



# Chlorides of Sulfur



Sulfur and chlorine can react together to form  $\text{S}_2\text{Cl}_2$ . When 1.00 g of this sulfur chloride reacted with water, 0.36 g of a yellow precipitate was formed, together with a solution containing a mixture of sulfurous acid,  $\text{H}_2\text{SO}_3$ , and hydrochloric acid.

## Part A Reaction with water

Use the above data to deduce the equation for the reaction between  $\text{S}_2\text{Cl}_2$  and water. Balance it by using the lowest possible integer coefficients and include state symbols.

## Part B Neutralisation

What volume of  $1.00 \text{ mol dm}^{-3}$  sodium hydroxide would be required to neutralise the final solution?

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## Periods 1-3



This question refers only to the elements in the first three periods (H–Ar) of the Periodic Table.

Identify an element that, at room temperature and pressure,

### Part A $2-$ ion

forms a  $2-$  ion with the same electronic configuration as neon.

### Part B $2+$ ion

forms a  $2+$  ion with an electronic configuration of  $1s^2 2s^2 2p^6$ .

### Part C $X_4O_{10}$

reacts with oxygen forming an oxide  $X_4O_{10}$ .

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**Part D**    **Giant molecular oxide**

forms an oxide with a giant molecular structure.

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**Part E**    **XO<sub>3</sub>**

forms an oxide XO<sub>3</sub> that gives a strongly acidic solution in water.

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**Part F**    **Trigonal planar fluoride**

forms a trigonal planar fluoride.

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**Part G**    **XCl<sub>4</sub>**

forms a chloride XCl<sub>4</sub>,  $M_r = 153.8$ .

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# Ionisation of Elements



The table below shows the first five ionisation energies of five elements in the same group of the Periodic Table.

		Element	Ionisation Energy / $\text{kJ mol}^{-1}$				
			1st	2nd	3rd	4th	5th
Increasing proton (atomic) number	↓	<i>A</i>	1090	2350	4610	6220	37830
		<i>B</i>	786	1580	3230	4360	16090
		<i>C</i>	762	1540	3300	4390	6970
		<i>D</i>	707	1410	2940	3930	6970
		<i>E</i>	716	1450	3080	4080	6640

## Part A Group

In which group of the Periodic Table are the elements found?

## Part B Ionisation of Na

Write an equation, with state symbols, to define the first ionisation energy of Na.

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**Part C**    **Decrease in ionisation energy**

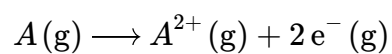
Why does the first ionisation energy of the element tend to show a decrease down the table?

- ☐ Electronegativity decreases.
  - ☐ Lattice energy decreases.
  - ☐ Hydration energy decreases.
  - ☐ Electrons are being removed from higher energy shells.
  - ☐ Electron affinity decreases.
  - ☐ The effective nuclear charge experienced by the electron decreases down the group.
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**Part D**     $A^{2+}$

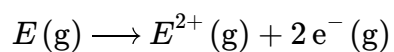
Calculate the energy change of:



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**Part E**     $E^{2+}$

Calculate the energy change of:



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**Part F**   **A bonding**

What sorts of bond would you expect A to form?

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# Iodate Ions

A Level



Each Group 2 element forms an iodate(V) with the formula  $M(\text{IO}_3)_2$ .

## Part A Structure of iodate ion

Use the [structure editor](#) to draw the structure of the iodate(V) ion.

Enter your answer as a SMILES string.

## Part B Decomposition

These iodates readily decompose on heating.

Write a likely equation (including state symbols) for the decomposition of  $\text{Mg}(\text{IO}_3)_2$ , balancing it so as to use the lowest possible integer coefficients.

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# Al and Fe

A Level



Aluminium, Al, and iron, Fe, are both metallic elements. However, their compounds show significant differences in their properties. For example, aluminium compounds are usually colourless and they contain the metal in only one oxidation state. In contrast, most iron compounds are coloured and the metal can be present in a variety of oxidation states.

## Part A Al configuration

What is the ground-state electron configuration of Al?

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Items:

[Ne]	[Ar]	[Kr]	[Xe]	3s	4s	3p	3d	4p	1	2	3	4	5	6
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### Part B Fe configuration

What is the ground-state electron configuration of Fe?

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Items:

[Ne]	[Ar]	[Kr]	[Xe]	3s	4s	3p	3d	4p	1	2	3	4	5	6
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### Part C Al oxidation state

What is the only non-zero oxidation state observed for aluminium?

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### Part D Oxidation states of Fe

What are the two commonly found non-zero oxidation states for Fe?

- ☐ +1
  - ☐ +2
  - ☐ +3
  - ☐ +4
  - ☐ +6
  - ☐ +7
  - ☐ +8
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### Part E Maximum oxidation state of Fe

In theory, what is the highest oxidation state possible for Fe?

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### Part F Thiocyanate ion

A common test for the presence of Fe ions is the addition of thiocyanate ions,  $(\text{SCN})^-$ . The result is a blood-red colour, caused by the formation of the complex ion  $[\text{Fe}(\text{SCN})]^{2+}$ .

Using the [structure editor](#), draw a possible structure for the thiocyanate ion. Give your answer as a SMILES string copied from the editor (click the smiley face in the top left of the editor to generate this).

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