

**Group 17 – 2016**

1. 9701/11/O/N/16/14

The properties of chlorine, bromine and their compounds are compared.

Which property is **smaller** for chlorine than for bromine?

- A bond strength of the hydrogen-halide bond
- B first ionisation energy
- C solubility of the silver halide in  $\text{NH}_3(\text{aq})$
- D strength of the van der Waals' forces between molecules of the element

2. 9701/11/O/N/16/17

Compound **T** is a white crystalline solid.

When a sample of **T** was mixed with aqueous sodium hydroxide and heated, a pungent smelling gas was produced which turned damp red litmus paper blue. This same gas produced dense white smoke with hydrogen chloride gas.

Further testing of a solution of **T** with barium chloride solution produced a dense white precipitate which did not dissolve when dilute hydrochloric acid was added to the mixture.

What is the identity of compound **T**?

- A ammonium carbonate
- B ammonium sulfate
- C sodium carbonate
- D sodium sulfate

3. 9701/12/O/N/16/15

When chlorine reacts with hot aqueous sodium hydroxide, two chlorine-containing ions are formed. One of these is the chloride ion,  $\text{Cl}^-$ .

What is the other ion?

- A  $\text{ClO}^-$
- B  $\text{ClO}_2^-$
- C  $\text{ClO}_3^-$
- D  $\text{ClO}_4^-$

4. 9701/11/O/N/16/19

X, Y and Z represent different halogens. The table shows the results of nine experiments in which aqueous solutions of  $X_2$ ,  $Y_2$  and  $Z_2$  were separately added to separate aqueous solutions containing  $X^-$ ,  $Y^-$  and  $Z^-$  ions.

	$X^-(aq)$	$Y^-(aq)$	$Z^-(aq)$
$X_2(aq)$	no reaction	no reaction	no reaction
$Y_2(aq)$	$X_2$ formed	no reaction	$Z_2$ formed
$Z_2(aq)$	$X_2$ formed	no reaction	no reaction

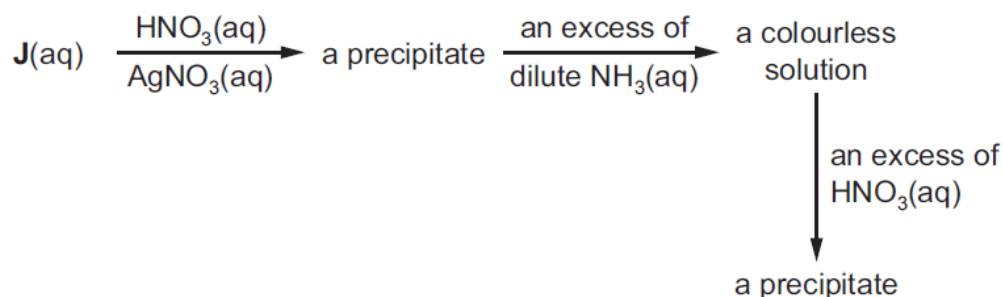
Which row of the following table contains the ions  $X^-$ ,  $Y^-$  and  $Z^-$  in order of their **decreasing** strength as reducing agents?

	strongest	→	weakest
<b>A</b>	$X^-$		$Z^-$
<b>B</b>	$X^-$		$Y^-$
<b>C</b>	$Y^-$		$X^-$
<b>D</b>	$Z^-$		$Y^-$

5. 9701/12/O/N/16/16

**J** is a salt of one of the halogens chlorine, bromine, iodine or astatine.

The reaction scheme shows a series of reactions using a solution of **J** as the starting reagent.



What could **J** be?

- A** sodium chloride
- B** sodium bromide
- C** potassium iodide
- D** potassium astatide

6. 9701/12/O/N/16/18

Chlorine and bromine have different volatilities.

Which row identifies the more volatile of the two elements, and gives the correct explanation?

	identity of the more volatile element	explanation for the difference in volatility
<b>A</b>	bromine	instantaneous dipole-induced dipole forces are greater in bromine than they are in chlorine
<b>B</b>	bromine	instantaneous dipole-induced dipole forces are greater in chlorine than they are in bromine
<b>C</b>	chlorine	instantaneous dipole-induced dipole forces are greater in bromine than they are in chlorine
<b>D</b>	chlorine	instantaneous dipole-induced dipole forces are greater in chlorine than they are in bromine

7. 9701/12/F/M/16/14

Chlorine gas is widely used to treat contaminated water.

Which species present in water when chlorine gas has been added is responsible for killing bacteria?

- A**  $\text{ClO}_2^-$       **B**  $\text{Cl}^-$       **C**  $\text{HCl}$       **D**  $\text{OCl}^-$

8. 9701/11/M/J/16/15

The solids sodium chloride and sodium iodide both react with concentrated sulfuric acid at room temperature.

With  $\text{NaCl}$ , the products are  $\text{NaHSO}_4$  and  $\text{HCl}$ .

With  $\text{NaI}$ , the products are  $\text{NaHSO}_4$ ,  $\text{HI}$ ,  $\text{I}_2$ ,  $\text{SO}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{S}$  and  $\text{H}_2\text{S}$ .

What is the best explanation for this difference in products?

- A** Chloride ions will displace iodine from solution.
- B** Hydrogen chloride is more volatile than hydrogen iodide.
- C** Iodide ions are better reducing agents than chloride ions.
- D** Sulfuric acid is able to act as a dehydrating agent with  $\text{NaI}$ .

9. 9701/11/M/J/16/35

The element astatine, At, is below iodine in Group 17 of the Periodic Table.

Which statements concerning At are likely to be correct?

- 1 It is a dark-coloured solid at room temperature.
- 2 It is a more powerful oxidising agent than iodine.
- 3 Its hydride is thermally stable.

10. 9701/12/M/J/16/18

An excess of chlorine gas,  $Cl_2$ , is passed through  $60\text{cm}^3$  of cold aqueous  $0.1\text{mol dm}^{-3}$  sodium hydroxide. In a separate experiment an excess of chlorine gas is passed through  $60\text{cm}^3$  of hot aqueous  $0.1\text{mol dm}^{-3}$  sodium hydroxide until no further reaction takes place.

How much **more** sodium chloride will be produced by the reaction with hot NaOH than with cold NaOH?

- A 0.002 moles
- B 0.003 moles
- C 0.005 moles
- D 0.006 moles

11. 9701/12/M/J/16/19

Fluorine and iodine are Group 17 elements. Their melting points are different due to differing strengths of van der Waals' forces between molecules.

Which row is correct?

	melting point	strength of van der Waals' forces between molecules
<b>A</b>	$F_2 > I_2$	$F_2 > I_2$
<b>B</b>	$F_2 > I_2$	$F_2 < I_2$
<b>C</b>	$F_2 < I_2$	$F_2 < I_2$
<b>D</b>	$F_2 < I_2$	$F_2 > I_2$

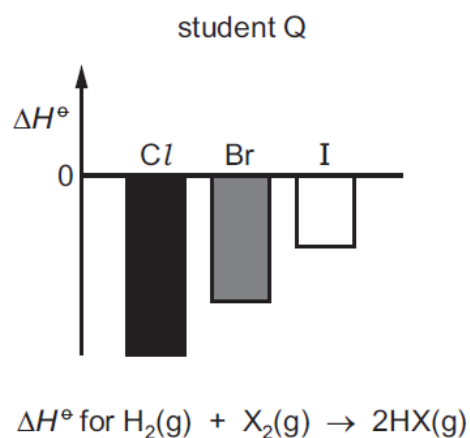
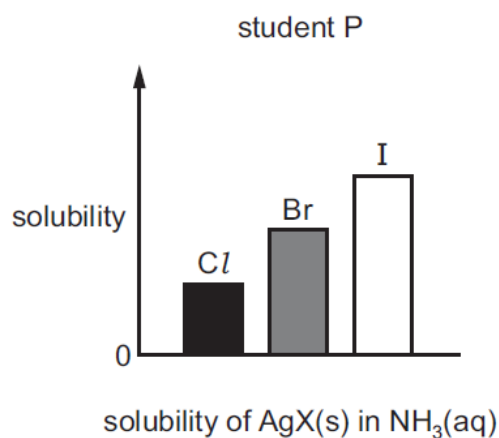
12. 9701/12/M/J/16/36

Which properties increase in the sequence hydrogen chloride, hydrogen bromide and hydrogen iodide?

- 1 thermal stability
- 2 bond length
- 3 ease of oxidation

13. 9701/13/M/J/16/17

Two students, P and Q, were asked to draw bar charts to represent how some properties of the halogens and their compounds differ in magnitude. Their diagrams are shown. The bar charts show trends only and not actual values.



Which of the students have drawn bar charts which show the trends correctly?

- A both P and Q
- B P only
- C Q only
- D neither P nor Q

14. 9701/13/M/J/16/18

In a series of nine experiments to test the reactivity of the halogens, an aqueous solution of each halogen was added to an equal volume of an aqueous solution containing halide ions as shown in the table below.

solution	sodium chloride (aq)	sodium bromide (aq)	sodium iodide (aq)
chlorine (aq)	experiment 1	experiment 2	experiment 3
bromine (aq)	experiment 4	experiment 5	experiment 6
iodine (aq)	experiment 7	experiment 8	experiment 9

The nine resulting mixtures were then shaken with hexane. The nine tubes were corked and left to stand so that the aqueous and organic solvents could separate into layers.

How many test-tubes contained a purple upper layer?

**A** 1

**B** 2

**C** 3

**D** 5