

Cambridge Technicals Applied Science

Unit 1: Science fundamentals

Level 3 Cambridge Technical in Applied Science
05847 - 05849, 05874 & 05879

Mark Scheme for June 2022

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

TRADITIONAL

Before the Standardisation meeting you must mark at least 10 scripts from several centres. For this preliminary marking you should use **pencil** and follow the **mark scheme**. Bring these **marked scripts** to the meeting.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the traditional 40% Batch 1 and 100% Batch 2 deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or by email.

5. **Crossed Out Responses**

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of questions across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. (The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate). When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. (The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)

Short Answer Questions (requiring a more developed response, worth **two or more marks**)















If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional lined pages if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add an annotation to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
 - if there is nothing written at all in the answer space
 - OR if there is a comment which does not in anyway relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the questionNote: Award 0 marks - for an attempt that earns no credit (including copying out the question)
8. Assistant Examiners will email a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

9. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

10. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

11. **Subject-specific Marking Instructions****INTRODUCTION**

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

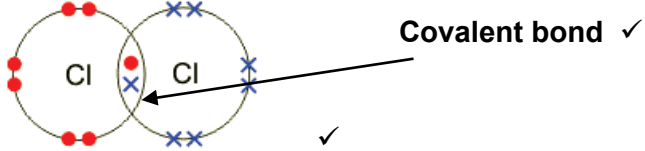
You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader

Question			Answer	Marks	Guidance
1	(a)	(i)	electromagnetic ✓	1	
		(ii)	strong nuclear ✓	1	DO NOT ALLOW unqualified nuclear
		(iii)	weak nuclear ✓	1	DO NOT ALLOW unqualified nuclear
		(iv)	electromagnetic ✓	1	
	(b)	(i)	84 ✓	1	
		(ii)	218 and 84	1	${}_{84}^{218}\text{Po}$ ALLOW 218 and 84 in reverse position ALLOW ecf for 84, using answer to (b)(i)
		(iii)	(different), mass number OR number of neutrons OR number of nucleons OR atomic mass ✓	1	ALLOW different half-lives DO NOT ALLOW electrons / protons
		(iv)	FIRST CHECK ANSWER ON ANSWER LINE If answer for R = 7.57×10^{-15} (m) award 2 marks $1.25 \times 10^{-15} \times 222^{1/3}$ or $1.25 \times 10^{-15} \times \sqrt[3]{222}$ ✓ 7.57×10^{-15} (m) ✓	2	ALLOW rounding to 7.6×10^{-15} (m) ALLOW correct value without $\times 10^{-15}$ = 1 mark max ALLOW correct value with incorrect power of ten = 1 mark max
	(c)	(i)	16 OR 6 ✓	1	

Question		Answer	Marks	Guidance
	(ii)	Any three from: Ionic ✓ Covalent ✓ Po is a metal AND H is a non-metal ✓ Po might behave like other Group 16 (6) non-metals ✓	3	IGNORE levels of reactivity ALLOW correct reference to electron exchange ALLOW covalent because O in the same group as Po forms a covalent bond with hydrogen
	(iii)	Tellurium has more than one isotope / has isotopes OR atomic mass is the mean of the isotopic masses	1	ALLOW average = mean IGNORE it is an isotope
		Total	14	

Question			Answer	Marks	Guidance
2	(a)	(i)	2,8,7 ✓	1	ALLOW 1s2 2s2 2p6 3s2 3p5
		(ii)		2	ALLOW only a covalent bond label line clearly directed at the overlapped area in the centre of the model drawn. MUST have overlapping intersections DO NOT ALLOW all dots or all crosses
	(b)		Any two from: electrostatic forces / attraction ✓ (between) oppositely charged / + and - ions ✓ strong bonds / bonds hard to break / requires lots of energy to break ✓	2	ALLOW ionic bonds between oppositely charged ions IGNORE references to electron shells
	(c)	(i)	(colourless to) red / brown / orange ✓	1	
	(c)	(ii)	$\text{Cl}_2(\text{aq}) + 2 \text{I}^- \rightarrow \text{I}_2(\text{aq}) + 2\text{Cl}^-$ ✓	1	2 correct responses = 1 mark MUST show charges
		(iii)	Chlorine / it is reduced AND it gains electrons ✓	1	
	(d)		(in solid NaI) particles are less free to move ✓ so less frequent collisions ✓	2	ALLOW particle must be in solution / solid needs to dissolve IGNORE references to packing / held tightly ALLOW reverse argument ALLOW correct reference to surface area
			Total	10	

Question			Answer	Marks	Guidance
3	(a)	(i)	<p style="text-align: center;">Label</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">X</div> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">Y</div> </div> <p style="text-align: center;">Structure</p> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Cristae</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Cytoplasm</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Cilia</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Stroma</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Thylakoid</div> </div> <p style="text-align: right;">✓✓</p>	2	
	(a)	(ii)	<p>(cellular / aerobic) respiration ✓</p> <p>Any two from:</p> <ul style="list-style-type: none"> • oxygen used / needed • glucose / sugar used / needed • carbon dioxide given out • water given out • does not need light energy / sunlight • does not use chlorophyll / photosynthetic pigment <p style="text-align: right;">✓✓</p>	3	<p>DO NOT ALLOW anaerobic respiration</p> <p>ALLOW reverse arguments for photosynthesis if qualified</p> <p>OWTTE</p> <p>IGNORE references to chloroplast / limiting factors / phases of photosynthesis / references to ATP</p> <p>DO NOT ALLOW energy creation / production / released</p>
	(b)	(i)	oxygen / O ₂ ✓	1	DO NOT ALLOW the symbol O
	(b)	(ii)	16/17 ✓	1	

Question		Answer	Marks	Guidance
	(b) (iii)	<p>Any three from</p> <p>Increasing distance means decreasing light intensity ✓</p> <p>Decreased light intensity linked to decreased rate (of photosynthesis) ✓</p> <p>Between 0.1 metres and 0.3 metres, light intensity does not affect rate / rate stays constant ✓</p> <p>From 0.3 metres, decreasing light intensity / increasing distance causes rate to decrease ✓</p>	3	<p>IGNORE reference only to bubbles / other limiting factors</p> <p>ORA ALLOW correct reference to distance of light if qualified with light intensity</p> <p>OWTTE</p> <p>OWTTE</p>
		Total	10	

Question			Answer	Marks	Guidance
4	(a)		connective ✓	1	
	(b)	(i)	Ca ²⁺ ✓	1	
	(b)	(ii)	<p>Any three from:</p> <p>myosin heads attach to actin ✓</p> <p>myosin and actin filaments slide over each other ✓</p> <p>actin filaments pulled inwards ✓</p> <p>Z lines move closer together ✓</p> <p>(this is called) the sliding filament theory ✓</p> <p>pulls the bones / parts of the skeleton together ✓</p>	3	<p>ALLOW thin = actin thick = myosin</p> <p>DO NOT ALLOW shorten / contract</p> <p>ALLOW sarcomere shortens</p> <p>IGNORE muscle shortens / contracts</p>
	(b)	(iii)	<p>relaxes ✓</p> <p>more ✓</p> <p>decreases ✓</p>	3	
			Total	8	

Question		Answer	Marks	Guidance								
5	(a)	peptide ✓	1	ALLOW (poly)peptide								
	(b)	<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 50%;">Molecule</th> <th style="text-align: left; width: 50%;">Role</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 5px; width: 50%;">DNA</td> <td style="border: 1px solid black; padding: 5px; width: 50%;">Brings the amino acids to the site of protein synthesis at the ribosome</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">Messenger RNA</td> <td style="border: 1px solid black; padding: 5px;">Copies the genetic code and carries this to the ribosome</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">Transfer RNA</td> <td style="border: 1px solid black; padding: 5px;">Holds the genetic code in the nucleus</td> </tr> </tbody> </table> <p style="text-align: right; margin-top: 10px;">✓✓</p>	Molecule	Role	DNA	Brings the amino acids to the site of protein synthesis at the ribosome	Messenger RNA	Copies the genetic code and carries this to the ribosome	Transfer RNA	Holds the genetic code in the nucleus	2	All 3 correct = 2 marks 1 or 2 correct = 1 mark
Molecule	Role											
DNA	Brings the amino acids to the site of protein synthesis at the ribosome											
Messenger RNA	Copies the genetic code and carries this to the ribosome											
Transfer RNA	Holds the genetic code in the nucleus											
	(c) (i)	has a membrane ✓ spherical shape ✓	2									
	(c) (ii)	golgi apparatus ✓	1									

Question		Answer	Marks	Guidance
	(c) (iii)	<p>Any three from</p> <p>enzyme is digestive ✓</p> <p>breaks down pathogens / bacteria / viruses ✓</p> <p>breaks down unwanted organelles ✓</p> <p>destroys the cell ✓</p> <p>general description of enzymes ✓</p>	3	<p>ALLOW phagocytosis / description of phagocytosis</p> <p>ALLOW autolysis / description of autolysis</p> <p>ALLOW e.g biological catalyst / active site / increases rate of reaction / references to activation energy / not used up / denatured by heat</p>
		Total	9	

Question			Answer	Marks	Guidance
6	(a)	(i)	(the hydrocarbon is) unsaturated ✓ it has a triple bond / not all bonds are single ✓	2	MARK as independent marking points
	(a)	(ii)	alkyne ✓	1	
	(a)	(iii)	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}\equiv\text{C}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$ ✓	1	
	(b)	(i)	Addition ✓	1	
	(b)	(ii)	triple bond breaks and forms a (single) bond with another monomer ✓	1	OWTTE
	(b)	(iii)	geometric ✓	1	
	(b)	(iv)	polymer has a double bond ✓ restricts free rotation (of the carbon atoms in the bond) ✓ two different groups / atoms on each carbon (in the double bond) ✓	3	ALLOW all marking points from correctly labelled diagrams.
	(c)	(i)	polystyrene ✓	1	
	(c)	(ii)	CH ✓	1	
			Total	12	

Question		Answer	Marks	Guidance
7	(a)	+ ✓	1	
	(b)	<p>Any one from:</p> <p>charge carriers (create a) potential difference action potential change in polarisation ✓</p>	1	ALLOW correct reference to synapse
	(c)	<p>Any four from:</p> <p>cytoplasm and tissue fluid no longer in isotonic balance ✓ cell / cytoplasm is hypertonic to surrounding tissue fluid ✓ (relative) amount / concentration of water in cell / cytoplasm lower than outside cell ✓ water moves into the cell (by osmosis) ✓ definition of osmosis ✓ cell expands / bursts ✓</p>	4	<p>OWTTE</p> <p>ALLOW tissue fluid is hypotonic to the cell</p> <p>ALLOW inside cell has a lower water potential than outside of cell ORA</p> <p>IGNORE movement / diffusion of ions</p> <p>MUST refer to (semi permeable / cell surface) membrane for osmosis definition</p>
	(d)	<p>(i) Any one from:</p> <ul style="list-style-type: none"> • hypertension • bipolar (affective disorder) • depression <p style="text-align: right;">✓</p>	1	<p>DO NOT ALLOW cancer</p> <p>ALLOW other conditions correctly treated using Lithium</p> <p>ALLOW schizophrenia</p> <p>ALLOW anxiety = depression</p> <p>IGNORE low mood</p>

Question		Answer	Marks	Guidance
(d)	(ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 56.1 (mg) award 2 marks</p> $\frac{300 \times 2 \times 6.9}{73.8} \text{ OR } (300 \times 2 \times 6.9) \div 73.8 \checkmark$ <p>56.1 (mg) ✓</p>	2	ALLOW only the correct value to 3 SF for 2 nd mark
(d)	(iii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3.03 OR 3 award 2 marks</p> $46 = \frac{466 \times \text{number of Li ions in formula} \times 6.9}{209.7} \checkmark$ <p>OR $46 = (466 \times \text{number of Li ions in formula} \times 6.9) \div 209.7 \checkmark$</p> <p>3.03 OR 3 ✓</p>	2	ALLOW any correct rearrangement
		Total	11	

Question	Answer	Marks	Guidance
8	<p>[Level 3] Candidate shows a high level of understanding of the phase diagram and gives a detailed explanation of the composition of lead-tin solder <i>(5 - 6 marks)</i></p> <p>[Level 2] Candidate shows an understanding of the phase diagram and explains the composition of lead-tin solder <i>(3 – 4 marks)</i></p> <p>[Level 1] Candidate shows a basic understanding of the phase diagram with little or no explanation of the composition of lead-tin solder. <i>(1 – 2 marks)</i></p> <p>[Level 0] Candidate response includes fewer than two valid points. <i>(0 marks)</i></p>	6	<p>Valid points include:</p> <p><i>Melting points</i></p> <ul style="list-style-type: none"> • (pure) lead = 327 °C • (pure) tin = 232 °C • alloying tin / lead lowers the melting point • melting point changes as the percentage / composition of solder changes <p><i>Phases (with clear to reference to named phase)</i></p> <ul style="list-style-type: none"> • B – molten lead • B – molten tin • C – solid tin • C – molten mixture / lead • D – solid lead • D – solid tin <p><i>Explanation</i></p> <ul style="list-style-type: none"> ○ (alloying tin / lead lowers the melting point) up to 62:38 (or reverse trend) / minimised ○ in a 62:38 mixture the melting point is 183°C ○ at 62:38 the solder melts and freezes sharply ○ electronic components can be joined more quickly and efficiently ○ a small amount of energy is needed to join components <p>DO NOT ALLOW temperature = melting point</p>
	Total	6	

Question		Answer	Marks	Guidance
9	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 25 (Ω) award 2 marks</p> $\frac{1}{R_t} = \frac{1}{47} + \frac{1}{22} \quad \text{or} \quad R_t = 15 \Omega \checkmark$ <p>Total resistance = 15 + 10 = 25 Ω \checkmark</p>	2	<p>ALLOW any correct rounding of 24.9855 Ω to more than 2 sig. figs.</p> <p>ALLOW 1 mark max for internal ecf - answer to mp1 +10</p>
	(b)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.26 (A) award 2 marks</p> $12 = 47 \times I_y \quad \text{OR} \quad (I_y =) 12/47 \checkmark$ $I_y = 0.26 \text{ (A)} \checkmark$	2	<p>ALLOW 0.255(3) / 0.3 (A)</p>
	(c) (i)	$I_x = 0.26 \times 47/22 = 0.56 / 0.555 \text{ (A)}$ <p>OR</p> $12/22 = 0.55 / 0.545 \text{ (A)} \checkmark$	1	<p>ALLOW ecf using answer given for (b).</p> <p>ALLOW 0.6 (A)</p>
	(c) (ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 48.6 (C) award 2 marks</p> <p>Total current = 0.55 + 0.26 = 0.81 (A) \checkmark</p> <p>Charge transferred = 0.81 x 60 = 48.6 (C) \checkmark</p>	2	<p>ALLOW 1 mark max for total current x60(s)</p>
	(d) (i)	$V_z = 0.81 \times 10 = 8.1 \text{ (V)} \checkmark$	1	
	(d) (ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 16.3 (W) award 2 marks</p> <p>Total voltage = 12 + 8.1 = 20.1 (V) \checkmark</p> <p>Power dissipated = 20.1 x 0.81 = 16.3 (W) \checkmark</p>	2	
		Total	10	

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