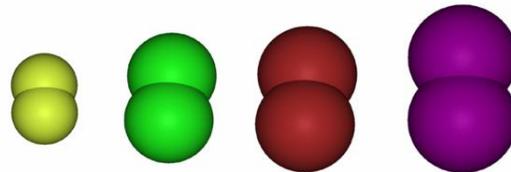


## Ex 1

### Oxidation and reduction — halogen displacement reactions



#### Background

The halogens, the group VII elements, are all oxidising agents as they tend to gain electrons to form halide ions. For example, chlorine tends to gain electrons to form chloride ions.



In this experiment the strength of chlorine, bromine and iodine as oxidising agents in aqueous solution will be compared.

Although solutions of chlorine, bromine and iodine in water exhibit different colours, the identification of a particular halogen is made more simple if a solvent such as dichloromethane is used. The halogens dissolve preferentially in the dichloromethane and exhibit characteristic colours. In part A of this experiment the colours of the halogens in dichloromethane are identified. This information is used in part B where several halogen displacement reactions are investigated.

## Equipment required

Test tubes (six)

Potassium bromide solution [KBr] 0.5 mol L<sup>-1</sup> (5 mL)

Potassium chloride solution [KCl] 0.5 mol L<sup>-1</sup> (5 mL)

Potassium iodide solution [KI] 0.5 mol L<sup>-1</sup> (5 mL)

Chlorine water [Cl<sub>2</sub>] (5 mL) Bromine water [Br<sub>2</sub>] (5 mL)

Iodine water I<sub>2</sub> (5 mL)

Dichloromethane [CH<sub>2</sub>Cl<sub>2</sub>]



- The halogen solutions are poisonous and must be handled with care.
- Do not breathe the vapours given off from these solutions.
- If the solutions come in contact with your skin immediately wash the affected area with plenty of water.
- Dichloromethane is poisonous and should be handled with care.
- Do not breathe in CH<sub>2</sub>Cl<sub>2</sub> vapour or allow it to come in contact with your skin.

## **A Colour of Halogens in Dichloromethane**

**#1** Place about 2 mL of bromine water in a test tube, add 1 mL of dichloromethane and shake vigorously for a few seconds. Allow the liquid layers to separate and note the colour of the dichloromethane layer, which is the bottom layer.

**#2** Repeat this procedure for chlorine water and iodine water.

**#3** Retain these samples for comparison in part B.

## **B Halogen Displacement Reactions**

**#1** To 2 mL of KBr solution in a test tube add about 2 mL of chlorine water and shake. Observe any changes that occur.

**#2** Add about 1 mL of dichloromethane to the same test tube. Shake and allow the dichloromethane layer to settle, and note its colour. Is it the colour of one of the halogens?

**#3** Repeat this procedure for solutions of the other halogens and halide ions, using the following combinations:

chlorine water + KI solution    bromine water + KCl solution    bromine water + KI solution

iodine water + KCl solution

iodine water + KBr solution

In each case add some dichloromethane and shake, to identify any newly formed halogen that might be present.

**#4** Draw up a table to summarise the results of the six reactions above.

## Processing of results, and questions

1 Where you have observed a chemical reaction, write the appropriate ionic equation.

2 Work out which of the halogens have been reduced, and which of the halide ions have been oxidised. Which of the halogens is the strongest oxidising agent?

