Chemguide – questions

TRANSITION METALS: MANGANESE

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. This question is about a simple reaction in manganese(II) chemistry.

    If you add sodium hydroxide solution or ammonia solution to some manganese(II) sulphate solution, you get identical reactions.

    a) Write the formula for the manganese(II) complex found in manganese(II) sulphate solution.

    b) Describe what happens when you add sodium hydroxide solution (or ammonia solution) to a solution of manganese(II) sulphate.

    c) Write the formula for the initial complex formed.

    d) You should have described a change in the colour of this complex on standing. Explain what has happened to cause this change.

2. This question is about the use of potassium manganate(VII) (potassium permanganate) as an oxidising agent in organic chemistry.

    a) In organic chemistry, the potassium manganate(VII) is usually used in alkaline solution. State the colour changes observed during oxidising reactions of potassium manganate(VII) under these conditions, and name the manganese compounds formed.

    b) Why isn't potassium manganate(VII) used as commonly in organic chemistry as an oxidising agent as potassium dichromate(VI) is?

    c) Name and write the formula for the organic product of the reaction between ethene and alkaline potassium manganate(VII) solution.

    d) One place where potassium manganate(VII) is used is in the oxidation of side chains on benzene rings. Name the organic product (after acidification of the reaction mixture) if you use it to oxidise (i) methylbenzene, (ii) ethylbenzene.

3. a) Potassium manganate(VII) is used in titrations, but it isn't a primary standard. Explain what a primary standard is, and give two reasons why potassium manganate(VII) isn't one.

    b) Potassium manganate(VII) can be standardised by titrating it against ethanedioic acid solution (oxalic acid - $(COOH)_2$) which is a primary standard. It oxidises the ethanedioic acid to carbon dioxide. Write the electron-half equation for the change in ethanedioic acid.

    c) Write the electron-half equation for the change to the manganate(VII) ion in acidic conditions.

d) Combine the equations in parts (b) and (c) to give the ionic equation for the reaction between ethanedioic acid and manganate(VII) ions.

e) Some potassium manganate(VII) solution was made up to a concentration of approximately 0.02 mol dm^{-3}, and its concentration was checked against ethanedioic acid solution of concentration 0.0500 mol dm^{-3}.

25 cm^3 of the ethanedioic acid solution was pipetted into a flask and acidified with an excess of dilute sulphuric acid. The solution was warmed, and the potassium manganate(VII) solution added from a burette. 25.7 cm^3 was needed to reach the end point. Calculate the actual concentration of the potassium manganate(VII) solution.

(Note: If you got the answer to part (d) wrong, you can't possibly get the answer to this last part right. If your equation doesn't show 5 moles of ethanedioic acid reacting with 2 moles of manganate(VII) ions, check it again.

I know there is no worked calculation on the Chemguide page. It assumes that by this time you ought to be confident about doing titration calculations. If you aren't, make it a priority!)