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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **February/March 2024**

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 February/March 2024 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 descriptions 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	<u>'List rule' guidance</u> 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.

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 normal)
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
( )	the word / phrase in brackets is not required, but sets the context

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Question	Answer	Marks
1(a)(i)	glycerol **;**	**1**
1(a)(ii)	*any **one** from:* hydroxyl / polar, group, interacts with, phosphate heads **;** **A** idea that both are, polar / hydrophilic **A** hydroxyl group, faces aqueous environment / AW, as it is, polar / hydrophilic non-polar part, in region of / AW, fatty acid tails / AW, as both are, non-polar / hydrophobic **;** **A** non-polar part is hydrophobic so, in centre of membrane / away from aqueous environment	**1**
1(a)(iii)	*any **one** from:* maintains / regulates, fluidity of membrane **;** **A** detail e.g. reduces fluidity at high temperature / increases fluidity at low temperature / AW maintains / regulates, (mechanical) stability of membrane **;** AW prevents entry of, hydrophilic substances / polar substances / ions **;** without cholesterol membranes would easily rupture flat ring *(structure)* interferes with the movement of fatty acid tails reduces lateral movement of phospholipids	**1**
1(b)(i)	*sodium ions are* (positively charged), so repelled / AW, by the, hydrophobic tails / non-polar core / non-polar tails / AW **;**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(b)(ii)</td><td>
similarity:
any one from
1 both occur through / involve, a, membrane / transport, protein ; A carrier protein if context is correct

2 (both can be) specific to the, molecule / ion (passing through) ; A correct ref. to binding site(s) on protein

3 (both involve) conformational change of (carrier) protein) ; R if incorrect context of channel protein

AVP ; e.g. can transport substances, into and out of cell / in both directions ;

differences:
<table>
<tr><td>facilitated diffusion</td><td>active transport</td></tr>
<tr><td>substances transported down the concentration gradient</td><td>substances transported against a concentration gradient</td></tr>
<tr><td>passive A does not require, ATP / (metabolic) energy</td><td>requires, ATP / (metabolic) energy</td></tr>
<tr><td>involves channel and carrier proteins</td><td>does not involve channel proteins / only involves carrier proteins</td></tr>
</table>
If not given as a similarity allow as differences
idea that active transport always involves conformational change (facilitated diffusion only carrier protein)
idea that active transport always involves specific binding site(s) (facilitated diffusion only with carrier proteins)
</td><td>3</td></tr>
<tr><td>1(c)(i)</td><td>
any one from:

SER (membrane-bound so) can provide, phospholipid / arachidonic acid / substrate ;

(prostaglandins are lipids and) SER is involved in lipid transport ;

prostaglandins can be transported (from SER) or stored (in SER) ;

idea of compartmentalisation / separated from other reactions in the cytoplasm / provides optimum conditions for pathway / higher concentration of enzymes (of pathway) ;
</td><td>1</td></tr>
</table>

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Question	Answer	Marks
1(c)(ii)	*any **three** from:* ref. to effect on, ionic bonding / hydrogen bonding / hydrophobic interactions, (with other R-groups) **;** changes the, shape / conformation, of the active site **;** active site no longer complementary to, arachidonic acid / substrate **;** ref. to effect of activation energy not being reduced **;** e.g. ref to changed charges (so no electron transfer) no longer provides hydrophobic regions for reaction to occur enzyme–substrate complex, not formed / formed at reduced rate **;**	**3**
1(c)(iii)	*any **two** from:* **A** ligands for prostaglandins *if in correct context* 1 prostaglandins are, secreted / released, by cells **or** prostaglandins are, transported / AW, to target cells **;** 2 prostaglandins bind to receptors (on target cell surface membranes) **;** **R** antigens 3 example of events triggered leading to a response **;** e.g. activation of secondary messenger enzyme, cascade / activation phosphorylation events signal transduction	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
<table>
<tr><th>description</th><th>name of white blood cell</th></tr>
<tr><td>A large cell that has a bean-shaped (kidney-shaped) nucleus. It can develop into a macrophage.</td><td>monocyte ;</td></tr>
<tr><td>A cell that has a large spherical nucleus and little cytoplasm. It responds to non-self antigens.</td><td>lymphocyte ; I B- / T-</td></tr>
<tr><td>A cell that has a lobed nucleus. It is phagocytic.</td><td>neutrophil ;</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>2(b)</td><td>allows, easier / quicker, flow / movement, of blood (compared to human red blood cells) ;

plus any two explanations from :

lozenge / torpedo / elliptical / AW, shape of camel red blood cells (vs, biconcave disc of human red blood cells) ;

camel red blood cells are smaller (than human red blood cells) ; ora

larger number of camel red blood cells (per unit volume) ;</td><td>3</td></tr>
<tr><td>2(c)(i)</td><td>any three from:
in context of better adapted for uptake in lungs
(at high altitude) haemoglobin of llama more highly saturated with oxygen (than haemoglobin of human) ;
I ref. to higher saturation in partial pressures found in tissues

at 6.4 kPa / 3500 m, oxygen saturation is, 86% for llama and 79 / 80% for human / 6 / 7% higher oxygen saturation for llama ;

llama haemoglobin has a higher affinity for oxygen than human haemoglobin ;

more oxygen, transported / delivered to tissues ;

(so) sufficient oxygen unloaded in tissues to satisfy demand ;</td><td>3</td></tr>
<tr><td>2(c)(ii)</td><td>curve drawn to the right of the human dissociation curve ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(c)(iii)	*any **three** from:* (metabolically active organs) release more carbon dioxide / partial pressure of carbon dioxide is higher ; ref. to decreased affinity of haemoglobin for oxygen / explained **;** e.g. ref to haemoglobinic acid more oxygen released **;** for more aerobic respiration / more ATP production **;** *look for 'more' once*	**3**

Question	Answer	Marks
3(a)(i)	R endodermis **; A** endodermal (tissue) S xylem **;** T phloem **;** *accept ecf if S and T both have 'vessels' after naming*	**3**
3(a)(ii)	*any **two** from:* to stop water moving through the apoplast / to force water movement to be symplastic / AW **;** so that water moves from the cell wall to the cytoplasm **;** AVP **;** e.g. to allow control of substances into root (stele) ref. to passage cells ref. to Casparian strip / suberin	**2**
3(a)(iii)	sucrose / amino acid / peptide / polypeptide / protein / RNA / (named) plant hormone **;** **A** other named sugar / named amino acid / named protein / enzyme **R** minerals	**1**
3(b)	correct label to a plasmodesma **;**	**1**

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Question	Answer	Marks
3(c)		**3**

polysaccharide	monomer	glycosidic bond(s)	function
amylopectin	α-glucose	1,4 and 1,6	energy storage in plants
amylose	α-glucose **;**	1,4	energy storage in plants
cellulose	β-glucose	1,4 **;**	structural role in plant cell walls
glycogen	α-glucose	1,4 and 1,6	energy storage in <u>animals</u> **;**

Question	Answer	Marks
4(a)(i)	all correct **;**	**1**

position of nucleotide	1	2	3	4	5	6	7	8	9	10	11	12
DNA template strand	C	A	C	T	A	C	T	C	C	A	A	C
primary transcript	G	U	G	A	U	G	A	G	G	U	U	G

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)(ii)</td><td>all 4 correct ;
<table>
<tr><td></td><td>aa1</td><td>aa2</td><td>aa3</td><td>aa4</td></tr>
<tr><td>amino acid</td><td>val
/ valine</td><td>met
/ methionine</td><td>arg
/ arginine</td><td>leu
/ leucine</td></tr>
</table></td><td>1</td></tr>
<tr><td>4(a)(iii)</td><td>any two from:
no effect on the protein structure ;
(because) all 4 triplets beginning with CA code for valine / CAA, CAG, CAT, CAC all code for valine ;
idea of the genetic code is, redundant / degenerate ;</td><td>2</td></tr>
<tr><td>4(a)(iv)</td><td>any three from:
first amino acid, unchanged / still val ;
changes the reading frame / described ; A.all codons (from mutation on) will change / frameshift mutation
deletion alters, all amino acids after the mutation / amino acid sequence / primary structure ;
ref. to, stop codon, causing premature chain termination / leading to shorter polypeptide ;
(leading to) changes, in the tertiary structure / active site / AW ;</td><td>3</td></tr>
<tr><td>4(b)</td><td>interphase <u>and</u> S phase circled ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
4(c)	*any **four** from:* *max three if points about transcription also given* 1 double helix unwinds, qualified **;** e.g. using, enzyme / helicase breaking hydrogen bonds between strands 2 both strands act as templates **;** 3 ref, activated (free DNA) nucleotides **;** 4 <u>DNA polymerase</u>, plus example of role **;** e.g. adds complementary nucleotides to exposed strand forms phosphodiester bonds (between adjacent nucleotides) proofreading / checking for errors / checking for mismatches 5 leading strand synthesised continuously / AW **;** 6 lagging strand synthesised in (Okazaki) fragments **;** 7 ligase connects (lagging strand), fragments / nucleotides, (with phosphodiester bonds) **;** 8 semi-conservative replication / AW **;** e.g. both new double helices have one, parental / conserved, strand and one newly synthesised strand	**4**
4(d)	ribose **;** **I** pentose	**1**

Question	Answer	Marks
5(a)(i)	scanning (electron microscope) **;**	**1**
5(a)(ii)	*Vibrio cholerae* **;**	**1**
5(b)	prokaryotic cell walls are, made of peptidoglycan / made of murein / not made of cellulose **;**	**1**

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Question	Answer	Marks
6(a)	capsid **;** **A** capsomere or protein coat **R** protein / glycoprotein / caspid	**1**
6(b)	*accept accounts based on primary and / or secondary immune response .* fewer cytokines released **;** *and any **two** from:* fewer plasma cells, so fewer antibodies produced **; A** B lymphocytes fewer macrophages stimulated / less production of 'angry' macrophages / AW / less antigen presentation by macrophages ; fewer T-killer cells stimulated to divide / less T-killer cells / less infected cells killed (by T-killer cells) **;** fewer memory cells (produced by the primary response) **;** AVP **;**	**3**
6(c)	virus cannot enter the T-helper cell **/** CCR5 unable to trigger endocytosis of viral particle **;**	**1**
6(d)	*any **three** from:* 1 (named) small mammal, injected / AW, with CCR5 **; A** antigen 2 immune response occurs (over several weeks) **; A** immune response described 3 plasma cells / B-lymphocytes / B-cells / splenocytes, extracted from spleen **;** 4 plasma cells / B-lymphocytes / B-cells, fused with, myeloma / tumour / cancer / AW, cells (to form hybridomas) **;** 5 screening / selection / AW, for hybridomas producing desired, (monoclonal) antibodies **;** 6 AVP **;** e.g. hybridoma cells separated (into wells) to produce clones ref. to large scale production	**3**

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