

# Iron chemistry – variable oxidation state

## Topic

Iron chemistry, transition elements, oxidation states, precipitation and redox reactions, complexes.

## Timing

20 min.

## Apparatus (per group)

- One student worksheet
- One clear plastic sheet (eg ohp sheet)
- Magnifying glass.

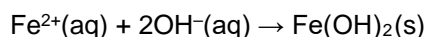
## Chemicals (per group)

Solutions contained in plastic pipettes, see 'Apparatus and techniques for microscale chemistry' handout.

- Sodium hydroxide 1 mol dm<sup>-3</sup>
- Potassium manganate(VII) 0.01 mol dm<sup>-3</sup>
- Potassium iodide 0.2 mol dm<sup>-3</sup>
- Iron(II) sulphate 0.2 mol dm<sup>-3</sup>
- Iron(III) nitrate 0.2 mol dm<sup>-3</sup>
- Silver nitrate 0.2 mol dm<sup>-3</sup>
- Potassium thiocyanate 0.1 mol dm<sup>-3</sup>
- Starch solution (freshly made).

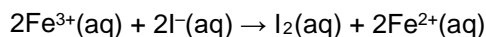
## Observations

1. The addition of sodium hydroxide produces a gelatinous green precipitate with iron(II) solution and a brown precipitate with iron(III) solution. On standing, oxidation causes the iron (II) hydroxide to turn a brown-yellow colour due to gradual formation of iron(III) hydroxide.

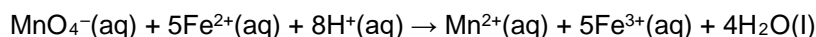


2. The thiocyanate ion gives a deep red colour with iron(III) but should give virtually no colour with iron(II). However, unless it is very pure and freshly prepared, iron(II) will probably give a faint red colour due to the presence of some iron(III).

3. Iron(III) oxidises iodide ions to iodine which gives the characteristic blue-black colour with starch. Iron(II) should give no reaction unless it contains some iron(III).



4. The deep purple colour of manganate(VII) ions gradually diminishes as it is reduced by iron(II) whereas iron(III) has no effect.



5. The reaction of silver nitrate and iron(II) ions produces a glittering of metallic silver which is seen using a magnifying glass. There is no corresponding reaction with iron(III) ions.

## Tips

These experiments can be done quickly so students might be encouraged to develop their explanations for the reactions. A book of data would be useful so that students can look up redox potentials. A biochemical development would be to consider the role of iron in haemoglobin and the types of iron compounds found in iron tablets (Iron(II) is required for haemoglobin, the +2 oxidation state being stabilised by complexation.)

The fact that many iron(II) compounds contain some iron(III) could form the basis of a discussion on the purities of chemical compounds.

## Health & Safety

Students must wear suitable eye protection (Splash resistant goggles to BS EN166 3).

Sodium hydroxide solution, 1 mol dm<sup>-3</sup> NaOH (aq), is CORROSIVE.

Silver nitrate, 0.2 mol dm<sup>-3</sup>, AgNO<sub>3</sub> (aq) is a skin/eye irritant. Keep separate from organic waste containers.

Potassium iodide, 0.2 mol dm<sup>-3</sup>, KI(aq), Iron(II) sulphate, 0.2 mol dm<sup>-3</sup>, FeSO<sub>4</sub>.7H<sub>2</sub>O (aq), Iron(III) nitrate, 0.2 mol dm<sup>-3</sup>, Fe(NO<sub>3</sub>)<sub>3</sub>.9H<sub>2</sub>O (aq), Potassium thiocyanate, 0.1 mol dm<sup>-3</sup>, KSCN (aq), Potassium manganate(VII), 0.01 mol dm<sup>-3</sup> KMnO<sub>4</sub> (aq) and starch solution are of low hazard..

Potassium manganate(VII) not hazardous < 0.01 M

## Credits

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*Health & safety checked May 2018*

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