TRANSITION METALS: IRON

You may not need to know all the chemistry below. Check your syllabus and past papers and concentrate on those questions that you need to be able to answer.

1. a) Iron is used as a catalyst in the Haber Process. Write the equation for the reaction.

    b) Iron(II) ions catalyse the reaction between persulphate ions and iodide ions. The overall equation for the reaction is

    $$S_2O_8^{2-} + 2I^- \longrightarrow 2SO_4^{2-} + I_2$$

    (i) Write equations to show the stages of this reaction in the presence of Fe^{2+} ions.

    (ii) By looking carefully at the overall equation compared with the catalysed version, suggest why the reaction is slow in the absence of the catalyst.

2. Sodium hydroxide solution and ammonia solution behave identically when added to solutions containing iron(II) or iron(III) ions.

    a) Describe what you would see if you added either of these solutions to

    (i) iron(II) sulphate solution,

    (ii) iron(III) chloride solution.

    b) If you have described these properly, in one of the cases, you will have noted that a change occurs on standing. Why does that change happen?

    c) Give the formulae for the initial iron complex and the complex formed after addition of the sodium hydroxide or ammonia solutions with

    (i) iron(II) sulphate solution,

    (ii) iron(III) chloride solution.

3. a) Describe what happens when sodium carbonate solution is added to

    (i) iron(II) sulphate solution,

    (ii) iron(III) chloride solution.

    b) Explain these results in terms of the acidity of the hexaaquairon ions.

    c) Give the formula for the precipitate formed in the iron(III) chloride case.

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4. Potassium thiocyanate solution was added to a solution with this result:

$SCN^-_{(aq)}$

Name the positive ion that the original solution contains, and write the formula for the blood red complex formed.

5. The concentration of a solution containing iron(II) ions can be found by titration with either potassium manganate(VII) solution or potassium dichromate(VI) solution. In each case, the reaction is done under acidic conditions, and the iron(II) ions are oxidised to iron(III) ions.

   a) During the reaction, the manganate(VII) ions (MnO_4^-) are reduced to manganese(II) ions. Work out the ionic equation for the reaction between potassium manganate(VII) ions and iron(II) ions under acidic conditions.

   b) During the reaction, the dichromate(VI) ions ($Cr_2O_7^{2-}$) are reduced to chromium(III) ions. Work out the ionic equation for the reaction between potassium dichromate(VI) ions and iron(II) ions under acidic conditions.

   Important: It is essential that you can work out this sort of equation, and not just rely on memorising a few common examples. Even if you can remember these particular equations, start from nothing more than the information you are given above and work them out again.