

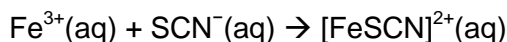
## Determination of thiocyanate using iron(III)

### Student worksheet

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#### Principle

Thiocyanate ions react with iron(III) ions in solution to form an intense red coloured complex ion:



or, more fully,  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + \text{SCN}^{-}(\text{aq}) \rightarrow [\text{Fe}(\text{H}_2\text{O})_5\text{SCN}]^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

You can use this reaction for the quantitative analysis of low concentrations of thiocyanate ions. You can find the concentration of the solution of thiocyanate ions using a colorimeter. You can also use simple colour matching although the results will be less precise.

#### Equipment and materials

- burettes x 3
- 100 cm<sup>3</sup> volumetric flasks x 7 (or use one, thoroughly washing it between samples)
- colorimeter and suitable filter (blue) - a solution of the complex displays maximum absorption at 480 nm
- potassium thiocyanate containing 250 mg dm<sup>-3</sup> thiocyanate (250 ppm) (30 cm<sup>3</sup>)
- iron(III) chloride solution 0.41 mol d<sup>-3</sup> (70 cm<sup>3</sup>)
- solution of unknown thiocyanate concentration (10 cm<sup>3</sup>)

#### Method

**Care:** Wear eye protection. Iron(III) chloride solution is an irritant.

1. Fill three burettes, one with the potassium thiocyanate solution containing 250 ppm thiocyanate, one with deionised water and one with iron(III) chloride solution.
2. Add 0.0, 2.0, 4.0, 6.0, 8.0 and 10.0 cm<sup>3</sup> of the potassium thiocyanate solution to six 100 cm<sup>3</sup> volumetric flasks A-F. Add deionised water to bring the volume in each flask to about 80 cm<sup>3</sup>.
3. To each flask add 10 cm<sup>3</sup> iron(III) chloride solution and then add deionised water to bring volume to 100 cm<sup>3</sup>. Mix the solutions thoroughly.

Flask	A	B	C	D	E	F
Volume of potassium thiocyanate solution / cm <sup>3</sup>	0.0	2.0	4.0	6.0	8.0	10.0
ppm thiocyanate	0	5	10	15	20	25

4. Measure the absorbance of each solution using a colorimeter.
5. Plot a graph of absorbance (y axis) against thiocyanate concentration (in ppm thiocyanate) (x axis) for the six solutions.
6. Add 10 cm<sup>3</sup> of the solution of unknown thiocyanate concentration to a 100 cm<sup>3</sup> volumetric flask and add deionised water to bring the volume in the flask to about 80 cm<sup>3</sup>.
7. Add 10 cm<sup>3</sup> iron(III) chloride solution to the flask and then add deionised water to bring volume to 100 cm<sup>3</sup> and mix the solution thoroughly.
8. Measure the absorbance of the solution using a colorimeter.
9. Use the graph to find the concentration of thiocyanate ions as ppm thiocyanate in the unknown solution.