CAMBRIDGE
International Education

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CO-ORDINATED SCIENCES **0654/43**

Paper 4 Theory (Extended) **October/November 2024**

MARK SCHEME

Maximum Mark: 120

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 October/November 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.

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.

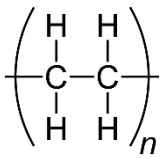
7 Guidance for chemical equations

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.

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>A trachea ;
B diaphragm ;</td><td>2</td></tr>
<tr><td>1(a)(ii)</td><td>any two from:
large surface area ;
thin (surface) (walls) ;
good blood supply ;
ventilation (with air) ;</td><td>2</td></tr>
<tr><td>1(a)(iii)</td><td>goblet (cells) ;</td><td>1</td></tr>
<tr><td>1(b)(i)</td><td>25 (breaths per minute) ;</td><td>1</td></tr>
<tr><td>1(b)(ii)</td><td><table>
<tr><td>There is a decrease in production of water vapour.</td><td></td></tr>
<tr><td>There is a decrease in the use of oxygen by muscles.</td><td></td></tr>
<tr><td>There is an increase in carbon dioxide concentration in blood.</td><td>✓ ;</td></tr>
<tr><td>There is an increase in the rate of aerobic respiration.</td><td>✓ ;</td></tr>
<tr><td>There is an increase in water intake.</td><td></td></tr>
</table></td><td>2</td></tr>
</table>

Question	Answer	Marks
2(a)	**D** ; contains oxygen / does not contain only carbon and hydrogen ;	**2**
2(b)	**A** ;	**1**

Question	Answer	Marks
2(c)	solvent ;	**1**
2(d)	contains only C-C single bonds ;	**1**
2(e)	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ correct formulae (reactants in either order and products in either order) ; balanced correctly ;	**2**
2(f)		**1**
2(g)	**addition polymerisation** only occurs in unsaturated monomers or monomers that contain C=C bonds / idea that involves the addition of many (identical) monomers (to make a long chained polymer) / monomers have one functional group / forms the polymer molecule only ; **condensation polymerisation** idea that two different monomers join together / (forms the polymer molecule and one) water molecule (per linkage) / monomers have two functional groups (one at each end) ;	**2**

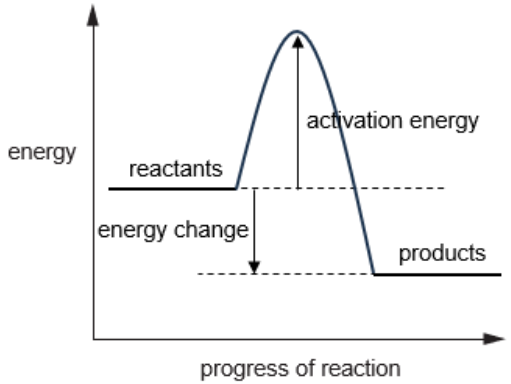
Question	Answer	Marks
3(a)(i)	correct thermistor symbol in correct place ; A and V correct ;	**2**

Question	Answer	Marks
3(a)(ii)	(Q =) It or 3×60 ; (Q =) 180 ; C / coulombs ;	**3**
3(b)	resistance (of thermistor) decreases ; current (in thermistor) increases ; reference to $P = IV$; power increases ;	**4**
3(c)	straight line goes / through the origin; Any one from: constant resistance ; current proportional to voltage ; obeys Ohm's law ; resistance = 1 ÷ gradient ;	**2**

Question	Answer	Marks
4(a)	**Y** root hair (cell) ; **Z (**root) cortex (cell) ;	**2**

Question	Answer	Marks
4(b)	contains lots of chloroplasts ; positioned at the top of the leaf (for maximum light) ; column-shaped / AW ; AVP ;	**2**
4(c)	decrease in evaporation (from the surfaces of mesophyll cells) ; due to a decrease in concentration / diffusion gradient (of water vapour) / AW ;	**2**
4(d)	transpiration ; water potential ; cohesion ;	**3**

Question	Answer	Marks
5(a)	carbon dioxide ;	**1**
5(b)	the reaction is fastest between **0** seconds and **16** seconds ;	**1**
5(c)	(50 cm^3 =) 0.050 dm^3 ; (moles = 0.050 ÷ 24) = 0.0021 ; **OR** (24 dm^3 =) 24 000 cm^3 ; moles = (50 / 24000 =) 0.0021 ;	**2**

Question	Answer	Marks
5(d)	molecules have higher (average) energy / molecules are moving faster ; more molecules with activation energy ; frequency of collision (of molecules) is higher / more collisions per second / more successful collisions ;	**3**
5(e)	 products shown below reactants ; energy change or ΔH correctly clearly indicated and labelled ; activation energy clearly indicated and labelled ;	**3**

Question	Answer	Marks
6(a)	(force per spring) 17000 ÷ 4 or 4250 ; (calculation of x) 1.7 (cm) ; (original length) 25.7 (cm) ;	**3**
6(b)(i)	20 000 (Hz):	**1**

Question	Answer	Marks
6(b)(ii)	parallel ; rarefactions ;	**2**
6(b)(iii)	(t =) 2.0×10^{-6} (s) ; (d =) $v \times t$ or $5200 \times 2.0 \times 10^{-6}$; (d =) 0.010(4) (m) ;	**3**

Question	Answer	Marks
7(a)(i)	lacteal ; absorption of fat / transport of fat ;	**2**
7(a)(ii)	thin walls / walls only one cell thick ; short diffusion distance ; for transfer of (named) nutrients ;	**3**
7(b)(i)	shorter / flatter / smaller AW ;	**1**
7(b)(ii)	less surface area ; for absorption (of nutrients) ;	**2**
7(c)(i)	marasmus / kwashiorkor ;	**1**
7(c)(ii)	biuret (solution) ;	**1**

Question	Answer	Marks
7(d)	<table><tr><th></th><th>involves enzymes</th><th>occurs in the mouth</th><th>produces soluble molecules</th></tr><tr><td>mechanical digestion</td><td></td><td>✓</td><td></td></tr><tr><td>chemical digestion</td><td>✓</td><td>✓</td><td>✓</td></tr></table> 1 mark for each correct row ;;	**2**

Question	Answer	Marks
8(a)	<table><tr><th>particle</th><th>charge</th><th>relative mass</th></tr><tr><td>electron</td><td>–1</td><td>**0.0005 / negligible / almost 0 / 1÷1835**</td></tr><tr><td>neutron</td><td>**0 / no charge**</td><td>**1**</td></tr><tr><td>proton</td><td>**+1**</td><td>1</td></tr></table> 1 mark for each correct column ;;	**2**
8(b)	giant covalent ;	**1**
8(c)	(graphite has) free / delocalised electrons ; which can move ;	**2**

Question	Answer	Marks
8(d)(i)	<table><tr><td></td><td>number of protons</td><td>number of neutrons</td><td>number of electrons</td></tr><tr><td>carbon-12</td><td>6</td><td>**6**</td><td>6</td></tr><tr><td>carbon-14</td><td>**6**</td><td>**8**</td><td>**6**</td></tr></table> 1 mark for each row ;;	**2**
8(d)(ii)	they (both) have the same number of electrons in the <u>outer</u> shell / they (both) have 4 electrons in the <u>outer</u> shell / they have the same electron(ic) structure / configuration ;	**1**
8(e)	Te^{2-} ;	**1**

Question	Answer	Marks
9(a)(i)	constant speed, for 20 s / 250 m ; stopping / stationary after 20 s / 250 m ;	**2**
9(a)(ii)	50 (s) ;	**1**
9(a)(iii)	(v =) 300 ÷ 60 or 5.0 (m / s) ; (KE =) ½ mv^2 or $0.5 \times 80 \times 5.0^2$; (KE =) 1000 (J) ;	**3**
9(b)(i)	(at **X**) the incident ray is at 90° / right angle to the surface / the angle of incidence is 0° / the incident ray is along the normal ;	**1**
9(b)(ii)	(at **Y**) <u>total internal reflection</u> occurs ; (because) **angle of incidence** is greater than the critical angle (for the two media) ;	**2**

Question	Answer	Marks
10(a)	provide oxygen ; for germination ;	**2**
10(b)(i)	phototropism ;	**1**
10(b)(ii)	auxin is made in the tip only ; so no cell elongation (stimulated) ;	**2**
10(c)	artificial ;	**1**
10(d)(i)	sepal labelled ;; 1 mark for correct part labelled 1 mark for correct name	**2**
10(d)(ii)	**any one from:** large petals ; anther / stamen / filament, inside flower ; stigma / style inside flower ; Idea that anther is below the stigma ;	**1**
10(e)	Less / no, synthesis / making of chlorophyll ; yellow leaves ;	**2**

Question	Answer	Marks
11(a)(i)	electrolysis ; carbon is less reactive than magnesium / ORA / carbon cannot displace the magnesium from the magnesium ore ;	**2**
11(a)(ii)	(idea that sodium atoms) form positive (sodium) ions more easily (than magnesium) / (idea that sodium atoms) lose electrons more easily (than magnesium) ;	**1**
11(b)	M_r of CO_2 = 44 / relative atomic mass of X = 163 – 44 / 163 – 32 – 12 ; 119 ;	**2**
11(c)	(moles of Fe_2O_3 = 800 / 160 =) 5 ; (moles of Al = 162 / 27 =) 6 ; (aluminium is limiting because) 6 mol is less than the (2 × 5 =) 10 mol (aluminium needed) **or** iron oxide is in excess because 5 mol is more than the (6 ÷ 2 =) 3 mol (iron oxide needed) ;	**3**
11(d)	oxidation because magnesium <u>atoms</u> lose electrons ; reduction because copper <u>ions</u> gain electrons ;	**2**
11(e)	oxidises **and** reduces ;	**1**

Question	Answer	Marks
12(a)(i)	(nuclear) fission ;	**1**
12(a)(ii)	geothermal ;	**1**
12(b)(i)	molecules (of steam) collide with the walls / container ; (collisions) exert a force (on the walls) ;	**2**
12(b)(ii)	increases ;	**1**
12(c)(i)	rotating coil experiences a **changing** magnetic, field / flux ; (output p.d.) is **induced** / reference to electromagnetic **induction** ;	**2**
12(c)(ii)	evidence of (KE / input energy) = output / efficiency × 100 or 3600 / 75 ×100 ; 4800 (J) ;	**2**
12(d)	$^{235}_{92}U \rightarrow {}^{231}_{90}Th + {}^{4}_{2}\alpha$ thorium correct ; alpha correct ;	**2**