Cambridge Technicals

Applied Science

Unit 1: Science fundamentals

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

Mark Scheme for January 2025

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.

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.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1.   Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training: OCR Essential Guide to Marking*.

2.   Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.

3.   Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

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 RM Assessor 50% and 100% (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, email or via the RM Assessor messaging system.

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 question 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 objects 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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

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 any way 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 is not an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8.   The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

9.   Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response: Not applicable in F501

   To determine the level – start at the highest level and work down until you reach the level that matches the answer

   To determine the mark within the level, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. **Annotations** available in RM Assessor

Annotation	Meaning
✔	Correct response
✘	Incorrect response
^	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

12. **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

13. **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)**	These particles reduce electrostatic repulsion in the nucleus → Neutrons These particles are responsible for making bonds with other atoms. → Electrons The number of these particles is the atomic number of an element. → Protons ✓✓✓	3	**ALLOW** 1 mark for each correct line
		(ii)	<table><tr><td></td><td>**Relative mass**</td><td>**Relative charge**</td></tr><tr><td>**Proton**</td><td>1</td><td>+1</td></tr><tr><td>**Neutron**</td><td>1</td><td>0</td></tr><tr><td>**Electron**</td><td>1/1840 **OR** negligible</td><td>−1</td></tr></table> ✓✓✓	3	**ALLOW** one mark for each correct row **ALLOW** + for +1 and – for -1 **ALLOW** "positive" for + and "negative" for - **ALLOW** 0 / zero, 1/1800 to 1/2000 **ALLOW** very small = negligible OWTTE

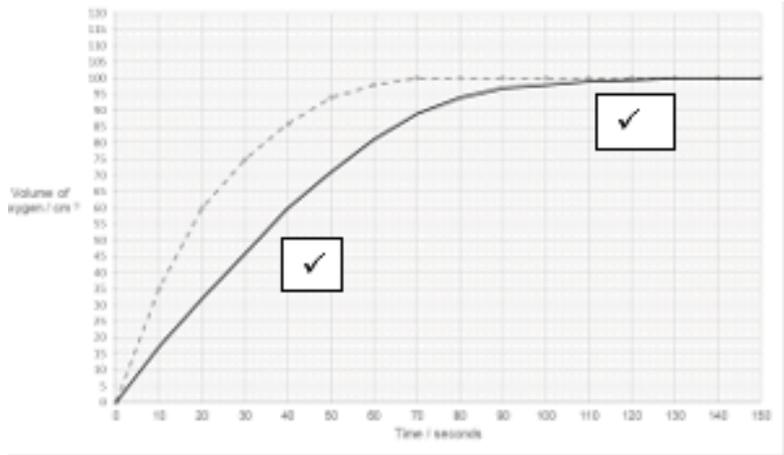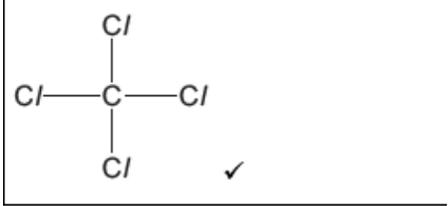|					
(b)	**(i)**	(One atom of P is 31 times) heavier / greater / larger / bigger than ✓ **1/12th** of the mass of a carbon-12 atom ✓	2	**IGNORE** references to mass / weight **ALLOW** 31/12 times bigger = **2 marks**	
	(ii)	2,8,5 ✓ 2,8,8 ✓	2	**ALLOW** $1s^2 2s^2 2p^6 3s^2 3p^3$ **OR** [Ne] $3s^2 3p^3$ **ALLOW** $1s^2 2s^2 2p^6 3s^2 3p^6$ **OR** [Ne] $3s^2 3p^6$	
(c)	**(i)**	**electrostatic attraction** between positive ions and negative ions	1	**ALLOW** electrostatic attraction between oppositely charged ions **IGNORE** references to metals / non-metals / electrons / unqualified charges/forces **DO NOT ALLOW** references to molecules	
	(ii)	Na_3P	1		
	(iii)	 3 pairs of bonding electrons AND 2 non-bonded electrons on P ✓ All four atoms have 8 outer electrons ✓	2	**ALLOW** dots or crosses for the Cl electrons. **ALLOW ONLY** a different symbol for the P electrons from the Cl electrons. **ALLOW** only bonding electrons within overlaps **ALLOW** correct numbers of electrons **IGNORE** distribution	
	(iv)	The electrons are shared unequally ✓	1	OWTTE **ALLOW** unevenly / not evenly / not equally **DO NOT ALLOW** references to charges/ions	
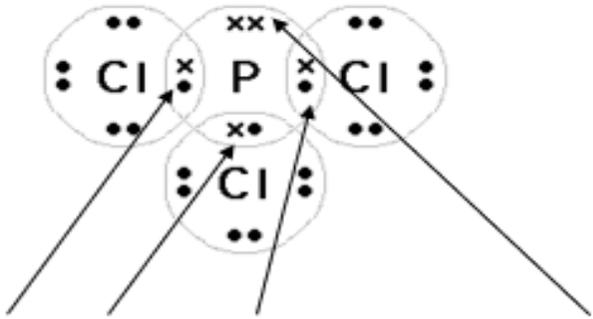
(d)	**(i)**	$Cl_2 + 2KBr \rightarrow Br_2 + 2\ KCl$ Correct balancing ✓ Correct formulae of products ✓	2	**ALLOW** correct balance of numbers of atoms ONLY = 1 mark **max**
	(ii)	 chlorine is more reactive than bromine ✓ iodine is less reactive than bromine ✓	2	ORA **ALLOW** order of reactivity is Cl> Br> I = **2 marks**
		Total	19	

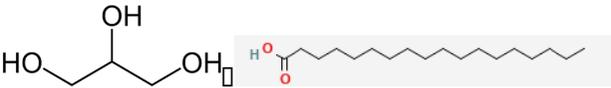| Question			Answer	Marks	Guidance
2	(a)	(i)	ribosomes ✓	1	
		(ii)		2	**ALLOW** 1 mark for correct links between type of endoplasmic reticulum and biological molecule **ALLOW** 1 mark for correct links between biological molecule and process
	(b)	(i)	Golgi apparatus ✓	1	
		(ii)	**Any two from;** ✓ ✓ • breakdown / destroys pathogens/(unwanted) bacteria/foreign bodies • breakdown / destroys (unwanted) organelles • autolysis/breakdown of the cell • releases digestive enzymes	2	**IGNORE** unqualified references to waste / unqualified materials **ALLOW** digest = destroy / correct ref. to phagosome **DO NOT ALLOW** engulfs **ALLOW** excretes = releases
	(c)	(i)	phosphate ✓	1	

Question			Answer	Marks	Guidance
		(ii)	**Any two from:** ✓ ✓ • DNA is double stranded / RNA is single stranded • DNA forms a (double) helix/spiral / RNA does not • DNA has deoxyribose (sugar) / RNA has ribose (sugar) • DNA has thymine / RNA has uracil	2	**IGNORE** references to location within the cell / size or length OWTTE **ALLOW** different sugars **ALLOW** ATCG / AUCG
		(iii)	**Any four from**: ✓✓✓✓ • the gene/genetic sequence/coded message (held in DNA) is **copied**/transcribed as/by <u>mRNA</u> • <u>mRNA</u> **leaves** nucleus (via a nuclear pore) • <u>mRNA</u> travels (through cytoplasm) to a **ribosome**/site of translation • <u>tRNA</u> (free) in **cytoplasm** • <u>tRNA</u> brings **amino acids** to the ribosome • <u>rRNA</u> produces/is part of ribosome • (binding site of) ribosome **joins** amino acids together / enables formation of a protein/polypeptide chain	4	**ALLOW** correct reference to transcription **IGNORE** unqualified ref. to transports **ALLOW** correct reference to translation/protein synthesis
	(d)	(i)	Pt^{2+} / platinum(II) ✓	1	**IGNORE** incorrect or no charge / oxidation number
		(ii)	interferes with DNA replication / mitosis / cell division/multiplication ✓ in cancer **cells** (but not in healthy cells) ✓	2	**ALLOW** inhibits (cancer) cell growth/division **ALLOW** killing cancer cells
			Total	16	

Question			Answer	Marks	Guidance
3	**(a)**	**(i)**	ammonium ✓	1	
		(ii)	$NH_4^+ + \textbf{3}\,H_2O \rightarrow NO_3^- + \textbf{10}\,H^+ + \textbf{8}\,e^-$ ✓✓ oxidised **AND** electrons are lost ✓	3	**ALLOW** 1 mark for the correct left side of the equation **ALLOW** 1 mark for the correct right side of the equation **ALLOW** correct multiples e.g. $2NH_4^+$ etc. **ALLOW** oxidation = oxidised
		(iii)	✓	1	**ALLOW** $-NH_2$
		(iv)	peptide ✓	1	**ALLOW** amide **IGNORE** covalent
	(b)	**(i)**	supports / binds / protects / gives structure to (other tissues) ✓	1	**IGNORE** holds together unless qualified (i.e. tissues/organs) **DO NOT ALLOW** ref. to strength
		(ii)	cells / fibrocytes (fibroblasts) ✓ fibres / elastin / collagen ✓ in a (gelatinous) matrix ✓	3	**IGNORE** ref. to layers **ALLOW** protein chains = fibres
			Total	**10**	
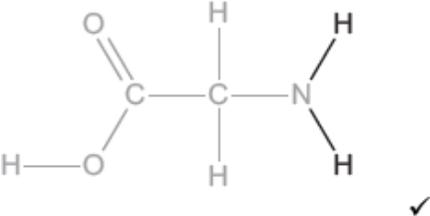
Question			Answer	Marks	Guidance
4	**(a)**		liver ✓	1	
	(b)	**(i)**	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer for average rate of reaction = 2.15 (cm^3 s^{-1}) award 2 marks** Volume of oxygen = 86 cm^3 ✓ Rate = 86/40 = 2.15 (cm^3 s^{-1}) ✓	2	**ALLOW** range from **2.12 to 2.17** for average rate of reaction = 2 marks **ALLOW** 85-87 inclusive for volume of oxygen **ALLOW** n/40 = 1 mark **max.**
		(ii)		2	**ALLOW** 1 mark for curve starting at 0,0 being **lower** than the original graph **ALLOW** 1 mark for graph becoming **horizontal** at 100 cm^3 **OR** tending towards 100cm^3 **DO NOT ALLOW** curve that plateaus below 100cm^3
		(iii)		1	

Question			Answer	Marks	Guidance
(c)	(i)		**Any two from:** ✓✓ • provides an alternative reaction pathway • (with) lower activation energy • more particles have enough energy to react • (provides a) surface/site for the reaction • correct alignment of reactant molecules	2	**ALLOW** more successful collisions
	(ii)		cofactors ✓	1	
	(iii)		**Any two from:** ✓✓ • matrix formation (in bone / cartilage structure) • choline formation (in the liver) • water splitting (in photosynthesis) • protein based transportation	2	**ALLOW** correct reference to oxidases (i.e. oxidases contain manganese ions) **ALLOW** decomposition of hydrogen peroxide
(d)			**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 23.91 (%) award 3 marks** Mass Mn consumed = $\frac{5.7}{2}$ or 2.85 (mg) ✓ Difference = 2.85 − 2.30 or 0.55 (mg) ✓ % difference = ($\frac{0..55}{2.30} \times 100$ =) 23.91% ✓	3	**ALLOW** 24 / 23.9 (%) = 3 marks **ALLOW** 2.85 (mg) seen anywhere in working space **IGNORE** negative sign **ALLOW** 124 (%) (2.85/2.30 x 100) = **2 marks**
			Total	**14**	

Question			Answer	Marks	Guidance
5	**(a)**	**(i)**	✓✓	2	**ALLOW** drawings with or without bonds shown between C and H atoms on CH_3 groups **ALLOW** either / both -CH_3 pointing either up or down on chain **ALLOW** -CH_3 on: • carbons 1 and 3 or 4 • carbons 2 and 3 or 4 **ALLOW** 1 mark **max**. for four (or more) carbon atoms joined by single bonds if diagram incorrect **IGNORE** brackets and the symbol 'n'
		(ii)	addition ✓	1	
	(b)	**(i)**	structural isomers ✓	1	
		(ii)	ester ✓	1	
		(iii)	propanoic acid ✓	1	**ALLOW** propionic acid
		(iv)	CH_3CH_2COOH + NaOH → CH_3CH_2COONa + H_2O ✓✓	2	**ALLOW** 1 mark for each correct formula **DO NOT ALLOW** "water" **ALLOW** $CH_3CH_2CO_2Na$ **ALLOW** responses in either order **IGNORE** coefficients

Question			Answer	Marks	Guidance
	(c)	(i)	**Displayed** CH₂—O—H CH—O—H CH₂—O—H ✓ C₁₇H₃₃—C(=O)—O—H ✓ **OR** **Structural** CH₂(OH)CH(OH)CH₂OH ✓ C₁₇H₃₃COOH / C₁₇H₃₃CO₂H ✓	2	**ALLOW** drawings with or without bonds shown between C and H atoms **ALLOW** any orientation of displayed formulae **ALLOW** functional groups written as -OH and -CO₂H **ALLOW** skeletal formulae **ALLOW** different type of formula in each box (e.g. displayed glycerol and skeletal fatty acid)

Question			Answer	Marks	Guidance
		(ii)	**[Level 3]** Candidate shows a high level of understanding of the function of a neuron **AND** the role of the myelin sheath **AND** the impact of a damaged myelin sheath. *(5 – 6 marks)* **[Level 2]** Candidate shows a clear understanding of the function of a neuron **AND** the role of the myelin sheath **OR** the impact of a damaged myelin sheath. *(3 – 4 marks)* **[Level 1]** Candidate shows a limited understanding of the function of a neuron **OR** the role of the myelin sheath **OR** the impact of a damaged myelin sheath. *(1 – 2 marks)* **[Level 0]** Candidate includes fewer than two valid points. *(0 marks)*	6	**Indicative valid points may include:** **Function of a neuron** • part of the nervous system • neuron = nerve cell • transmits/sends (electrical) impulses/signals/messages • at speed / quickly • (from) receptors/(from/to) brain • sensory, relay and/or motor neurons • spinal reflex arc / within the brain / periphery **Myelin sheath** • protects/insulates the axon/neuron • increases the speed of nerve impulse transmission • prevents / reduces transfer of impulses between (adjacent) neurons • gaps or nodes (of Ranvier) between parts of the sheath / Schwann cells • Na^+ / K^+ ion exchange • can only occur at the nodes • (so electrical) impulse can jump (from node to node) / saltatory response **Damaged myelin sheath** • the axon is not insulated/protected • Na^+ / K^+ ions can enter or leave axon at any point • impulses can jump from one neuron to an adjacent neuron • the transmitted electrical impulse is slower/hindered • makes it harder to move the body • e.g. poor muscle contraction / weakness • makes it harder to respond to stimuli • e.g. limited sense of touch / pain • may cause multiple sclerosis
			Total	**16**	

Question			Answer	Marks	Guidance
6	**(a)**	**(i)**	(constant) temperature **OR** (use the same) type of polymer / starch-based polymer ✓	1	**ALLOW** same cross-sectional area / mass **ALLOW** test immediately/at same time after mixing
		(ii)	**Any two from:** ✓✓ • measure the (original) length of the sample • suspend the sample (from a fixed point) • add a mass/weight (to the free end of sample) • allow the sample to stretch (until it breaks) • measure length of stretched sample • calculate extension • (extension/increase in length ÷ original length) x 100	2	OWTTE **ALLOW** use a ruler for one measurement only **ALLOW** material under stress = add weight/mass
		(iii)	**Any two from:** ✓✓ • as (%) glycerol increases (%) elongation increases / Young's modulus decreases • polymer/starch is made of chains held together by hydrogen bonds • glycerol breaks/dislodges the hydrogen bonds • glycerol breaks/weakens the forces between the polymer/starch chains • glycerol allows plasticiser and polymer to slide/neck • glycerol allows chains (within the polymer/starch) to slide over each other • glycerol allows chains (within the polymer/starch) to uncoil	2	OWTTE **ALLOW** correct use of data from table
	(b)		ability to withstand changes in length when under tension/compression/stress ✓	1	OWTTE **ALLOW** force needed to stretch (a material)
			Total	**6**	

Question			Answer	Marks	Guidance
7	**(a)**		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 1800 (C) award 2 marks** Charge = current x time (in seconds) ✓ 3 x 10 x 60 = 1800 C ✓	2	**ALLOW** one mark **max**. for charge = 30 C (i.e. no conversion to seconds) **ALLOW** Q = I x t / (Q =) 30 (C) x 60 (s)
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 134.85 or 135 (W) award 3 marks** $\frac{1}{R_t} = \frac{1}{10} + \frac{1}{2}$ = 0.6 **OR** R_t = 1.67/1.7 (**Ω**) ✓ I = V ÷ R_t = 15 ÷ 1.67/1.7 **=** 8.99/8.82/9 (A) ✓ $P = V\,I$ = 15 x 8.82/8.99/9 = 132.3/134.85/135 (W) ✓	3	**ALLOW** 134.7 = 3 marks **ALLOW** 375 (W) = 2 marks **max.** (mp2 & 3 ecf)) **ALLOW** ecf for 15 ÷ n **OR** **ALLOW** ecf for 15 x n = 1 **max.** **ALLOW** alternative method e.g. $I = V/R$ for both resistors: 15/10 = 1.5 **AND** 15/2 = 7.5 ✓ $P = V\,I$ for both resistors: 1.5 x 15 = 22.5 (W) **AND** 7.5 x 15 = 112.5 (W) ✓ (Total power = 22.5 + 112.5 = 135 (W)✓

Question			Answer	Marks	Guidance
	(c)		**Copper conducts electricity** because (outer shell) **electrons** ✓ are free to move **OR** are delocalised ✓ **Copper has a high melting point** because the, forces of attraction / bonds between the **metal ions** and **electrons** ✓ are strong **OR** difficult to break ✓	4	**IGNORE** ref. to ions **ALLOW** delocalised/free electrons = 2 marks **ALLOW** metallic bonds are strong = 1 mark **ALLOW** electrostatic force = force of attraction **IGNORE** electromagnetic force **ALLOW** requires a large amount of energy/heat needed to break
			Total	9	

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