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| **REDOX Titrations** |
| **Key Concepts**   * A REDOX titration is a volumetric method that relies on the [oxidation](http://www.ausetute.com.au/redox.html) of the analyte (substance to be analysed). * The titrant (solution of known concentration) is often an [oxidising agent](http://www.ausetute.com.au/redox.html).   Common oxidising agents are:   * 1. permanganate ion (MnO4-)  MnO4-(aq) + 8H+ + 5e -----> Mn2+(aq) + 4H2O     Eo = +1.51V  purple permanganate ion (MnO4-) is reduced to colourless manganese (II) ion (Mn2+)   2. dichromate ion (Cr2O72-)  Cr2O72-(aq) + 14H+ + 6e -----> 2Cr3+(aq) + 7H2O     Eo = +1.23V  orange dichromate ion (Cr2O72-) is reduced to green chromium (III) ions (Cr3+) * At the equivalence point E(forward) = E(reverse), or, http://www.ausetute.com.au/../images/capdelta.gifE(cell) = 0 * If the REDOX reaction does not produce a well-defined colour change at the equivalence point, an indicator should be used in the titration.  Starch can be used as an indicator for REDOX titrations using iodine as the titrant (iodine is a weak oxidising agent) because starch forms a blue complex with iodine. * The REDOX titration curve is a plot of Electrode Potential (volts) vs volume of titrant or analyte.   **Calculations**   1. Write a [balanced half equation](http://www.ausetute.com.au/halfeqtn.html) for the oxidation reaction. 2. Write a [balanced half equation](http://www.ausetute.com.au/halfeqtn.html) for the reduction reaction. 3. Add the oxidation and reduction half equations together to give a balanced REDOX reaction equation. 4. Extract all the relevant information from the question. 5. Check the data for consistency, for example, concentrations are often given in M or mol L-1 but volumes are often given in mL. You will need to convert the mL to L for consistency. The easiest way to do this is to multiply the volume in mL x 10-3. 6. Calculate the moles of reactant (titrant) (n) for which you have both volume (V) and concentration (M): n = M x V 7. From the REDOX reaction equation find the mole ratio of known reactant (titrant) : unkown reactant (analyte) 8. Calculate moles of unknown reactant (analyte) using this mole ratio. 9. From the volume (V) of the unknown reactant (analyte) and its calculated moles (n), calculate its concentration(M): M = n ÷ V   **Example**  A 0.0484M standard solution of potassium permanganate was titrated against 25.00mL of an iron (II) sulfate solution.  The equivalence point, as indicated by a faint pink colour, was reached when 15.50mL of potassium permanganate solution had been added.  Calculate the concentration of the iron (II) sulfate solution.   1. reduction half equation:   MnO4- + 8H+ + 5e -----> Mn2+ + 4H2O   1. oxidation half equation:   Fe2+ -----> Fe3+ + e   1. REDOX equation:  |  |  |  | | --- | --- | --- | | MnO4- + 8H+ + ~~5e~~ | -----> | Mn2+ + 4H2O | | 5Fe2+ | -----> | 5Fe3+ + ~~5e~~ | |  | | | | MnO4- + 8H+ + 5Fe2+ | -----> | Mn2+ + 4H2O + 5Fe3+ |  1. Extract all the relevant information:  |  |  | | --- | --- | | MnO4- | Fe2+ | | [MnO4-] = 0.0484 mol/L | [Fe2+] = ? mol/L | | V (MnO4-) = 15.50 mL | V (Fe2+) = 25.00 mL |  1. Check the data for consistency: convert volumes in mL to L  |  |  | | --- | --- | | MnO4- | Fe2+ | | [MnO4-] = 0.0484 mol/L | [Fe2+] = ? mol/L | | V (MnO4-) = 15.50 x 10-3 L | V (Fe2+) = 25.00 x 10-3 L |  1. Calculate moles of known reactant (titrant):  |  |  | | --- | --- | | MnO4- |  | | [MnO4-] = 0.0484 mol/L |  | | V (MnO4-) = 15.50 x 10-3 L |  | | n (MnO4-) = M x V = 0.0484 x 15.50 x 10-3 = 7.502 x 10-4 mol |  |  1. Find the mole ratio from balanced REDOX equation  MnO4- : Fe2+  1 : 5 2. Calculate moles (n) of Fe2+  n (Fe2+) = 5 x n (MnO4-) = 5 x 7.502 x 10-4 = 0.003751 mol 3. Calculate the concentration of Fe2+  [Fe2+] = n ÷ V = 0.003751 ÷ 25.00 x 10-3 = 0.1500 mol/L |