Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 2022**

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.

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PUBLISHED

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.

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.

6	<u>Calculation specific guidance</u> 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	<u>Guidance for chemical equations</u> 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.

Examples of how to apply the list rule: State three reasons … [3]

A

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

C

(4 responses)

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

E

(4 responses)

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

G

(5 responses)

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

I

(4 responses)

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

B

(4 responses)

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

D

(4 responses)

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

F

(4 responses)

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

H

(4 responses)

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

;	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
<u>underline</u>	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

Question	Answer	Marks
1(a)	pulmonary (circulation) **;** systemic (circulation) **; R** systematic vena cava / inferior vena cava / superior vena cava **; A** venae cavae	**3**
1(b)	venule / venules **;**	**1**
1(c)	label line pointing to, left atrioventricular / tricuspid, valve and labelled **R ;** **R** if pointing to one of the chordae tendinae label line pointing to, pulmonary artery and labelled **L ;** **A** pointing to left or right pulmonary artery	**2**
1(d)	globular **;** intracellular **; R** intercellular water <u>and</u> H_2O **;** carbonic acid **;** hydrogen <u>and</u> H^+ **;**	**5**

Question	Answer	Marks
2(a)	**S** = protein **;** **A** amino acid **R** protein coat **I** capsomere **T** = capsid **;** **A** protein coat **R** capsomere	**2**

Question	Answer	Marks
2(b)	170 (nm) **;**	**1**
2(c)	replication / synthesis / AW, of (viral) DNA **;** **I** replication of genes **A** *stated function of DNA polymerase* **I** unwinding of DNA e.g. forms phosphodiester bonds joins / AW, (adjacent DNA) nucleotides **R** joins complementary nucleotides **I** joins sugar phosphate backbone	**1**
2(d)	presence of (viral), envelope / (outer) membrane / phospholipid bilayer **;** ref. fluid / flexible **;** ref. to preparation (for electron microscopy) **;** e.g. distortion / squashed / artefact **I** ref. to use of the microscope e.g. electron beam affects AVP **;** e.g. *suggestion of* variation in <u>tegument</u> protein, number / arrangement / organisation / AW	**2**

Question	Answer	Marks
2(e)	*similarity, one mark:* both have DNA (double stranded, naked / no histones) **;** **A** DNA plus neutral feature e.g. not surrounded by a nuclear envelope **I** both have genes **I** components of DNA e.g. deoxyribose / nucleotides / phosphates **R** both have, single stranded / circular, DNA **R** both have, DNA free in the cytoplasm / DNA and RNA *difference, one mark:* bacterial DNA, circular / closed loop (v HCMV linear) **I** ref. to naked DNA **R** if comparison for HCMV is incorrect e.g. multilayered **or** bacteria (can also) have, plasmid DNA / plasmids **R** if implied that bacterial DNA is only plasmid DNA **or** bacterial DNA (also) has genes for, metabolism / AW **ora** **or** bacterial DNA free in cytoplasm but HCMV DNA surrounded by, capsid / protein coat / **T ;**	**2**

Question	Answer	Marks
2(f)	**I** transcription and translation stops *any **three** from:* **1** no, S phase / G_2 phase / mitosis / cytokinesis **;** **A** remains in (G_1) interphase **A** synthesis phase *for* S phase **I** named mitotic stages *look for* **CON** e.g. 'no S-phase, so mitosis only has one chromatid' **2** (semi-conservative) DNA, replication / synthesis, does not occur **;** **A** sister / identical, chromatids, do not form **R** if a phase is stated and it is not given as the S-phase **3** failure to pass checkpoints / does not reach checkpoints **;** **A** ref. to no error checking occurs (*in context of checkpoints)* **I** proofreading / error checking, (by DNA polymerase) during DNA replication **4** cell does not, grow / increase in size / increase cytoplasm **;** *(context of preparing for mitosis / cytokinesis)* **A** grows to normal (non-dividing) size **5** *idea that* the cell does not, duplicate / synthesise, organelles / extra materials *(context is for, cytokinesis / new cells)* **;** **A** centrioles do not replicate **A** microtubules not synthesised **R** if stated as occurring in S phase (even if e.g. G_2 given as well)	**3**

Question	Answer	Marks
2(g)	*allow virus or pathogen for HCMV* *look for ora in context of healthy immune system* *any **four** from:* **1** ref. to time delay in immune response (compared to normal) **;** e.g. takes a longer time for, immune system to respond slower (secondary) immune response immune response similar to primary response **2** more time / easier / AW, for HMCV to infect cells / replicate / spread (so cause damage) **;** AW **R** ref. to HCMV as, cells that reproduce / viruses that carry out mitosis *impact following primary response and after viral activation* **3** few(er), immune system cells / named, (in circulation) **; I** fewer white blood cells e.g. fewer, macrophages / neutrophils **A** phagocytes fewer (B- and T-) memory cells **A** no memory cells *(no longer present from primary response)* fewer, (B/T,-) lymphocytes / T-helper cells / T-killer (or cytotoxic) cells *context for lymphocytes could be reduced number circulating at time of viral activation or owing to poor secondary response(compared to normal)* fewer / no, plasma cells **4,5** consequence of fewer immune system cells **;;** *two marks* e.g. less chance of / AW, encounter with / recognition of / activation by, (non-self / foreign) antigen / HMCV / virus / pathogen / infected cell (fewer memory cells) ref. reduced clonal expansion / AW (so fewer lymphocytes / plasma cells)	**4**

Question	Answer	Marks
2(g)	(fewer plasma cells) lower concentration of antibodies **A** no antibodies (as no plasma cells) **A** longer time for antibody, production / concentration to build up (fewer T-helper cells) less cytokine released **A** effect of cytokine *if spelling of cytokine* rejected (fewer T-killer cells) fewer infected cells killed / **A** perforin / granzymes / hydrogen peroxide, not released (fewer phagocytes) less phagocytosis for antigen presentation	

Question	Answer	Marks
3(a)	protoctist **;**	**1**
3(b)(i)	*any **two** from:* **1** drugs have different, targets / mechanisms of action, **or** drugs, act on different, structures / processes / stages of life cycle **;** **2** unlikely / less likely, for mutations against all drugs to occur **;** **3** unlikely for resistance to occur against all the drugs **;** **I** immune / immunity **A** described example **4** if there is resistance to one, the other drug(s) will, kill / AW, all pathogens **;** AW **I** ref. to effective **5** (so) prevents, gene / allele, from being passed on **;** **6** AVP **;** e.g. low numbers left, so less probability of mutations arising *idea that* if all pathogens are killed, no replication / no mutations, for resistance to develop	**2**

Question	Answer	Marks
3(b)(ii)	*allow, pathogens / parasites, for* <u>*Plasmodium*</u> **I** increased time when person is infectious *any* ***two*** *from:* increased time when person, has *Plasmodium* in, blood / circulation **;** *allow mark if reference to, blood / circulation, not made but reference is made to blood in statements about Anopheles* **A** person acts as a reservoir for *Plasmodium* (so) quantity / concentration / number, of *Plasmodium*, remains high / increases **;** AW **A** ref. to allows *Plasmodium*, to reproduce / replicate **I** ref. to genes passing to offspring increased, time / risk / chance / AW, of, being exposed to, vectors / mosquitoes / *Anopheles* (for blood meal) **;** AW *idea of* more infected, *Anopheles* / mosquitoes available to feed on uninfected people **;**	**2**

Question	Answer	Marks
3(c)(i)	**1** correct use of examples **;** *two of gene, gene mutation, protein, altered protein* *gene = kelch13* *gene mutation = kelch13* mutation **or** F446I **or** (mutation has) adenine / A, not, thymine / T *protein/polypeptide* = PfK13 *altered protein* isoleucine / ile, instead of, phenylalanine / phe **2** (mutation has), changed / altered / AW, sequence / arrangement / order, of nucleotides / bases, (in DNA) **;** *ref. A replacing T still needs stated idea of a changed sequence* **R** *if gene explanation also given and stated as sequence of amino acids* **3** (gene) codes for the production of a, polypeptide / protein AW **or** (gene mutation) produces / results in, altered / changed / non-functioning / reduced function, polypeptide / protein **;** AW **A** produces changed sequence of amino acids **R** *if gene and gene mutation explanations given and one is incorrect*	**3**

Question	Answer	Marks
3(c)(ii)	*allow correct use of extracted data to help confirm points* *allow ideas such as higher survival = greater (partial artemisinin) resistance* **Key** 20 / lower concentration = 20 nmol dm^3 DHA 700 / higher concentration = 700 nmol dm^3 DHA survival / survival rate = mean percentage survival rate of trophozoite *any **three** from conclusions **1** to **5**:*	**3**

1 zero survival of no mutation	cultures 1 <u>and</u> 4 / no mutations, no survival / 0% survival rate / all killed, at, higher concentration / 700 **;**
2 concentrations compared	lower concentration / 20, higher survival rate than, higher concentration / 700 **ora** higher concentration / 700, lower survival rate than, lower concentration / 20 **;** *general statement or can take one culture to compare*
3 mutation (C580Y and F446I) v no mutation (control / cultures 1&4)	(**A** and **B** strains with) mutation<u>s</u> higher survival rate than no mutation **ora** (**A** and **B** strains with) no mutation lower survival rate than mutation<u>s</u> **;** *general statement for both strains, or* **A***, or* **B** *(if concentrations mentioned, need to refer to both concentrations)*
4 compare strain **A** with strain **B**	strain **A** higher survival rate than strain **B** **ora** strain **B** lower survival than strain **A ;** *general statement or comparing groups e.g. 1 and 4* ***or*** *2 and 5* ***or*** *3 and 6 (for both or one concentration)*
5 C580Y v F4461	C580Y, higher survival than F446I / highest survival rate **or** F446I lower survival rate than C580Y **;** *general statement or compare 2 and 3, or 5 and 6, for both or one concentration*

Question	Answer	Marks
4(a)	*any **two** from:* presence of mucus can, hinder / prevent / AW, gas exchange / entry of air (to alveoli) / airflow (to alveoli) **; A** named gases detail **;** e.g. (lumens of) airways / respiratory bronchioles, are narrow **or** airways / respiratory bronchioles, are close to alveoli *suggestion that* respiratory bronchioles *have,* few / no, cilia present so difficult to move mucus / AW **;** **R** bronchioles do not have cilia *as a general statement* mucus increases distance for diffusion of (respiratory) gases / oxygen / carbon dioxide **;** **R** if direction of diffusion of gas is incorrect increased risk of infection from trapped pathogens if mucus present **;** AW	**2**
4(b)(i)	*any **three** from:* (bronchioles) have columnar, epithelium / cells **;** **A** columnar and cuboidal, epithelium / cells (bronchioles) have ciliated, epithelium / (epithelial) cells **; A** cilia (are present) **ora** (alveoli) have squamous, epithelium / cells **;** **I** endothelium / endothelial cells detail **;** e.g. (bronchiole epithelial cells) longer / wider / thicker **R** if, mucus makes it thicker / stated as more than one layer **or** (alveolar cells) flatter / thinner *allow ideas if stated as epithelium (rather than cells)* AVP **;** e.g. ref. to alveolar type II cells / cells secreting surfactant	**3**

Question	Answer	Marks
4(b)(ii)	smooth muscle **;** *plus any **two** from:* *max 1 for function if stretch and recoil **or** vasoconstriction / vasodilation stated* (muscle) contracts / contraction (and relaxation of bronchiole, lining / wall) **;** **R** contraction of, bronchiole / lungs / other airways change / decrease, diameter of, bronchiole / lumen / airway **;** **A** adjust size of airway **A** constriction of, bronchiole / airway control of air flow (to and from alveoli) / AW **;** e.g. control volume of air, entering / leaving, alveoli *allow ecf **max two marks** if incorrectly stated as elastic fibres* stretch / expand, during inhalation **;** **A** stretch and recoil prevents, overstretching / bursting, during inhalation **;** recoils to help move air out during exhalation**;** *allow ecf to **max one mark** if incorrectly stated as cartilage* prevent collapse of, bronchiole / airway **;** provides support / keeps airway open **;**	**3**

Question	Answer	Marks
5(a)	*any **three** from: accept gly for glycine throughout* glycine every third amino acid **;** glycine, is, small / smallest, amino acid **;** **A** has H as R-group glycine allows tight coiling of polypeptides to form triple helix **;** AW **A** glycine presence allows a, compact / AW, triple helix gly (-NH) can form hydrogen bonds with (C=O in pro of) other polypeptides of triple helix **;** **A** *idea that* H bonds can form with other polypeptides in the triple helix AVP **;** e.g. pro / ala, also small amino acids (for tight coiling) high proportion of smaller amino acids / amino acids with small side chains **A** high proportion of glycine *if mp1 not given and mp2 is* pro can form hydroxyproline for stability ref. insoluble and (some), amino acids with non-polar R-groups (e.g. ala)	**3**

Question	Answer	Marks
5(b)	*any **three** from:* **1** (Golgi /secretory) vesicles, detail **;** e.g. packaging of / containing, collagen vesicles bud off from Golgi body *context of movement to surface (not movement to other areas within cell)* **2** vesicles moved by, microtubules / cytoskeleton (to cell surface membrane) **;** **3** ATP required **;** **A** energy required / active process **R** active transport **4** fuse / merge / combine, with the <u>cell surface membrane</u> **;** **A** <u>plasma membrane</u> **5** AVP **;** e.g. budding from trans face of Golgi detail of fusion e.g. phospholipid bilayers merge into one	**3**
5(c)(i)	*any **two** from:* collagen, not broken down / not hydrolysed / breakdown prevented **;** **A** ECM *for collagen* **A** less hydrolysis / AW detail **;** e.g. suggestion that, collagen does not fit into active site / active site changes shape no / few, ESC / enzyme substrate complexes, form collagen, continues to be, synthesised / released **;** **A** increase in collagen / maintenance of collagen	**2**
5(c)(ii)	(V_{max}) decreases **;** (K_m) stays the same **;**	**2**

Question	Answer	Marks
6(a)	*any **two** from:* **1** (water is a) solvent, for, assimilates / minerals / ions / polar molecules **A** hydrophilic **A** named **or** substances, in xylem and phloem sap / that are transported, dissolve in water / are in solution **;** **A** (water is a) good / universal / versatile, solvent **2** feature for xylem **;** e.g. water can move up, as part of transpiration stream ref. cohesion between water molecules adhesion between water and, cellulose / wall of xylem / xylem lining hydrogen bonds for cohesion and adhesion **I** for cohesion-tension **3** feature for phloem **;** e.g. water used to build up, hydrostatic pressure / pressure gradient / pressure differences, for, mass flow / translocation / transport / AW *if not gained for mp2 allow similar ref. to cohesion / adhesion, for, phloem sap movement / transport* **4** AVP **;** e.g. (xylem sap) water moving down a water potential gradient contributes to transpiration stream	**2**
6(b)	**A** phloem sieve tube element **;** **B** companion cell **;** **C** companion cell **;**	**3**