphysema and chronic bronchitis do not need to be named* *any one from must be in context of COPD* less, air / oxygen, able to reach, alveoli / air sacs / gas exchange surface **;** less <u>oxygen</u> able to, diffuse to / AW, capillaries (from, alveoli / air sacs) **;** ventilation impaired / AW **;** *any two from effects of chronic bronchitis and emphysema* inflammation (of respiratory airways) **;** build up / accumulation / excess / AW, of mucus decreased lumen of, trachea / bronchus / bronchioles / respiratory tubes / airways **;** **A** airway obstruction **I** blocked **A** constriction / narrowing (loss of, elastin / elastic fibres, so) less ability (of alveoli) to recoil **;** alveoli, burst / destroyed **or** alveolar walls break down **;** large(r) air sacs (instead of alveoli) / AW **;** decreased / reduced, SA:V **;** *of, alveolar area / gas exchange surface area* AVP **;** e.g. relevant effect of pulmonary hypertension affecting gas exchange	**3**
5(c)(ii)	*any two from* decreases quantity of, <u>oxygen / O_2</u>, taken into blood / absorbed / transported (back to heart) **;** AW **A** fewer red blood cells to take up <u>oxygen</u> **A** blood less oxygenated decreases quantity of, <u>carbon dioxide / CO_2</u>, leaving blood / excreted / AW **;** **A** more carbon dioxide remains in the blood (than normal) increased, ventilation / breathing, rate **;** **R** breathes more deeply AVP **;** e.g. further increase in pulmonary hypertension	**2**

Question	Answer	Marks
6(a)	correct working **;** e.g. 14 000 000 ÷ 1400 (**A**–**B** = 13 to 15 mm) (x) 9286 / 9642 / **10 000** / 10 357 / 10 714 **;** *incorrect conversions used in working or incorrect measured value of* **A**–**B** *can be awarded the answer mark as ecf – the working must show use of dividing by 1400 (or incorrect conversions of 1400)*	**2**
6(b)	*any four from* two chromatids drawn with, non-metacentric centromere / chromosome arms unequal length **;** (sister) chromatid **;** centromere **;** *allow as a constriction* telomere **;** *must be labelled at / towards the end* AVP **;** e.g. four telomeres labelled **or** telomere sectioned off at each chromatid end and one labelled DNA and histones gene / allele *must be shown as a section*	**4**
6(c)	**R** homologous chromosomes *any one from* most condensed state **;** AW **I** chromosomes, are condensing / condense chromosomes (all) in one, plane / focus **;** **A** *idea of* all at the equator (so clearly visible) **I** line up. horizontally / vertically	**1**
6(d)	anaphase **;**	**1**