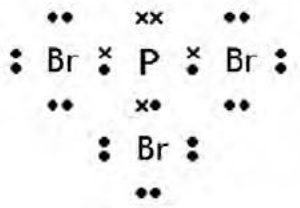
Question number			Answer	Notes	Marks
1	a		B (red-brown liquid)		1
	b		2 (1) 2	Accept multiples and fractions	1
	c	i	a halogen/an element cannot displace itself **OR** no reaction / no displacement (would occur)	Accept a halogen does not react with its own (halide) ions Accept correct reference to a specific 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	**M1** **M2**	(correct products) KCl AND I_2 2 2	Accept in either order M2 DEP on M1	
	c	v		(both) reduction AND oxidation occur (in the same reaction)	Accept (both) gain AND loss of electrons occurs (in the same reaction) Accept (both) gain AND loss of oxygen occurs (in the same reaction) Accept (both) increase AND decrease of oxidation states/oxidation numbers (in the same reaction) Ignore incorrect species being oxidised and reduced / losing and gaining electrons	1

		vi	**M1**	(species) I^- / iodide (ion)		1
			M2	(reason) loss of electron(s)	Accept increase in oxidation number **OR** oxidation number changes from −1 to 0 Ignore number of electrons lost **M2** DEP on **M1** correct, or near miss e.g. iodine	1
						Total 10 marks

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 a</td><td>
<table>
<tr><th>Halogen</th><th>Colour</th><th>Physical state</th></tr>
<tr><td>bromine</td><td></td><td>liquid</td></tr>
<tr><td>iodine</td><td>black</td><td></td></tr>
</table>
</td><td>M1 (bromine) liquid / (l)

M2 (iodine) black
allow (dark) grey</td><td>2</td></tr>
<tr><td>b</td><td></td><td>M1 three bonding pairs of electrons correct

M2 rest of electrons correct

Accept any combination of dots and crosses
Ignore circles</td><td>2</td></tr>
<tr><td>c</td><td>$PBr_3 + \mathbf{3}H_2O \rightarrow \mathbf{3}HBr + H_3PO_3$</td><td>M1 all formulae correct

M2 balanced
M2 DEP on M1</td><td>2

Total 6 marks</td></tr>
</table>

Question number	Answer	Accept	Reject	Marks
3	**M1** – add (aqueous) chlorine to (aqueous) KBr **M2** – (solution) turns orange **M3** – add (aqueous) bromine to (aqueous) KI **M4** - (solution) turns brown **M5** – $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$ OR $Br_2 + 2KI \rightarrow I_2 + 2KBr$ Ignore state symbols	yellow / brown red-brown / orange correct ionic equations accept $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ if chlorine is added to potassium iodide	red yellow	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	i		hydrogen chloride	Ignore gas	1
				hydrochloric acid	Ignore aqueous / solution / dilute / concentrated	1
					Award 1 for both correct names in wrong places	
		ii	M1	white smoke/solid/ cloud	Accept ring Reject precipitate Ignore powder / fumes	1
			M2	$NH_3 + HCl \rightarrow NH_4Cl$	Ignore state symbols	1
		iii	M1	white 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
(b)	M1 and M3 can be scored from labelled diagrams **sodium:** **M1** – positive ions/cations/Na^+ and (delocalised/sea of) electrons **IGNORE** metal ions **M2** – (electrostatic) forces/attraction between positive ions/cations/Na^+ and (delocalised) electrons **IGNORE** references to metallic bonding **sodium chloride**: **M3** – positive and negative ions/cations and anions / Na^+ and Cl^- (ions) **M4** – electrostatic forces/attraction between (oppositely charged/positive and negative) ions / cations and anions / Na^+ and Cl^- **IGNORE** references to ionic bonding **comparison:** **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]	Sodium / metal ions oppositely charged ions chlorine ions if stated as being negative less energy required to overcome forces in Na bonds / lattice for forces ORA	atoms/molecules nuclei intermolecular forces atoms/molecules nuclei intermolecular forces reference to covalent loses M4	1 1 1 1 1

Question number	Answer	Accept	Reject	Marks
5 (c)	**M1** - $n(Na) = \frac{0.138}{23}$ or 0.006			1
	M2 - $n(H_2)$ = ½ x **M1** or 0.003			1
	M3 - vol. H_2 = 24 000 x **M2** or 72 (cm^3)	0.072 $\underline{dm^3}$		1
	[Mark consequentially. $n(Na)$ and $n(H_2)$ need not be evaluated.]			
	correct final answer on its own without working scores 3			

Question number	Answer	Accept	Reject	Marks
5 (d) (i)	**M1** - (add dilute) nitric acid	addition of silver nitrate before nitric acid for both M1 and M2		1
	M2 - (add aqueous) silver nitrate	correct formulae throughout		1
	M3 - white precipitate / solid / suspension			1
	M3 dependent on **M2**			
(ii)	**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 = sodium carbonate / sodium 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 both 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**