

Higher

GCSE

Chemistry A Gateway Science

J248/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2022

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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.

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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 50% 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. Work crossed out:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
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 a tick 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 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 isn't 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.**
- If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.
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:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in *italics*) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in *italics*) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response question on this paper is **18**.

11. 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

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
✓	Separates marking points
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**.

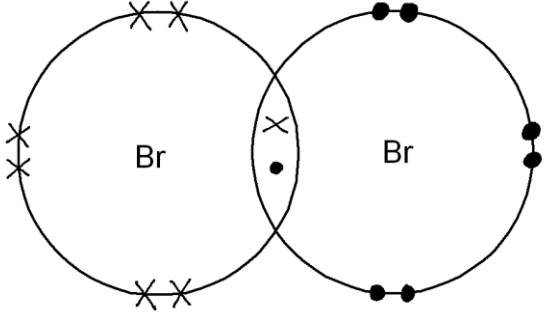
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry A:

	Assessment Objective
AO1	Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	B ✓	1	1.1	
2	B ✓	1	1.2	
3	C ✓	1	1.1	
4	A ✓	1	1.1	
5	D ✓	1	1.1	
6	D ✓	1	1.1	
7	C ✓	1	1.2	
8	C ✓	1	1.2	
9	B ✓	1	2.1	
10	B ✓	1	1.1	
11	D ✓	1	1.1	
12	B ✓	1	2.2	
13	C ✓	1	2.1	
14	D ✓	1	2.1	
15	A ✓	1	2.1	

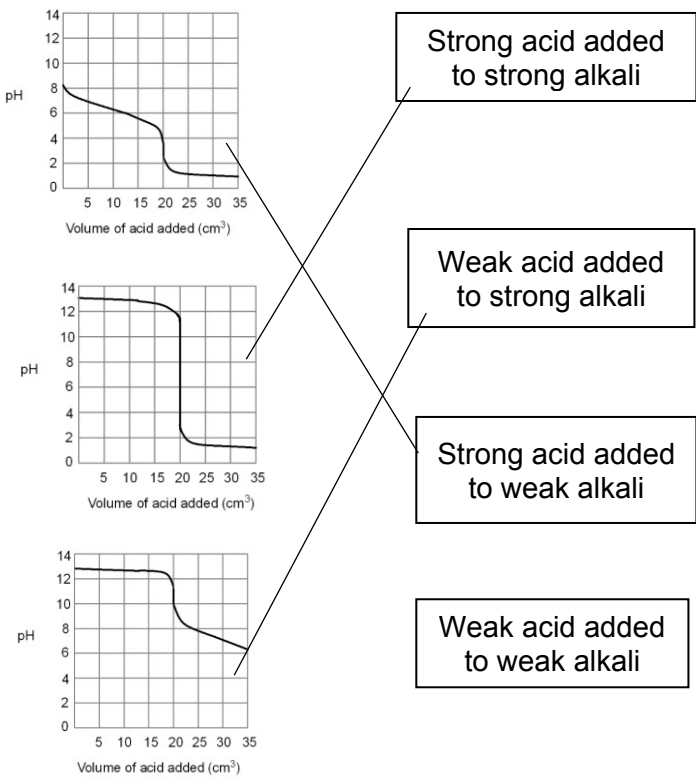
Question	Answer	Marks	AO element	Guidance
16 (a)	The model shows how many electrons the carbon atoms have. ☐ The model shows how many electrons the hydrogen atoms have. ☐ The model shows how much space each atom fills. ☐ The model shows that the carbon atoms are bigger than the hydrogen atoms. ☒ ✓ The model shows the difference between double bonds and single bonds. ☒ ✓	2	2 x 2.1	
(b)	 Shared pair of electrons ✓ Rest of structure correct ✓	2	2 x 1.2	ALLOW electrons as all dots, all crosses, or a mix of dots and crosses ALLOW diagrams with inner electron shells, but inner shells must be correct if shown Second marking point is dependent on one shared pair of electrons

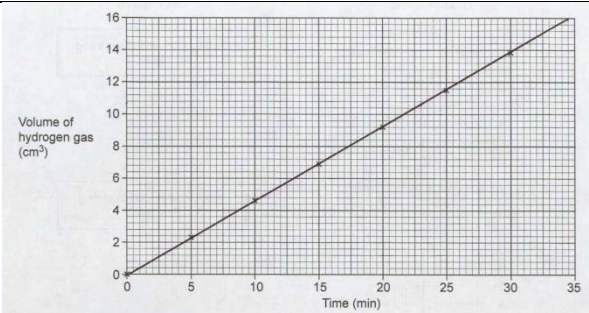
Question			Answer	Marks	AO element	Guidance
16	(c)		Any two from: Particles are closer together in bromine / further apart in ethene ✓ Particles move faster in ethene / move slower in bromine ✓ Particles have more energy in ethene / less energy in bromine ✓ Particles are arranged more randomly in ethene / less randomly in bromine ✓ Forces between particles are stronger in bromine / weaker in ethene ✓	2	2 x 2.1	Answers must be comparative ALLOW gas for ethene and liquid for bromine ALLOW 1 mark for 2 correct ideas without explicit reference to particles
	(d)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2 award 3 marks (2 x 12.0 = 24.0 and 4 x 1.0 = 4.0) ✓ OR 24.0 + 4.0 = 28.0 ✓ 187.8 – 28.0 = 159.8 ✓ 159.8 ÷ 79.9 = 2 ✓	3	3 x 2.1	ALLOW (2 x 12 = 24 and 4 x 1 = 4) ✓ OR ALLOW 24 + 4 = 28 ✓ ALLOW ECF from MP1 ALLOW ECF from MP2

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	(Paper / gas / thin layer) chromatography	1	2.2	ALLOW test or measure melting point / test or measure boiling point
		(ii)	C ₃ H ₇	1	2.1	ALLOW H ₇ C ₃ DO NOT ALLOW C ₃ H ₇ or C ³ H ⁷ or (C ₃ H ₇) ₂
		(iii)	Any four from: (Simple) distillation ✓ BUT fractional distillation ✓✓ Use of a condenser ✓ Description of liquid (hexane) <u>boiling</u> (to gas) and then condensing (back to liquid) ✓ Idea of heating the mixture to or higher than the boiling point of hexane ✓ Idea that (hexane will boil at a lower temperature than cyclohexane, so) hexane will be collected first ✓	4	4 x 3.3a	Marks can be awarded from a labelled diagram ALLOW 1 mark for a fractionating column when used with a condenser for idea of fractional distillation IGNORE condensing tube IGNORE idea of hexane evaporating ALLOW hexane will boil first
	(b)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 79(%) award 2 marks $\frac{12.0}{15.2} \times 100 = 78.947 \checkmark$ 79 (%) (2 significant figures) ✓	2	2 x 2.2	ALLOW ECF for sig fig mark
		(ii)	2C ₆ H ₁₄ + 19 O ₂ → 12 CO ₂ + 14 H ₂ O ✓	1	2.1	ALLOW correct multiples

Question		Answer	Marks	AO element	Guidance
18	(a)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Analyses the information to correctly identify all 3 solutions as acidic or alkaline AND Uses knowledge and understanding to accurately explain how both tests can determine the acidity/alkalinity of a solution <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Analyses the information to correctly identify all 3 solutions as acidic or alkaline OR Uses knowledge and understanding to attempt to explain how both tests can determine the acidity/alkalinity of a solution OR Analyses the information to correctly identify at least one solution AND discusses how one test can determine the acidity/alkalinity of a solution <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Analyses the information to correctly identify one solution as acidic or alkaline OR	6	3 x 1.1 3 x 3.2b	AO 1.1 Demonstrates knowledge and understanding of acids and alkalis • Acids react with carbonates • Alkalis do not react with carbonates • In the reaction between acid and carbonates, carbon dioxide is formed • Carbon dioxide is a gas, so bubbling will be observed • Alkalis are neutralised by the addition of acid • Acids are not neutralised by the addition of acid • Acid + alkali → salt + water AO 3.2b Analyses information and ideas to draw conclusions • Solution A is neutralised by hydrochloric acid • Solution B and C are not neutralised by hydrochloric acid (therefore must be acidic or neutral) • Solution A does not react with magnesium carbonate (therefore must be alkali or neutral) • Solutions B and C both react with magnesium carbonate • Solution B reacts more vigorously with magnesium carbonate than solution C • Solution A is an alkali • Solution B is an acid • Solution C is an acid • Solution B is a stronger or more concentrated acid than solution C

Question			Answer	Marks	AO element	Guidance
			Uses knowledge and understanding to explain one test and how it can determine the acidity of a solution. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.			

Question	Answer	Marks	AO element	Guidance
18 (b)	 Strong acid added to strong alkali Weak acid added to strong alkali Strong acid added to weak alkali Weak acid added to weak alkali	3	3 x 1.1	
(c)	$\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$ Correct formulae ✓ Correct state symbols ✓	2	2 x 1.1	ALLOW any correct multiple, including fractions ALLOW = instead of $\rightarrow$ DO NOT ALLOW and / & instead of '+' Second MP is dependent on the first

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)		1	1.2	LOBF must go through the origin
		(ii)	10.5 (cm ³) ✓	1	2.2	ALLOW Answer $\pm \frac{1}{2}$ square of their own graph
		(iii)	Cathode / negative electrode ✓	1	1.2	
		(iv)	Chlorine / Cl ₂ ✓	1	1.2	DO NOT ALLOW Cl DO NOT ALLOW Chloride / Cl ⁻
	(b)		Idea that hydrogen is produced (at the cathode) if ions from a more reactive metal (than hydrogen) are present / idea that only 1 ion is discharged at each electrode / discharge is based on the reactivity series / less reactive ions are discharged in preference ✓ Hydrogen is less reactive than sodium / ORA ✓ Copper is less reactive than hydrogen / ORA ✓	3	3 x 1.2	

Question			Answer	Marks	AO element	Guidance
	(c)		Weigh the <u>negative</u> electrode / <u>cathode</u> before the experiment ✓ Weigh the <u>negative</u> electrode / <u>cathode</u> with the copper formed ✓ Calculate the change in mass / mass increase ✓	3	3 x 3.3b	ALLOW idea of weighing <u>both</u> electrodes in MP1 and MP2 MP3 is independent of MP1 and MP2, i.e. MP3 can still be awarded if anode referred to ALLOW for MP3 weigh the mass of copper formed on the cathode / weigh the residue on the cathode ALLOW weigh the electrode before the experiment and weigh the electrode after the experiment for 1 mark if no other mark awarded

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.73 / 0.75 / 0.74 award 3 marks $R_f = \frac{\text{distance moved by dye}}{\text{distance moved by solvent}}$ ✓ BUT $R_f = 4.4 \div 6$ / $R_f = 4.5 \div 6$ / $R_f = 4.45 \div 6$ ✓✓ THEN $R_f = 0.73$ / $R_f = 0.75$ / $R_f = 0.74$ (2 significant figures) ✓	3	1 x 1.1 2 x 2.1	R_f calculation scores MP1 and 2 ALLOW ECF for sig fig mark
		(ii)	(Cake) 1 and (cake) 3 ✓ Idea that the spots in the dyes from cakes 1 and 3 match / cakes 1 and 3 both contain blue and yellow colours / idea that blue and yellow spots in cakes 1 and 3 have the same R_f values / idea that the dye in cake 2 contains different substances ✓	2	2 x 3.2b	Second marking point is dependent on choice of cakes 1 and 3 ALLOW cakes 1 and 3 have the same substances in them
	(b)	(i)	Formulation ✓	1	1.1	
		(ii)	Alloy ✓	1	1.1	
	(c)		(Use a different) solvent / mobile phase ✓	1	3.3b	ALLOW (use a different) stationary phase

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 248 (g) award 2 marks M_r of $P_4 = 4 \times 31.0 = 124.0$ ✓ Mass of $P_4 = 124.0 \times 2 = 248$ (g) ✓	2	2 x 2.2	ALLOW ECF from incorrect M_r (but not from A_r of 31.0, i.e. 2×31.0)
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1100 (g) award 3 marks Mole ratio $P_4 : PCl_3$ is 1 : 4 OR 2 moles of P_4 makes 8 moles of PCl_3 ✓ $M_r PCl_3 = 31 + (35.5 \times 3) = 137.5$ ✓ Mass of $PCl_3 = 137.5 \times 8 = 1100$ (g) ✓	3	3 x 2.2	ALLOW ECF from incorrect mole ratio and/or M_r
		(iii)	Limiting reagent – phosphorus / P_4 ✓ Moles of $Cl_2 = (866.2 \div 71.0 =) 12.2$ ✓ Mole ratio of $P_4 : Cl_2$ is 1 : 6 or 2 : 12 ✓ There are 2 mol of P_4 to 12.2 mol of Cl_2 / stoichiometry of 1:6.1 / Idea that the ratio is higher than the stoichiometry of the equation / higher than 1:6 or 2:12 ✓	4	1 x 2.2 1 x 1.2 2 x 2.2	ALLOW idea that the mass of chlorine needed is 852g and there is 866.2g ALLOW 12.2 moles of Cl_2 means that Cl_2 is in excess IGNORE simply there is less phosphorus than chlorine

Question			Answer				Marks	AO element	Guidance
21	(b)	(i)	Name	Melting point (°C)	Boiling point (°C)	State at room temperature	2	2 x 2.1	All 3 correct = 2 marks 1 or 2 correct = 1 mark
			Phosphorus trichloride	- 94	76	Liquid			
			Phosphorus pentachloride	161	167	Solid			
			Phosphorus trifluoride	- 152	-102	Gas			
			✓✓						
		(ii)	Phosphorus trifluoride ✓ Any two from: Idea that the weakest intermolecular forces require the least energy to break / the least energy to separate the molecules ✓ Idea that less energy to break the forces means a lower melting point and/or boiling point ✓ Idea that the weakest intermolecular forces mean a lower melting and/or boiling point ✓				3	1 x 2.1 2 x 1.1	ALLOW phosphorus trifluoride circled in the table DO NOT ALLOW references to covalent bonds or intermolecular forces between atoms ALLOW idea that phosphorus trifluoride is a gas (at room temperature)

Question			Answer	Marks	AO element	Guidance
		(iii)	Idea that giant covalent compounds have high melting points / high boiling points ✓ Phosphorus trichloride does not have a high melting point / boiling point or Phosphorus trichloride has a low melting point / boiling point ✓	2	2 x 3.1b	ALLOW idea that giant covalent compounds have <u>many</u> strong covalent bonds (which need to be broken) DO NOT ALLOW references to breaking intermolecular forces in giant covalent compounds ALLOW phosphorus trichloride is a liquid (at room temperature) DO NOT ALLOW references to strong intermolecular forces OR strong covalent bonds between molecules

Question			Answer	Marks	AO element	Guidance
22	(a)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.09×10^{-22} (g) award 3 marks Moles of zinc = $1 \div 6.02 \times 10^{23} = 1.66113 \times 10^{-24}$ ✓ Mass of one atom = $65.4 \times (1.66113 \times 10^{-24})$ = 1.086379×10^{-22} ✓ = 1.09×10^{-22} (g) (3 sig figures) ✓	3	3 x 2.1	ALLOW ECF from incorrect moles of zinc ALLOW ECF if significant figures correct from incorrect calculation of mass of one atom
	(a)		IF CANDIDATE USES AVOGADRO CONSTANT AS 6.02×10^{-23} FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.09×10^{24} (g) award 3 marks Moles of zinc = $1 \div 6.02 \times 10^{-23} = 1.6611296 \times 10^{22}$ ✓ Mass of one atom = $65.4 \times (1.66113 \times 10^{22})$ = 1.0863787×10^{24} ✓ = 1.09×10^{24} (g) (3 sig figures) ✓			ALLOW ECF from incorrect moles of zinc ALLOW ECF if significant figures correct from incorrect calculation of mass of one atom
	(b)	(i)	$\text{Zn}^{2+} + 2\text{Br}^- \rightarrow \text{ZnBr}_2$ Formulae ✓ Balancing ✓	2	2 x 2.1	ALLOW any correct multiple, including fractions ALLOW = instead of $\rightarrow$ DO NOT ALLOW and / & instead of '+' IGNORE state symbols balancing mark is dependent on the correct formulae but ALLOW 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. $\text{Zn}^{2+} + 2\text{BR}^- \rightarrow \text{ZnBr}_2$

Question			Answer	Marks	AO element	Guidance
		(ii)	Zinc bromide Idea that zinc bromide has ions that are free to move when zinc bromide is aqueous or molten / Idea that zinc bromide has ions that cannot move when zinc bromide is solid ✓ Zinc metal Has electrons ✓ (Electrons) can move / electrons can carry the charge ✓ BUT Delocalised electrons scores 2 marks	3	3 x 1.1	IGNORE just charged particles throughout the question DO NOT ALLOW electrons can move IGNORE bromine ions DO NOT ALLOW free ions IGNORE free (electrons) for idea of movement IGNORE electrons can carry the electricity
	(c)	(i)	B and D ✓	1	2.1	BOTH required for the mark
		(ii)	B ✓ (B is) a nanoparticle so it has a large surface area to volume ratio ✓ Idea that (B is) cheap and has a high purity ✓	3	3 x 3.2a	No marks awarded if B not given ALLOW B (is the smallest particle so) has the <u>largest</u> surface area to volume ratio

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