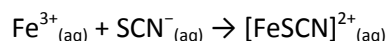


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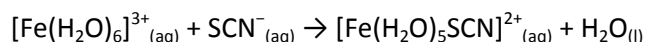
## Become a water quality analyst

### Worksheet 2: Determining the concentration of thiocyanates using iron(III) chloride

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



or, more fully,



This reaction is an easy method to test for the presence of thiocyanate ions and to measure their concentration. By using a colorimeter, you can measure the absorbance at 480 nm of the complex formed,  $[\text{Fe}(\text{H}_2\text{O})_5\text{SCN}]^{2+}$ , and deduce the precise concentration of thiocyanate ions, provided it is not too high. You can also use simple colour matching, although the results will be less precise and only qualitative.

#### Materials

- Burette
- 100 cm<sup>3</sup> volumetric flasks (7)
- colorimeter and suitable filter (blue) – a solution of the complex displays maximum absorption at 480 nm
- 30 cm<sup>3</sup> of a solution of potassium thiocyanate at 250 mg/dm<sup>3</sup> for the thiocyanate ions (250 ppm)
- 70 cm<sup>3</sup> of a solution of iron(III) chloride solution at 0.41 mol/dm<sup>3</sup>
- 10 cm<sup>3</sup> of a solution of unknown thiocyanate concentration (which you will need to test in your role as a quality analyst)

#### Procedure

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

##### 1. Create a calibration graph

- a. Fill three burettes, one with the potassium thiocyanate solution containing 250 ppm thiocyanate, one with distilled water, and one with iron(III) chloride solution.
- b. To six 100 cm<sup>3</sup> volumetric flasks, add 0.0, 2.0, 4.0, 6.0, 8.0 and 10.0 cm<sup>3</sup> of the solution of potassium thiocyanate at 250 mg/dm<sup>3</sup> and label them A to F.
- c. Add distilled water to each flask to bring the volume up to about 80 cm<sup>3</sup>.
- d. To each flask, add 10 cm<sup>3</sup> iron(III) chloride solution and then add distilled water to bring the volume up 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
Thiocyanate (ppm)	0	5	10	15	20	25

- e. Measure the absorbance of each solution using a colorimeter.
- f. Plot a graph of absorbance (*y* axis) against thiocyanate concentration (in ppm thiocyanate) (*x* axis) for the six solutions.

## 2. Analyse the sample

- g. Add 10 cm<sup>3</sup> of the solution of unknown thiocyanate concentration to a 100 cm<sup>3</sup> volumetric flask and add distilled water to bring the volume up to about 80 cm<sup>3</sup>.
- h. Add 10 cm<sup>3</sup> of iron(III) chloride solution to the flask and then add distilled water to bring the volume up to 100 cm<sup>3</sup>. Mix the solution thoroughly.
- i. Measure the absorbance of the solution using a colorimeter.
- j. Use the graph to find the concentration of thiocyanate ions (as ppm) in the unknown solution.

### Safety note

You should wear suitable eye and hand protection to handle acids and thiocyanates. You can check the safety guidelines on the Science in School website ([www.scienceinschool.org/safety](http://www.scienceinschool.org/safety)) and at the end of this print issue.