Cambridge Technicals
Applied Science

Unit 1: Science fundamentals

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

Mark Scheme for January 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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.

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 question

   Note: 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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>element</th><th>electronic structure</th><th>group number</th><th>period</th><th>proton number</th></tr>
<tr><td>W</td><td>2,4</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>X</td><td>2,8</td><td>0 OR 18</td><td>2</td><td>10</td></tr>
<tr><td>Y</td><td>2,8,6</td><td>6 OR 16</td><td>3</td><td>16</td></tr>
<tr><td>Z</td><td>2,8,8,2</td><td>2</td><td>4</td><td>20</td></tr>
</table>
✓✓✓✓</td><td>4</td><td>One mark for each correct row</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>W AND Y ✓</td><td>1</td><td>ALLOW responses in either order / lower case letters</td></tr>
<tr><td></td><td></td><td>(iii)</td><td><u>Calcium</u> ✓

$Ca \rightarrow Ca^{2+} + 2e^-$ ✓✓</td><td>3</td><td>Correct answer only

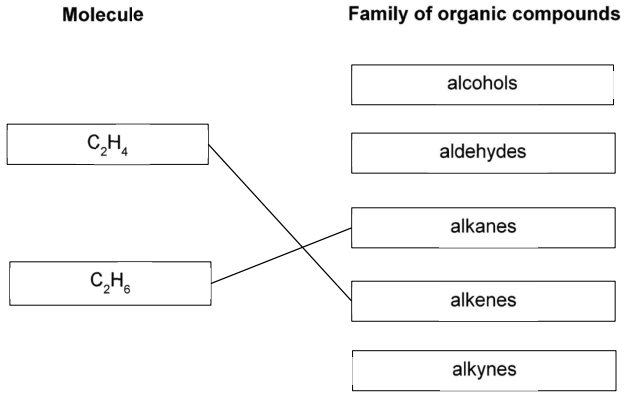
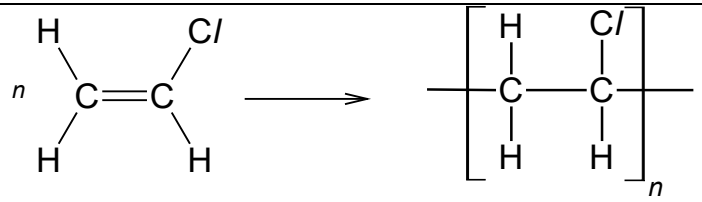
Correct response for calcium ion = Ca^{2+} (in any location) = 1 mark

Correct balanced equation = (e.g. $2Ca \rightarrow 2Ca^{2+} + 4e$) = 2 marks
DO NOT ALLOW = symbol instead of ⟶ symbol</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Na_2S ✓</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>8 ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>FIRST CHECK ANSWER ON ANSWER LINE
If answer = 3.01 x 10^{-15} (m) award 2 marks

R = 1.25 x 10^{-15} x $14^{1/3}$ ✓

= 3.01 x 10^{-15} (m) ✓</td><td>2</td><td>MUST be to 3 sf for 2 marks

ALLOW 3.01 (only) without working = 1 mark only</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Electromagnetic AND repulsion OR strong AND attraction</td><td>1</td><td>BOTH words needed for 1 mark</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Unstable AND weak ✓</td><td>1</td><td>BOTH words needed for 1 mark</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Strong AND short ✓</td><td>1</td><td>BOTH words needed for 1 mark</td></tr>
<tr><td colspan="4">Total</td><td>15</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
2	(a)		 ✓✓	2	
	(b)	(i)	Addition ✓	1	
		(ii)	Substitution ✓	1	
	(c)	(i)	C_2H_5Cl + $\mathbf{Cl_2}$ → $C_2H_4Cl_2$ + **HCl**	2	Correct left hand side of equation = 1 mark Correct right hand side of equation = 1 mark
		(ii)	**Definition of radical** (Species with an) unpaired electron ✓ **Explanation for reaction C** ultraviolet / UV light ✓ splits / breaks the chlorine molecule / bond ✓	3	**DO NOT ALLOW** atom / ion / molecule = species **IGNORE** free electron **ALLOW** high temperature / heat
	(d)		 structural formula of monomer✓ structural formula of one unit of polymer✓	2	**ALLOW** C*l* at top or bottom of monomer / mirror image **ALLOW** C*l* at top or bottom of one unit of polymer / mirror image **ALLOW** free bond lines in polymer that do **not** extend beyond brackets

Question			Answer	Marks	Guidance
	(e)	(i)	Polyethene ✓	1	**ALLOW** polythene / polyethylene
		(ii)	CH_2 ✓	1	
	(f)	(i)	Structural ✓	1	
		(ii)	**Structure** E ✓ **Justiifcation** (any three from) E is a **straight** chain / has **no branches**✓ Larger surface area **Stronger intermolecular** forces / between molecules ✓ Molecules can pack together (more) **closely**✓ Density = mass ÷ volume	4	**Mark structure and justification separately** **IGNORE** long chains **DO NOT ALLOW stronger** bonds. For 3rd mp, the answer must imply forces **between** molecules
			Total	18	

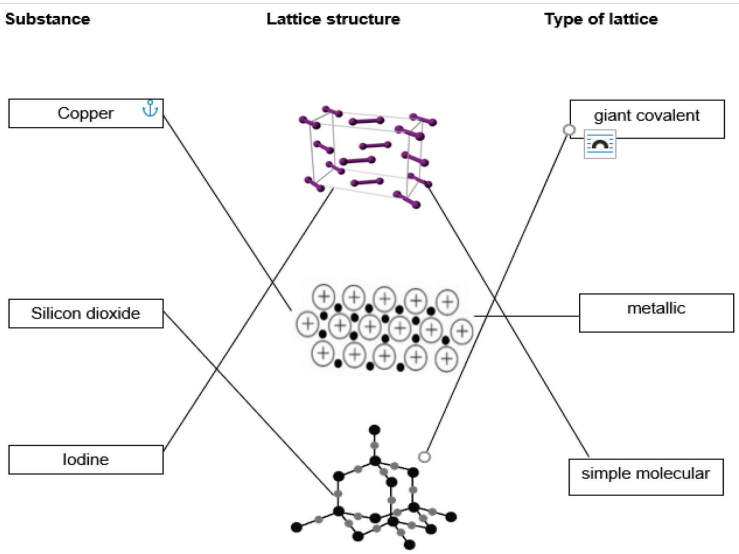
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>Any two from
• mitochondria
• nucleus
• chloroplast
• 80S-ribosome
• Golgi apparatus
• Lysosome ✓✓</td><td>2</td><td>ALLOW vacuole
ALLOW cellulose / lignin / chitin cell wall

IGNORE cell wall (unqualified)

IGNORE ribosome (unqualified)</td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><td>carbohydrate</td><td>✓</td></tr><tr><td>chlorophyll</td><td></td></tr><tr><td>lipid</td><td>✓</td></tr><tr><td>protein</td><td></td></tr><tr><td>RNA</td><td></td></tr></table></td><td>2</td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Ribosome ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Any two from
• protein synthesis
• packages protein (into a vesicle)
• sends protein to Golgi apparatus
• combines protein and carbohydrate / makes glycoprotein
✓✓</td><td>2</td><td>IGNORE carbohydrate synthesis

ALLOW protein transport/secretion/targeting</td></tr>
</table>

Question	Answer	Marks	Guidance
(d)	Any **four** from • (goblet cell) release / produce mucus • (mucus) traps dust / other foreign particles / dirt / pathogens / bacteria / viruses • cilia are small hair(-like) structures • cilia move the mucus (out of the lungs) • mucus moves up towards the mouth / buccal cavity / coughed (up) • mucus is swallowed ✓✓✓✓	4	**DO NOT ALLOW** cilia produce mucus **ALLOW** stops bacteria, dust etc from entering (the lungs) **IGNORE** stop infections **IGNORE** finger-like structures
	Total	11	

Question			Answer	Marks	Guidance
4	(a)		 ✓✓✓	3	One mark for each correct pair of lines for each lattice structure **ALLOW** all three left hand links correct = 2 marks max. **OR ALLOW** all three right hand links correct = 2 marks max.
	(b)		**Silicon dioxide:** **very strong covalent bonds** **OR** highest amount of **energy** required to break bonds / overcome forces ✓ **Copper:** **strong metallic bonds / electrostatics forces** **OR** intermediate amount of **energy** to break bonds / overcome forces✓ **Iodine:** **weak intermolecular / van der Waals forces** **OR** least **energy** required to break bonds / to overcome forces✓	3	**EITHER** award mark for **type AND relative strength** of bond/force **OR** award mark for amount of energy needed **DO NOT ALLOW** electrostatic forces
			Total	6	

Question			Answer	Marks	Guidance
5	(a)	(i)	biosynthesis of choline ✓	1	
		(ii)	Any **three** from • glucose molecules / sugar molecules / monosaccharides • many (glucose molecules/sugar molecules) / polysaccharide • condensation reaction / OH groups combine / water lost • glycosidic links/bonds form • glucose molecules appear as residues • C1-4 **AND** C1-6 links • (glycogen/polymer is) branching • overall reaction is glycogenesis ✓✓✓	3	**DO NOT ALLOW** glucose (molecules) if incorrectly qualified
		(iii)	Maltose ✓	1	
		(iv)	Starch ✓	1	**DO NOT ALLOW** Cellulose
	(b)	(i)	Any **two** from • support structure / shape / strength • protection • movement / mobility • produces blood cells / contains (bone) marrow • storage of minerals / calcium reservoir/store ✓✓	2	**ALLOW** any correctly named blood cell **IGNORE** calcium (unqualified)

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>(ii)</td><td>Composition
• connective tissue / fibres
• osteocytes / osteoclasts / osteoblasts / bone cells
• calcified/calcium (matrix) / contains calcium
• (bone) marrow / spongy layer/tissue/mass

Role of manganese
• activator of enzymes / essential for enzymes to work
• formation of matrix
✓✓✓✓</td><td>4</td><td>ALLOW for composition - periosteum / cartilage on contact surfaces / or correct alternatives
up to two marks max.</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 11.58 (mg) award 2 marks

Mass = 500 × 2.2 ÷ 95 ✓

= 11.58 (mg) ✓</td><td>2</td><td>

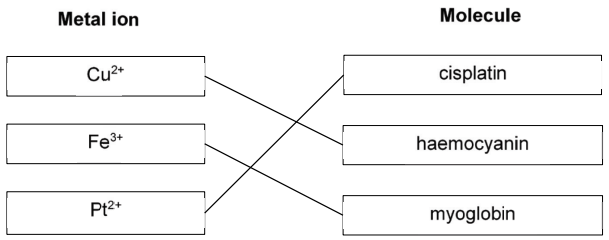
MUST be 2 dp for 2nd mp

ALLOW 11.6 / 11.57 / 12 = 1 mark max</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th>Brown rice</th><th>Pinto beans</th><th>Spinach</th></tr><tr><td>$\frac{1.8}{195 \times 1000} \times 100$
= 0.0009(%)</td><td>$\frac{0.8}{171 \times 1000} \times 100$
= 0.0005(%)</td><td>$\frac{0.3}{30 \times 1000} \times 100$
= 0.001(%)</td></tr></table>✓✓

Food type corresponds with lowest % manganese ✓</td><td>3</td><td>3 correct responses in table = 2 marks
1 or 2 correct responses in table = 1 mark

ALLOW brown rice = 0.00092 / 0.000923 / etc

ALLOW pinto beans = 0.00047 / 0.000468 / etc</td></tr>
<tr><td colspan="4">Total</td><td>17</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
6	(a)	(i)	 ✓✓	2	3 correct link lines = 2 marks 1 or 2 correct link lines = 1 mark
		(ii)	cancer treatment / chemotherapy / interrupts mitosis✓	1	**IGNORE** kills cancer cells
		(iii)	invertebrate✓	1	
	(b)	(i)	co-factor✓	1	**IGNORE** active site / specific example e.g. Nickel
		(ii)	hydrogenase ✓	1	
		(iii)	H_2O ✓ O_2 ✓	2	**ALLOW** formulae in either order **DO NOT ALLOW** the words water and/or oxygen

Question			Answer	Marks	Guidance
		(iv)	**[Level 3]** Candidate gives a detailed description of the graph **AND** explanation of the data. (5 – 6 marks) **[Level 2]** Candidate gives a limited description of the graph **AND** explanation of the data. (3 – 4 marks) **[Level 1]** Candidate gives a basic description of the graph **AND / OR** explanation of the data. (1 – 2 marks) **[Level 0]** Candidate response includes fewer than two valid points. (0 marks) ✓✓✓✓✓✓	**6**	**Valid points:** **Description of graph** • Time starts at 100(s) • As temperature is increased, time taken/speed decreases / graph goes down/negative gradient (until about 38°C) • Until 38°C (±2°C) • Increasing (negative) gradient / slope (until 38°C (±2°C)) • (After approx. 38°C) then the time increases as temperature is increased / graph goes up / positive gradient • Increasing (positive) gradient / slope (after 38°C (±2°C)) • Correct reference to optimum temperature at 38°C (±2°C) / shortest time taken was 10s **Explanation of data** • **Rate** increases up to 38°C (±2°C) / decreases after 38°C (±2°C) • As temperature increases **kinetic energy** / speed of the particles increases, • Particles **collide** more **frequently** (with each other / with the enzyme) • **More** particles (collide with) the required **activation energy** to react together • Enzyme becomes **denatured** with temperature above 38°C so rate decreases • Enzyme loses its **shape** so substrate/H_2O_2 cannot fit into active site • Activation energy is increased (above 38°C) **DO NOT ALLOW** decompose = denature
			Total	**14**	

Question			Answer	Marks	Guidance
7	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5.8×10^{28} award 2 marks** $n = 2.0 \div (5.0 \times 10^{-7} \times 4.3 \times 10^{-4} \times 1.6 \times 10^{-19})$ ✓ $= 5.8 \times 10^{28}$ (per m^3) ✓	2	**ALLOW** 5.81×10^{28} **ALLOW** 5.81/5.8 x10 (incorrect power) = 1 mark max
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2 (Ω) award 2 marks** $R (= V \div I) = 4 \div 2$ ✓ $= 2$ (Ω) ✓	2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8 W award 2 marks** $P = (V \times I) = 4 \times 2$ ✓ $= 8$ (W) ✓	2	
		(iii)	Any **three** from • **resistance** decreases(as wire length is shorter) ✓ • **current**, I increases ✓ • $v \propto I$ **OR drift velocity** is **proportional** to current ✓ • **resistance** is inversely proportional to drift velocity	3	
			Total	9	

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