

Group 7(Halogens) – Chlorine, Bromine, Iodine

Mark Scheme 3

Level	IGCSE(9-1)
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2C)
Topic	Inorganic Chemistry
Sub-Topic	Group 7 (Halogens) – Chlorine, Bromine Iodine
Booklet	Mark Scheme 3

Time Allowed: 63 minutes

Score: /52

Percentage: /100

Grade Boundaries:

9	8	7	6	5	4	3	2	1
>90%	80%	70%	60%	50%	40%	30%	20%	10%

Question number			Answer	Notes	Marks
1	a		B (red-brown liquid)		1
	b		2 (1) 2	Accept multiples and fractions	1
	c	i	a halogen/an element cannot displace itself OR no reaction / no displacement (would occur)	Accept a halogen does not react with <u>its own</u> (halide) ions Accept correct reference to a specific halogen/halide ion Accept nothing happens Reject any references to a halogen having the same reactivity as a halide (ion)	1
		ii	a halogen cannot displace a more reactive halogen OR a halogen cannot react with the (halide) ions of a more reactive halogen	Reject any references to a halogen having a different reactivity to a halide (ion) Accept correct reference to a specific halogen/halide ion	1
		iii	potassium bromide	Ignore any formula Reject any other species with corrected name	1

Question number			Answer	Notes	Marks
1		iv	<p>M1 (correct products) KCl AND I₂</p> <p>M2 2 2</p>	<p>Accept in either order</p> <p>M2 DEP on M1</p>	
	c	v	(both) reduction <u>AND</u> oxidation occur (in the same reaction)	<p>Accept (both) gain <u>AND</u> loss of electrons occurs (in the same reaction)</p> <p>Accept (both) gain <u>AND</u> loss of oxygen occurs (in the same reaction)</p> <p>Accept (both) increase <u>AND</u> decrease of oxidation states/oxidation numbers (in the same reaction)</p> <p>Ignore incorrect species being oxidised and reduced / losing and gaining electrons</p>	1

Question number	Answer	Notes	Marks									
2 a	<table border="1" data-bbox="321 386 995 570"> <thead> <tr> <th data-bbox="321 386 537 448">Halogen</th> <th data-bbox="537 386 751 448">Colour</th> <th data-bbox="751 386 995 448">Physical state</th> </tr> </thead> <tbody> <tr> <td data-bbox="321 448 537 509">bromine</td> <td data-bbox="537 448 751 509"></td> <td data-bbox="751 448 995 509">liquid</td> </tr> <tr> <td data-bbox="321 509 537 570">iodine</td> <td data-bbox="537 509 751 570">black</td> <td data-bbox="751 509 995 570"></td> </tr> </tbody> </table>	Halogen	Colour	Physical state	bromine		liquid	iodine	black		<p>M1 (bromine) liquid / (l)</p> <p>M2 (iodine) black allow (dark) grey</p>	2
Halogen	Colour	Physical state										
bromine		liquid										
iodine	black											
b	<pre> •• xx •• : Br x P x Br : •• xx •• x• •• : Br : •• </pre>	<p>M1 three bonding pairs of electrons correct</p> <p>M2 rest of electrons correct</p> <p>Accept any combination of dots and crosses Ignore circles</p>	2									
c	$\text{PBr}_3 + 3\text{H}_2\text{O} \rightarrow 3\text{HBr} + \text{H}_3\text{PO}_3$	<p>M1 all formulae correct</p> <p>M2 balanced M2 DEP on M1</p>	2									

Total 6 marks

Question number	Answer	Accept	Reject	Marks
3	<p>M1 – add (aqueous) chlorine to (aqueous) KBr</p> <p>M2 – (solution) turns orange</p> <p>M3 – add (aqueous) bromine to (aqueous) KI</p> <p>M4 - (solution) turns brown</p> <p>M5 – $\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}$</p> <p>OR</p> <p>$\text{Br}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KBr}$</p> <p>Ignore state symbols</p>	<p>yellow / brown</p> <p>red-brown / orange</p> <p>correct ionic equations</p> <p>accept $\text{Cl}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KCl}$ if chlorine is added to potassium iodide</p>	<p>red</p> <p>yellow</p>	5

Total 5 marks

Question number		Answer	Notes	Marks
4	a	bromine AND iodine	Accept symbols and formulae Do not accept names or formulae of ions	1
	b	hydrogen chloride hydrochloric acid	Ignore gas Ignore aqueous / solution / dilute / concentrated	1 1
			Award 1 for both correct names in wrong places	
	ii	M1 <u>white</u> smoke/solid/ cloud	Accept ring Reject precipitate Ignore powder / fumes	1
		M2 $\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$	Ignore state symbols	1
	iii	M1 <u>white</u> precipitate		1
		M2 aq s aq	Award 1 for s and 1 for both aq	2

Question number			Answer	Notes	Marks
4	c	i	hydrogen / H ₂	Ignore H	1
		ii	becomes smaller / disappears	Accept dissolves Ignore references to bubbles	1
		iii	acidic / contains (hydrochloric) acid / hydrogen ions / H ⁺ (ions)	Accept pH below 7 or any value below 7	1
		iv	not acidic / no (hydrochloric) acid (formed) / no hydrogen ions / no H ⁺ (ions) OR HCl/hydrogen chloride does not ionise / dissociate	Reject references to alkali(ne) or pH above 7 Ignore neutral Do not accept it/hydrochloric acid in place of HCl	1
TOTAL					12

Question number	Answer	Accept	Reject	Marks
5 (a)	(giant) ionic IGNORE three-dimensional / lattice		any other answer	1
5 (b)	<p>M1 and M3 can be scored from labelled diagrams</p> <p>sodium:</p> <p>M1 – positive ions/cations/Na⁺ <u>and</u> (delocalised/sea of) electrons IGNORE metal ions</p> <p>M2 – (electrostatic) forces/attraction between positive ions/cations/Na⁺ and (delocalised) electrons IGNORE references to metallic bonding</p> <p>sodium chloride:</p> <p>M3 – positive <u>and</u> negative ions/cations <u>and</u> anions / Na⁺ <u>and</u> Cl⁻ (ions)</p> <p>M4 – <u>electrostatic</u> forces/attraction between (oppositely charged/positive and negative) ions / cations and anions / Na⁺ and Cl⁻ IGNORE references to ionic bonding</p> <p>comparison:</p> <p>M5 - forces in Na are weaker (than forces in NaCl) can be awarded even if an incorrect description of the forces has been given. [standalone]</p>	<p>Sodium / metal ions</p> <p>oppositely charged ions</p> <p>chlorine ions if stated as being negative</p> <p>less energy required to overcome forces in Na bonds / lattice for forces ORA</p>	<p>atoms/molecules nuclei</p> <p>intermolecular forces</p> <p>atoms/molecules nuclei</p> <p>intermolecular forces</p> <p>reference to covalent loses M4</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>

Question number	Answer	Accept	Reject	Marks
5 (c)	<p>M1 - $n(\text{Na}) = \frac{0.138}{23}$ or 0.006</p> <p>M2 - $n(\text{H}_2) = \frac{1}{2} \times \text{M1}$ or 0.003</p> <p>M3 - vol. $\text{H}_2 = 24\,000 \times \text{M2}$ or 72 (cm^3)</p> <p>[Mark consequentially. $n(\text{Na})$ and $n(\text{H}_2)$ need not be evaluated.]</p> <p>correct final answer on its own without working scores 3</p>	0.072 <u>dm</u> ³		<p>1</p> <p>1</p> <p>1</p>

Question number	Answer	Accept	Reject	Marks
5 (d) (i)	M1 - (add dilute) <u>nitric</u> acid	addition of silver nitrate before nitric acid for both M1 and M2		1
	M2 - (add aqueous) silver nitrate	correct formulae throughout		1
	M3 - <u>white</u> precipitate / solid / suspension			1
(ii)	M3 dependent on M2			
	Reason – it fizzed / a gas was evolved OR sodium hydroxide would not fizz / produce a gas IGNORE incorrect identification of gas	sodium hydroxide is soluble		1
	X = <u>sodium</u> carbonate / <u>sodium</u> hydrogencarbonate			1
(e)	M1 - 8 electrons around Na	any combination of dots and crosses 0 electrons		1
	M2 - 8 electrons around Cl. IGNORE inner shells even if incorrect IGNORE starting diagrams showing atoms either with or without arrow to show movement of electron			1
	M3 - correct charge on <u>both</u> Na and Cl [standalone]			1
(f)	M1 - potassium is more reactive than sodium	reactivity increases down Group 1 ORA		1
	M2 - (but) bromine is less reactive than chlorine	reactivity decreases down Group 7 ORA	-ide endings	1
			Total	19