Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

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.

[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.

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.

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.

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)	

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

Question	Answer	Marks
1(a)	actual width = image width ÷ magnification **;** **A** A = I ÷ M M = I ÷ A I = A × M or magnification triangle working = width divided by 4275 **;** e.g. 16 000 ÷ 4275 17 000 ÷ 4275 18 000 ÷ 4275 19 000 ÷ 4275 **;** 3.7 (μm) 4.0 (μm) 4.2 (μm) 4.4 (μm) **;** **R** answer if given to more than 1 dp or whole number	**3**
1(b)(i)	DNA – **A** / **B** / **C** **;** cellulose – **E** **;** phospholipid – **A** / **C** **;** histone proteins – **A** / **B** **;**	**4**
1(b)(ii)	chloroplast / mitochondrion **;**	**1**
1(b)(iii)	nucleus **;** **A** chloroplast / mitochondrion **R** nucleolus	**1**

Question	Answer	Marks
1(c)	*any two from* **1** (section at) high <u>resolution</u> **;** **A** suggestion of a correct value of resolution for a TEM **2** any named structure visible in Fig. 1.1 that can, only be seen in a TEM / not be seen in a photomicrograph **;** e.g. internal structure of chloroplasts / thylakoid(s) / grana e.g. internal structure of mitochondria / cristae **3** high magnification / higher magnification (magnification > 1000 / higher than with light microscope) **;** *in context of higher than light microscope* **4** (very) thin **;** **5** 2D / no surface contours / no surface features / AW **;** **A** not 3D	**2**

Question	Answer	Marks
2(a)	*any three from* **1** (diagram shows) hydrogen bond is a weak bond **;** **2** each oxygen (atom) forms two hydrogen bonds / each hydrogen (atom) forms one hydrogen bond **;** **3** (attraction) between oxygen (atom) of one water molecule and hydrogen (atom) of another (forms a hydrogen bond) **;** **R** cohesion / adhesion – *if used for attraction* **4** water is <u>dipolar</u> **;** **5** detail **;** e.g. electrons not shared equally between oxygen and hydrogen **A** oxygen is more electronegative (than hydrogen) **A** *ref. to* (two) lone pair(s) (of electrons) on oxygen **A** uneven distribution of, electrons / charge e.g. oxygen has, <u>small</u> / <u>slight</u>, negative charge / δ^-, **and**, hydrogen has, <u>small</u> / <u>slight</u>, positive charge / δ^+ *only needs to state 'small' once*	**3**

Question	Answer	Marks
2(b)(i)	*idea that* (H-bonds) maintain / AW, (shape / structure, form of) α-helices / β-pleated sheets **;** **A** allows formation of, α-helices / β-pleated sheets **R** if bonds are between R groups	**1**
2(b)(ii)	*any two from* **1** *idea that* hydrogen bonds help to, stabilise / AW, further folding of, amylase / polypeptide / protein **;** **2** between, R groups with amine and carboxyl groups **;** **A** between R groups with -NH and, -CO / -OH **3** *idea that* may be between amino acids far apart in primary structure **;** **4** *either* helps to maintain / form / AW, globular shape / 3D shape / structure (of amylase / polypeptide / protein) ***or*** maintains / forms / AW, (specific) shape / structure, of, active site / binding site **;**	**2**
2(c)	*any three from* **1** dissolves / AW, ions / minerals / salts, <u>and</u> (named) polar molecules **;** **A** 'assimilates' as polar **I** substances / nutrients **2** transports, solute(s) / named solutes / dissolved substance, in, xylem / phloem / xylem and phloem **;** **3** storage of, solutes / named solutes, in vacuoles **;** **4** metabolic / chemical / cellular, reactions occur in water **;** **5** dissolves, carbon dioxide / oxygen, with ref to, respiration / photosynthesis**;**	**3**

Question	Answer	Marks
3(a)	*any three from* **1** *differences in height show that* concentrations of sucrose, 0, 0.4 and 0.8 (mol dm^{-3}) *or* ⩽ / less than, 0.8 / 0.9, water moves out of Visking tubing **;** **A** one of 0, 0.4 or 0.8 **R** sucrose moving **2** concentrations of sucrose 1.2, 1.6, 2.0 (mol dm^{-3}) *or* ⩾ / more than, 0.9 /1.2, water moves into Visking tubing **;** **A** one of 1.2, 1.6 or 2.0 **R** sucrose moving **3** *ref. to* net water movement **;** *if water enters Visking tubing* – **A ora** *for water leaving* **4** external solution has higher water potential (than contents of Visking tubing) **;** **A** high water potential to low water potential **5** water moves, down, water potential / Ψ, gradient **;**	**3**

Question	Answer	Marks
3(b)	*mark whole question to a max of four marks* *descriptions* **1** at concentrations, less than / ⩽, 0.04 mol dm^{-3} all cells, burst / AW **;** **2** at concentrations between 0.04 and 0.14 mol dm^{-3} decreasing percentage of cells burst / AW **; A** use of percentages **3** at concentrations, greater than / ⩾, 0.14 mol dm^{-3} no cells, burst / AW **;** *explanations to max 3* **4** in low concentrations / ⩽ 0.04, of sodium chloride water moves into cells down water potential gradient / from high Ψ to low Ψ **;** **5** cells increase in, volume / size / internal pressure **;** **6** *either* cell membranes are not strong enough to withstand increase in volume / pressure **or** red blood cells burst because they have no cell wall **;** **7** between 0.04 and 0.14 (mol dm^{-3}) water potential gradient into cells, decreases / becomes less steep / AW **;** **8** above 0.14 (mol dm^{-3}) / in high concentrations, water potential inside cells is the same or higher than the sodium chloride solution **;** **9** at high concentration / ⩾ 0.14, water leaves cells / cells shrink / cells shrivel / cells show crenation **;**	**4**

Question	Answer	Marks
4(a)	*idea* of *shape needs to be in the answer for mp2 and mp4* **I** *'substrate changes shape'* *any three from* **1** active site is not (fully) complementary to substrate **;** **2** active site, changes shape / moulds around, to fit the substrate **;** **A** conformational change for shape change **3** enzyme-substrate complex / ESC, forms **;** **4** active site returns to original shape on release of product **;** **5** AVP **;** e.g. change of shape (to give complementary fit) lowers activation energy / puts strain on bonds / AW *ref. to* binding site / catalytic site (of active site)	**3**
4(b)(i)	***A** peroxidase for enzyme* *any three from* *rate of reaction increases as substrate concentration increases to 0.33 – 0.35 mmol dm^{-3}* **1** (up to 0.33 to 0.35 mmol dm^{-3}) some active sites are not occupied **;** **2** more collisions between, enzyme / active site, and substrate molecules **;** **A** more collisions lead to increase in formation of enzyme-substrate complexes *rate of reaction remains constant above 0.33–0.35 mmol dm^{-3}* **3** all active sites, occupied / saturated **;** **4** correct reference to limiting factor for slope **; A** limits / limiting e.g. at low substrate concentrations, substrate concentration limiting / enzyme concentration not limiting **5** correct reference to limiting factor for plateau **; A** limits / limiting e.g. at high substrate concentrations, enzyme concentration limiting / substrate concentration not limiting	**3**
4(b)(ii)	*idea that* determined V_{max} / maximum rate / *ref. to* 5.6 (μmol min^{-1}) **;** **A** if V_{max} shown on graph K_m is the substrate concentration at half the V_{max} **;**	**2**

Question	Answer	Marks
4(c)	*any three from* *in respiring tissue* **1** (carbonic anhydrase) catalyses the reaction between water and carbon dioxide in, red (blood) cells / erythrocytes **;** **2** to form carbonic acid, which dissociates to form HCO_3^- and H^+ **;** **A** from equation **A** use of word ion(s) **3** HCO_3^-, moves / passes / diffuses (through membrane proteins from red blood cells) into plasma **;** **4** (activity of enzyme) maintains (steep) concentration gradient for diffusion of carbon dioxide into red blood cells **;** **5** *idea that* so helps to remove large quantities of carbon dioxide **;** *in lungs* **6** (carbonic anhydrase) converts HCO_3^- back into carbon dioxide so can be, excreted / removed / exhaled **;** *if described earlier* **A** catalyses reverse reaction so carbon dioxide can be, excreted / AW	**3**

Question	Answer	Marks
5(a)	**1** vector is female *Anopheles* (mosquito) **;** **2** mosquito / (female) *Anopheles*, takes blood from infected person **; I** 'bites' alone **3** (vector / mosquito / *Anopheles*) inserts / AW, saliva / anticoagulant, with, pathogen / *Plasmodium* / parasite, into (blood of) uninfected person **;** **R** if incorrect type of pathogen	**2**
5(b)	B-lymphocytes / B-cells **;** fuse / combine / join / merge / AW **;** **R** hybridise / bind / bond hybridoma **;**	**3**

Question	Answer	Marks
5(c)	*any three from* **1** results are accurate (rely on monoclonal antibodies) **;** **2** results are obtained quickly / diagnosis is quick **;** **3** low cost / cheap **;** **4** does not need highly trained medical professional / easy to read / easy to use / AW **;** **5** does not need specialised equipment **;** **6** easily, transported / distributed (in bulk) **;** **7** can ensure appropriate treatment is given immediately malaria is confirmed **;** **8** reduces unnecessary use of antimalarial drugs (just in case) **;** **9** (a small area for S so) only a small sample of blood needed **;** **10** AVP **;** e.g. can identity different species of *Plasmodium* **I** *ref. to* line C and working correctly	**3**

Question	Answer	Marks
5(d)	***ignore*** *ref. to* sickle cell anaemia *any five from* *habitat of* Anopheles *mosquito* **1** tropical / warm and humid / AW, climate / regions **;** **A** in context of global warming (increases life span of *Anopheles*) **2** in areas where, *Anopheles* (mosquito) / vector, occurs **;** **3** *Anopheles* mosquitoes only live in humid conditions **;** **4** warm temperatures for, development / growth, of, parasite / *Plasmodium* (in vector / mosquito) **;** **5** warm temperature for, development / growth, of mosquito larvae **;** **6** mosquitoes require bodies of, still / AW, water for breeding **;** **A** ponds, puddles, lakes, swamps **7** mosquitoes require places where there is sufficient rainfall **;** **8** low altitude **;** *resistance* **9** insecticide / repellent, resistance of mosquitoes **;** **10** drug resistance of parasite **;** *prevention* **11** in countries / areas, where, prevention / control measures, are not implemented by, governments / health authorities **;** **12** further detail e.g. any example of a, prevention / control measure that is not used or not implemented fully **;** *immunity* **13** immunity to malaria in human population (limits distribution) **;** *people* **14** migration of infected people from areas (with high rates of malaria) **;** **15** high rates of HIV infection **;**	**5**

Question	Answer	Marks
6(a)	**A** rough endoplasmic reticulum **;** **E** Golgi, body / apparatus / complex **;**	**2**
6(b)	transport from, (R)ER / ribosomes, to Golgi **; A** from **A** to **E** **A** transport from Golgi to, cell surface membrane / phagosome **A** separate, acid hydrolases / enzymes, from, rest of cell / AW	**1**
6(c)	phagocytosis / endocytosis **;**	**1**
6(d)	*any three from* **1** break down / digest / destroy, bacteria / pathogen(s) **;** **2** break down / digest / destroy, (worn out / defective / AW), organelles / named organelle (in animal cell) **; A** autophagy **3** catalyse / speed up, hydrolysis **;** **4** any **two** named substrates **;** e.g. (any named) polysaccharides / proteins / (phospho)lipids / (named) nucleic acids **5** *idea that* recycle / reuse, biological molecules within cell **;** **6** (macrophage / phagocyte) cut up to present antigen **;**	**3**
6(e)	moves / pump(s), hydrogen ions / protons, into the lysosome against concentration gradient **;** active transport / uses ATP / energy from respiration / ref to conformational change of carrier **;** **R** if a ref to facilitated diffusion	**2**