

Q3 a. This is correct. Which information have they used from the question to work out the answer?

- 3 The elements chlorine, bromine and iodine are part of group 7 in the periodic table.
- (a) The appearances of chlorine, bromine and iodine at room temperature are shown in Figure 10.

halogen	appearance
chlorine	green gas
bromine	red-brown liquid
iodine	grey solid

Figure 10

Astatine is the element below iodine in group 7.

Predict the appearance of astatine.

astatine will be a grey-black solid.

- *(b) The order of reactivity of chlorine, bromine and iodine can be determined by carrying out displacement reactions.

Explain how displacement reactions can be used to show the reactivity of these three elements.

By using displacement reactions we can work out the reactivity of the 3 elements chlorine, bromine and iodine. For example, if you were to add chlorine gas to bromine the bromine would displace the chlorine and bromine gas would be formed. The same goes for if you add iodine to bromine liquid, the iodine would displace bromine and form iodine liquid.

Q3 c ii. Why is this wrong? What do we call the reaction when atoms of bromine become ions? $\text{Br} \rightarrow \text{Br}^-$ Clue: OILRIG

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- (c) When iron wool is heated in bromine vapour, it reacts to form iron bromide.
- (i) In an experiment, 5.60 g of iron reacted exactly with 24.0 g of bromine, Br_2 .

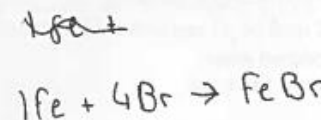
[relative atomic masses: Fe = 56.0, Br = 80.0]

Determine, using this information, the balanced equation for the reaction between iron and bromine.

You must show your working.

$$\frac{5.6}{56} = 0.1 \quad \frac{24.0}{80} = 0.3$$

$$0.1 : 0.3 = 1 : 3$$



Q3 c i. Why is this wrong? Work through these steps...

- Think about how many moles of each element you have
- work out the mole ratio
- Deduce an empirical formula for iron bromide (the product)
- Deduce LHS (the reactants) of equation so that it's balanced.

- (ii) When iron reacts with bromine, bromide ions are formed.

Explain the type of reaction bromine atoms undergo when they are converted to bromide ions.

When bromine atoms are converted to bromide ions they pair together and become charged.

(Total for Question 3 = 13 marks)

Q3 a. This is correct. Look at the pattern-halogens get darker in colour as you go down the group. The elements at the bottom of the group are solids.

3 The elements chlorine, bromine and iodine are part of group 7 in the periodic table.
 (a) The appearances of chlorine, bromine and iodine at room temperature are shown in Figure 10.

halogen	appearance
chlorine	green gas
bromine	red-brown liquid
iodine	grey solid

Figure 10

Astatine is the element below iodine in group 7.
 Predict the appearance of astatine.

astatine will be a grey-black solid.

(b) The order of reactivity of chlorine, bromine and iodine can be determined by carrying out displacement reactions.
 Explain how displacement reactions can be used to show the reactivity of these three elements.

By using displacement reactions we can work out the reactivity of the 3 elements chlorine, bromine and iodine. For example, if you were to add chlorine gas to bromine the bromine would displace the chlorine and bromine gas would be formed. The same goes for if you add iodine to bromine liquid, the iodine would displace bromine and form red iodine liquid.

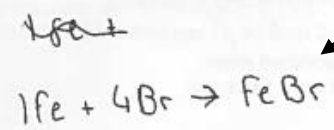
Q3 b. Why is this wrong?
 -What is the order of reactivity?
 -What displacement reactions would you do to show this order?
 -Can you state and explain what would see happen in these displacement reactions?
 -Can you write down the balanced symbol equations for these displacement reactions?

Q3 c ii. Why is this wrong? $\text{Br} \rightarrow \text{Br}^-$ Clue: OILRIG
 Bromine atoms have gained electrons so this is called reduction.

(c) When iron wool is heated in bromine vapour, it reacts to form iron bromide.
 (i) In an experiment, 5.60 g of iron reacted exactly with 24.0 g of bromine, Br_2 .
 [relative atomic masses: Fe = 56.0, Br = 80.0]

Determine, using this information, the balanced equation for the reaction between iron and bromine.
 You must show your working.

$$\frac{5.6}{56} = 0.1 \quad \frac{24.0}{80} = 0.3$$



Q3 c i. Why is this wrong?
 Work through these steps...
 -work out the mole ratio:
 $\frac{5.6\text{g}}{56} = 0.1$ $\frac{24}{80} = 0.3$
 Ratio = 1:3
 Formula for Iron bromide (the product) = FeBr_3
 - Deduce LHS (the reactants) of equation so that it's balanced.
 - $2\text{Fe} + 3\text{Br}_2 \rightarrow 2\text{FeBr}_3$

(ii) When iron reacts with bromine, bromide ions are formed.

Explain the type of reaction bromine atoms undergo when they are converted to bromide ions.

When bromine atoms are converted to bromide ions they pair together and become charged.

(Total for Question 3 = 13 marks)

Answers!

Question number	Answer	Mark
5(a)	Candidates relate information given to order of elements in the periodic table to predict: dark grey/black and solid/crystals	(1)

Question number	Indicative content	Mark
*5(b)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;">AO1 (6 marks)</p> <ul style="list-style-type: none"> order of reactivity: chlorine > bromine > iodine <p>The order of reactivity supported by suitable experiments from:</p> <ul style="list-style-type: none"> add (aqueous) chlorine to a solution of potassium bromide the solution turns orange/yellow bromine is produced / $\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}$ / $\text{Cl}_2 + 2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{Cl}^-$ (so) chlorine is more reactive than/displaces bromine /oxidises bromide ions add (aqueous) bromine to a solution of potassium iodide the solution turns brown iodine is produced / $\text{Br}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KBr}$ / $\text{Br}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Br}^-$ (so) bromine is more reactive than/displaces iodine/ oxidises iodide ions add (aqueous) chlorine to a solution of potassium iodide the solution turns brown iodine is produced / $\text{Cl}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KCl}$ / $\text{Cl}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Cl}^-$ (so) chlorine is more reactive than/displaces iodine/oxidises iodide ions <p>Allow use of suggested reactions which do not produce a displacement reaction, e.g. add (aqueous) bromine to a solution of a potassium chloride with suitable conclusion/explanation</p>	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas, enquiry, techniques and procedures lacks detail. (AO1) Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	<ul style="list-style-type: none"> Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	<ul style="list-style-type: none"> Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark												
5(c)(i)	<ul style="list-style-type: none"> calculates mol of Fe (1) calculates mol of Br₂ (1) determines simplest ratio/LHS of equation (1) deduces formula of iron bromide produced/RHS of equation (1) <p>OR</p> <ul style="list-style-type: none"> divides mass by relative atomic mass (1) simplest ratio (1) empirical formula (1) deduces LHS to obtain balanced equation (1) 	<p><u>Example of calculation</u></p> $\text{mol Fe} = \frac{5.6}{56} = 0.1$ $\text{mol Br}_2 = \frac{24}{(2 \times 80)} = 0.15$ <p>ratio Fe:Br₂ = 2 : 3/ 2Fe + 3Br₂</p> <p>2FeBr₃/Fe₂Br₆</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>Fe</td> <td></td> <td>Br</td> </tr> <tr> <td>$\frac{5.6}{56}$</td> <td>:</td> <td>$\frac{24}{80}$</td> </tr> <tr> <td>0.1</td> <td>:</td> <td>0.3</td> </tr> <tr> <td>1</td> <td>:</td> <td>3</td> </tr> </table> <p>FeBr₃</p> $2\text{Fe} + 3\text{Br}_2 \rightarrow 2\text{FeBr}_3$	Fe		Br	$\frac{5.6}{56}$:	$\frac{24}{80}$	0.1	:	0.3	1	:	3	(4)
Fe		Br													
$\frac{5.6}{56}$:	$\frac{24}{80}$													
0.1	:	0.3													
1	:	3													

Question number	Answer	Mark
5(c)(ii)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> bromine atoms are reduced (1) because electrons are gained to form bromide ions (1) 	(2)

Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> a limited description of at least one experiment in which any halogen solution is added to any halide solution (not of the same halogen) <p>OR describes order of reactivity as $\text{Cl} > \text{Br} > \text{I}$</p> <ul style="list-style-type: none"> the answer communicates ideas using simple language and uses limited scientific terminology spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> a simple description of at least two displacement experiments <p>AND</p> <ul style="list-style-type: none"> EITHER at least one correct explanation/conclusion <p>OR</p> <ul style="list-style-type: none"> at least one correct observation of a displacement reaction that works/balanced equation. the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> a detailed description of at least two displacement experiments <p>AND</p> <ul style="list-style-type: none"> (a total of) at least two correct explanations/conclusions <p>AND</p> <ul style="list-style-type: none"> at least one correct observation of a displacement reaction that works/ balanced equation the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately spelling, punctuation and grammar are used with few errors