CAMBRIDGE
International Education

Cambridge IGCSE™

BIOLOGY **0610/41**

Paper 4 Theory (Extended) **May/June 2024**

MARK SCHEME

Maximum Mark: 80

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 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

 [Turn over

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 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.

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.

Mark scheme abbreviations

- **;** separates marking points
- **/** alternative responses for the same marking point
- **R** reject the response
- **A** accept the response
- **I** ignore the response
- ecf error carried forward
- AVP any valid point
- ora or reverse argument
- AW alternative wording
- underline actual word given must be used by candidate (grammatical variants excepted)
- ( ) the word / phrase in brackets is not required but sets the context

Question	Answer	Marks	Guidance
1(a)	*any two from:* *(fish has)* fins / no legs / no limbs **;** scales / scaly skin **;** operculum **;** deeper body / larger ratio of depth to length **;**	**2**	**A** amphibian has (2 pairs of) legs **A** amphibian has smooth skin
1(b)	reptiles / birds **;**	**1**	
1(c)	*total of four from:* *similarities to max 3:* 1 both have, heart / blood vessels / capillaries / arteries / veins **;** 2 (heart with) one ventricle / no (visible) septum **;** 3 both have valves (in the heart) **;** 4 blood flows through atrium and then ventricle **;** 5 no (visible) separation of oxygenated and deoxygenated blood **;** *differences to max 3:* 6 fish have capillaries in gills **and** amphibians have capillaries in lung and skin **;** 7 fish have a single circulatory system **and** amphibians have a (incomplete) double circulatory system **;** 8 fish has a 2-chambered heart / amphibian has 3-chambered heart **;** 9 amphibians have two atria / fish have one atrium **;** 10 amphibians have a separate circuit to the, gas exchange surface / AW **;** 11 fish have one valve (in heart) / amphibians have three valves (in heart) **;**	**4**	MP7 **A** blood flows through the heart once <u>in a circuit</u> in fish and twice in an amphibian

Question	Answer	Marks	Guidance
1(d)	*any three from:* 1 ref. to double (rather than single) circulatory system **;** 2 (allows / maintains) high(er) blood pressure (to tissues / body) **;** 3 for faster / more efficient, transport, (named) substances / blood **;** 4 supports fast(er), metabolism / respiration **;** 5 allows lower pressure to lungs **;** 6 (lower pressure) allows more time for, gas exchange / absorption of oxygen **;** 7 prevents damage to lungs / AW **;** 8 AVP **;**	**3**	MP1 **A** separation of oxygenated and deoxygenated blood / heart has a septum MP8 e.g. ref. to temperature regulation
1(e)	*total of four from:* *arteries to max 3* 1 *idea of* arteries have <u>thick</u> walls to, withstand / cope with / deal with, high pressure **;** 2 arteries have (thick layer of) elastic tissue to, stretch / recoil (due to the changing pressure) **;** 3 arteries have (thick layer of) muscular tissue to change pressure **;** 4 arteries have narrow(er) lumen to maintain high pressure **;** 5 veins have valves to prevent backflow of blood (due to low pressure) **;** 6 veins have, thin walls / large lumen, to provide less resistance to blood flowing at low pressure / allow large volumes of blood / AW **;** 7 veins have thin walls so blood is moved by contraction of (surrounding) muscles / AW **;**	**4**	

Question	Answer	Marks	Guidance
1(f)	<table><tr><th>name of the organ</th><th>name of the artery that brings blood to the organ</th></tr><tr><td>lungs</td><td>pulmonary (artery) **;**</td></tr><tr><td>kidney **;**</td><td>renal artery</td></tr><tr><td>liver</td><td>hepatic (artery) **;**</td></tr></table>	**3**	

Question	Answer	Marks	Guidance
2(a)(i)	28.0 (°C) to 39.0 (°C) **;**	**1**	
2(a)(ii)	*any six from:* 1 (internal temperature is maintained by) homeostasis / negative feedback **;** 2 external temperature detected by, (thermo)receptors / sensory neurones, in the skin **;** 3 (nerve) impulses (via sensory neurones) to the brain **;** 4 change / increase / decrease in, blood / internal / core, temperature is detected by the brain **;** 5 (nerve) impulses are sent (via motor neurones) to (effectors in) the skin **;** *6, 7, and 8 when environmental temperature below body temperature / body is cold / before 3½ hours:* 6 vasoconstriction / <u>arterioles</u> become narrow **;** 7 decrease in blood flow (to capillaries), to / in, the skin **;** 8 shivering / increase in metabolism (to generate heat) / hairs raised (to trap air for insulation) **;** *9, 10 and 11 when environmental temperature above body temperature / body is hot / after 3½ hours:* 9 (increase in) sweating / produce sweat **;** 10 vasodilation occurs / <u>arterioles</u> widen **;** 11 increase of blood flow (to capillaries), to / in, the skin **;** 12 AVP **;**	**6**	MP5 **A** impulses are sent to, hair erector muscles / arterioles MP7 **A** less blood to surface of the body MP8 **A** increased metabolism described MP12 e.g. ref. to insulation

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2(b)</td><td>
<table>
<tr><th>name of the part</th><th>letter in Fig. 2.2</th><th>role in maintaining internal body temperature</th></tr>
<tr><td>fatty tissue
OR
hair</td><td>D

F</td><td>insulation</td></tr>
<tr><td>(hair) erector muscle</td><td>E</td><td>(contracts) to raise hair (to trap heat) / (relax to) lower hair (to lose heat)</td></tr>
<tr><td>receptor / sensor / sensory neurone</td><td>B</td><td>detect temperature changes</td></tr>
</table>
;;;</td><td>3</td><td>one mark for each correct row

in row one the letter must agree with name of the part given</td></tr>
</table>

Question	Answer	Marks	Guidance
3(a)	*total of five from:* *mitochondria to max 4:* 1 more in root hair cell / ORA **;** 2 (site of) <u>aerobic respiration</u> **;** 3 to, release / provide, energy **;** 4 for active, transport / uptake, of, minerals / ions / named ion(s) **;** 5 up/against, a concentration gradient **;** *chloroplasts to max 4:* 6 in palisade only / none in root hair cell **;** 7 no light reaches root hair cells / cells are underground *or* in soil **;** ora 8 (site of) photosynthesis **;** 9 contain chlorophyll **;** 10 transfers / changes, energy from light to, energy in chemicals / ATP **;** 11 to synthesise, glucose / carbohydrate **;**	**5**	MP5 **A** low to high concentration
3(b)(i)	group of, same (type) / similar, <u>cells</u> **;** carry out a, specific / same / common, function / role / job / task **;**	**2**	
3(b)(ii)	*any two from:* thick (cell) wall / (cell) wall with lignin **;** no end *or* cross walls / continuous tube / no cell contents / hollow **;** wide lumen / wide (tube) / large cross-sectional area / large (internal) diameter / AW **;** pits (in the walls) **;**	**2**	
3(b)(iii)	*any one from:* thick (waxy) cuticles **;** small (leaves) / small surface area / needle-like / AW **;** rolled / curled (leaves) **;** (leaves reduced to / leaves are) spines / spikes **;** hairs **;** fleshy / swollen **;** few stomata **;** sunken stomata / stomata in grooves **;**	**1**	

Question	Answer	Marks	Guidance
3(b)(iv)	deep / long shallow / widespread / spreading / roots cover a wide area **;**	**1**	

Question	Answer	Marks	Guidance
4(a)(i)	*any three from:* *row 1* – lactase breaks down <u>lactose</u> into glucose (and galactose in milk) **;** *row 2* – <u>lactose-free milk</u> has already been treated with lactase (so glucose is already present) **;** *row 3* – sucrose, is not broken down / does not contain lactose / AW **;** lactase is specific for breakdown of lactose / AW OR lactose only fits into active site of, lactase / enzyme **;**	**3**	*accept simple sugar(s) for glucose throughout* MP2 **A** lactose already broken down to glucose MP3 **A** lactase cannot breakdown sucrose MP4 **A** 'lactose is only complementary to lactase'

Question	Answer	Marks	Guidance
4(a)(ii)	*any four from:* 1 at optimum temperature maximum enzyme activity *or* rate of reaction OR outside the optimum / when cold / when hot, reduced, enzyme activity / rate of reaction **;** 2 at optimum temperature maximum, successful collisions / enzyme-substrate complexes (ESCs) OR outside the optimum / when cold / when hot, fewer, successful collisions / enzyme-substrate complexes (ESCs) **;** 3 as temperature increases kinetic energy increases / ora **;** 4 ref to denaturation at, high temperatures / temperatures above optimum **;** 5 (so) shape of active site changes **;** 6 (so) lactase is no longer complementary to the lactose **;** 7 AVP **;** e.g. ref. to temperature as a standardised variable	**4**	**A** enzyme and substrate for lactase and lactose MP2 **A** binding of lactose to lactase for ESC MP3 **A** at high temperatures kinetic energy is high / at low temperatures kinetic energy is low
4(b)(i)	*any two from:* milk contains, calcium **;** calcium / vitamin D, required for, healthy / strong / AW, teeth / bones **;** (calcium / vitamin D) prevent, rickets / any symptom of rickets **;** AVP **;**	**2**	e.g. vitamin D stimulates absorption of calcium calcium needed for, blood clotting / muscle contraction / nerve function
4(b)(ii)	*ref. to* all nutrients / all food groups / AW **;** *idea of* nutrients in the, correct / appropriate / healthy, proportions / amounts OR to provide suitable amount of energy for, level of activity / (stated) lifestyle(s) **;**	**2**	

Question	Answer	Marks	Guidance
5(a)	*any three from:* rate of transpiration increases and then remains constant with increasing temperature **;** ora (the rate of transpiration) is higher from the lower surface **;** rates of both become constant at (nearly) the same temperature **;** transpiration from lower surface increases, at a greater rate / faster, than from the upper surface (in X) **;**	**3**	
5(b)	*total of four from:* ***X*** *to max 3:* *as temperature increases and rate increases* 1 the rate of evaporation from the mesophyll (cells) increases **;** 2 the rate of diffusion of water vapour (through the stomata / from the leaf) increases **;** 3 particles / molecules, have more kinetic energy / move faster **;** 4 temperature is the limiting factor (for transpiration) **;** 5 more stomata opening / stomata open wider **;** ***Y*** *to max 3:* *as temperature increases and rate remains constant* 6 rate of diffusion of water vapour through stomata at a maximum **;** 7 evaporation from mesophyll (cells) at a maximum **;** 8 rate of movement of water in xylem slows **;** 9 rate of uptake of water is at a maximum **;** 10 the stomata are, all / fully, open **;** 11 humidity / light intensity / number of stomata, is the limiting factor **;**	**4**	
5(c)	more stomata on the lower surface ***I*** lower surface has a thinner cuticle **;** ora	**1**	

Question	Answer	Marks	Guidance
6(a)(i)	– 64 (%) / 64 (%) decrease **;;;**	**3**	MP1 selection of values from the graph MP2 correct calculation to any number of sig figs **and** negative value indicated MP3 correct rounding to two significant figures ecf from previous MP if evidenced
6(a)(ii)	*any five from:* 1 (vaccination confers) <u>active immunity</u> **;** 2 (vaccine contains) weakened / inactivated / dead / AW, virus / pathogen **;** 3 (vaccine) stimulates (primary) <u>immune response</u> **;** 4 lymphocytes produce antibodies **;** 5 antibodies, destroy / agglutinate / immobilise / kill, virus / pathogen **;** 6 antibodies, mark / attached to, virus / pathogen, so phagocytes destroy them **;** 7 production of memory cells **;** 8 long-term immunity / AW **;** 9 herd immunity / protecting unvaccinated people **;** 10 person to person transmission interrupted / prevents the spread of polio through the population / AW **;** 11 AVP **;**	**5**	MP2 **A** vaccine contains antigen(s) MP11 e.g. antibodies, are specific / complementary, to antigen antibodies bind to virus
6(a)(iii)	*any two from:* ref. to specificity (in context of antigen or antibody) **;** antibodies (produced in response to the polio vaccine) have a complementary shape only to polio antigens **;** antibodies bind only to polio virus **;** *idea that* memory cells (produced by polio vaccine) are not activated by other pathogens **;** AVP **;**	**2**	

Question	Answer	Marks	Guidance
6(b)	*total of three from:* (blood clot / scab) prevents entry of pathogens / pathogens trapped in mesh / (blood clot / scab) is a barrier to pathogens **;** *max two from:* conversion of fibrinogen to fibrin **;** conversion of soluble (protein) to, insoluble / fibrous (protein) **;** forms, network of fibres / mesh **;** ref to role of platelets **;** formation of a scab **;**	**3**	
6(c)	plasma **;**	**1**	

Question	Answer	Marks	Guidance
7(a)	nitrate / ammonium / phosphate(s) / ions **;** algae / plants / producers **;** light **;** photosynthesise **;** (aerobic) respiration **;** dissolved **;**	**6**	
7(b)(i)	sigmoid(al) **;**	**1**	
7(b)(ii)	lag **;**	**1**	
7(b)(iii)	*one from:* build-up of (named), toxins / waste / carbon dioxide **;** (change in) pH **;** high temperature **;** overcrowding **;** disease / virus attack **;**	**1**	