

**Question 1**

1(b)(i)	2 (NaBr) (1) Br <sub>2</sub> (1)	2
1(b)(ii)	iodine is less reactive than bromine / bromine is more reactive than iodine	1
1(b)(iii)	bonding pair of electrons between iodine atoms (1) 6 non-bonding electrons on each iodine atom (1)	2

**Question 2**

2(d)(i)	I <sub>2</sub> (1) 2(KCl) (1)	2
2(d)(ii)	displacement	1
2(d)(iii)	(pale) yellow-green	1

**Question 3**

3(a)(i)	values between -100 °C and +58 °C (inclusive of these values)	1
3(a)(ii)	values between 3.20 and 10.0 (inclusive of these values)	1
3(a)(iii)	gas	1
	-10 °C is above the boiling point	1
3(b)(i)	displacement	1
3(b)(ii)	chlorine is more reactive than iodine / iodine is less reactive than chlorine	1

**Question 4**

4(a)	colour of astatine: black / grey-black	1
	boiling point of bromine: any value between 0 and 177 (°C)	1
	state of iodine at 190 °C: gas / vapour	1
4(b)(i)	potassium chloride	1
4(b)(ii)	chlorine is more reactive than bromine	1
4(b)(iii)	pair of electrons in overlap area between the atoms	1
	six unbonded electrons on each Cl atom in the molecule	1

**Question 5**

5(a)	substance containing only one type of atom / substance where the atoms have the same proton number	1
5(b)	water treatment / water purification / killing bacteria	1
5(c)(i)	2 (P) (1)	2
	5 (Cl <sub>2</sub> ) (1)	
5(c)(ii)	releases thermal energy / releases heat	1
5(d)(i)	bromine (1)	2
	sodium chloride (1)	
5(d)(ii)	(add nitric acid and aqueous) silver nitrate (1)	2
	cream precipitate / cream solid (1)	
5(d)(iii)	bromine is less reactive than chlorine / chlorine more reactive than bromine	1

**Question 6**

6(a)	electrons: 17 (1) neutrons: 20 (1) protons: 17 (1)	3
6(b)	to kill bacteria (1)	1
6(c)(i)	2 (KI) (1) 2 (KCl) (1)	2
6(c)(ii)	chlorine is more reactive than iodine / iodine is less reactive than chlorine	1
6(d)(i)	boiling point of fluorine: values between $-40$ and $-210$ (inclusive of these values) (1)  density of chlorine: values between $1.6$ and $3.0$ (inclusive of these values) (1)	2
6(d)(ii)	solid (1)  $-105\text{ }^{\circ}\text{C}$ is lower than the melting point / the melting point is above $-105\text{ }^{\circ}\text{C}$ (1)	2

**Question 7**

7(a)(i)	melting point of chlorine: values between $-10$ and $-210$ (inclusive of these values) (1)  density of fluorine: values lower than $0.003$ (inclusive of this value) but not below $0.0001$ (1)	2
7(a)(ii)	gas (1)  $0\text{ }^{\circ}\text{C}$ higher than the boiling point / the boiling point is below $0\text{ }^{\circ}\text{C}$ (1)	2
7(b)(i)	2 ( $\text{F}_2$ ) (1) 4 ( $\text{HF}$ ) (1)	2
7(b)(ii)	gain of oxygen / addition of oxygen	1

**Question 8**

8(a)	fluorine	1
8(b)	red-brown <b>AND</b> liquid	1
8(c)	<b>M1</b> Ts <b>M2</b> 7	2
8(d)(i)	<b>M1</b> pair of electrons <b>M2</b> electron(s) shared between <b>two</b> atoms	2
8(d)(ii)	iodide / astatide / tenesside	1
8(d)(iii)	bromine is more reactive than iodine / astatine / tenessine	1
8(e)	<b>M1</b> cobalt(II) chloride <b>M2</b> anhydrous	2

## Question 9

9(a)(i)	<b>M1</b> Ag column all X (1) <b>M2</b> X in Pb <b>AND</b> 2 ✓ in Zn (1) <b>M3</b> Zn, Mn, Pb Ag (1)	3
9(a)(ii)	(all) nitrates are soluble <b>OR</b> lead sulfate is insoluble	1
9(a)(iii)	$\text{Zn} + 2\text{AgNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{Ag}$ <b>M1</b> $\text{Zn}(\text{NO}_3)_2$ on the right hand side (1) <b>M2</b> correct equation (1)	2
9(b)(i)	<b>M1</b> colourless (1) <b>M2</b> orange (1)	2
9(b)(ii)	$\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{Cl}^-(\text{aq})$ <b>M1</b> $\text{Br}_2 + \text{Cl}^-$ as products (1) <b>M2</b> correct equation (1) <b>M3</b> state symbols (1)	3
9(b)(iii)	tenessine / Ts	1

## Question 10

10(c)	solid	1
10(d)(i)	colourless (1) orange / brown / yellow (1)	2
10(d)(ii)	$\text{Br}^-$ (1) loses electron(s) (1)	2