

# Reactivity trends in group 2 and the halogens

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Lab

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

How can you tell chloride, bromide and iodide apart, and how does the oxidising power of chlorine compare with bromine and iodine? You will use precipitation, ammonia and displacement tests, and record observations that you then analyse with equations and a calculation.

**Level:** Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.2.2-3.2.3

## Aim

To identify three unlabelled sodium halide solutions with silver nitrate and ammonia, and to compare the oxidising power of chlorine, bromine and iodine by displacement.

## Equipment

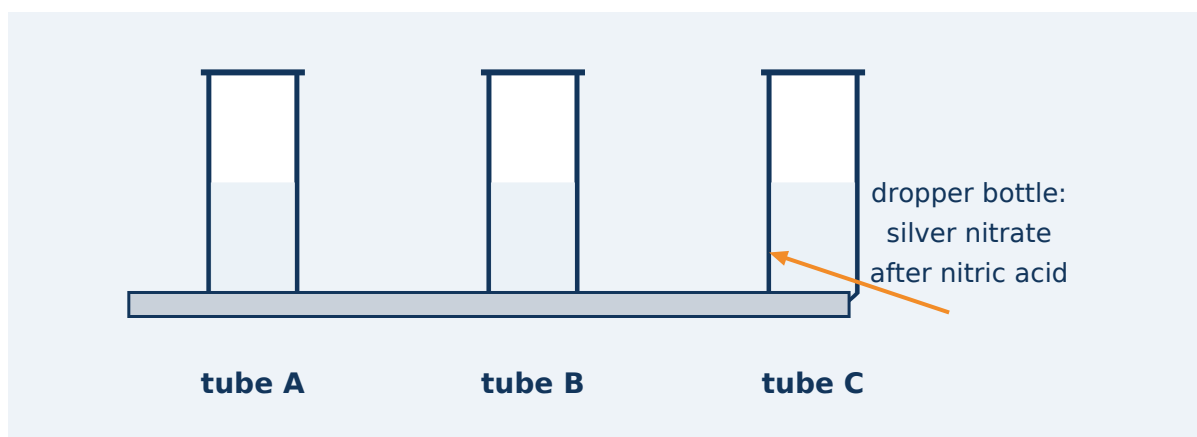
- Three solutions A, B and C ( $0.10 \text{ mol dm}^{-3}$  sodium chloride, bromide and iodide in random order)
- $0.05 \text{ mol dm}^{-3}$  silver nitrate solution in a dropper bottle
- Dilute nitric acid, dilute and concentrated ammonia (teacher dispensed)
- Chlorine water, hexane or cyclohexane
- Test tubes, rack, droppers, goggles

## Safety

### Safety

Wear goggles and gloves. Silver nitrate stains skin and clothes. Chlorine water and concentrated ammonia must be used in a fume cupboard or well-ventilated room. Hexane is flammable, so keep naked flames away.

## Method



Set-up: three unlabelled sodium halide solutions in a test tube rack.

1. Place about 1 cm depth of each solution in tubes A, B and C.
2. Add 5 drops of dilute nitric acid to each, then 5 drops of silver nitrate. Record the precipitate colour.
3. Add dilute ammonia dropwise, shaking, to each tube and note whether the precipitate dissolves. Repeat with concentrated ammonia on those that remain.
4. In fresh tubes, add 1 cm depth of chlorine water to 1 cm of each solution, then 1 cm of hexane. Shake gently and record the colour of the upper layer.

## Results

| Tube | Colour with $\text{AgNO}_3$ | Dilute $\text{NH}_3$ | Conc. $\text{NH}_3$ | Hexane layer with $\text{Cl}_2$ water |
|------|-----------------------------|----------------------|---------------------|---------------------------------------|
| A    | white                       | dissolves            | —                   | colourless                            |
| B    | yellow                      | no change            | no change           | violet                                |
| C    | cream                       | slowly paler         | dissolves           | orange-brown                          |

## Analysis questions

### Question 1 Identify the solutions

Identify A, B and C and justify each answer from the results.

### Question 2 Ionic equations

Write ionic equations (with state symbols) for the precipitate in tube A and for the reaction in the hexane test with C.

### Question 3 Role of nitric acid

Explain why nitric acid was added before silver nitrate and why hydrochloric acid could not be used.

**Question 4 Reactivity order**

Use the hexane results to deduce the order of oxidising power of  $\text{Cl}_2$ ,  $\text{Br}_2$  and  $\text{I}_2$ . Explain your reasoning.

**Question 5 Mass of precipitate**

In another test  $5.00 \text{ cm}^3$  of  $0.200 \text{ mol dm}^{-3}$  solution A was mixed with excess silver nitrate. Calculate the maximum mass of precipitate ( $M_r = 143.4$ ).

**Question 6 Reliability**

Suggest one reason why the dilute ammonia result for C is hard to judge and how to make it clearer.

**Question 7 Improvement**

Suggest one way to make the identification of B and C more reliable.