HL pH curves questions

1. Calculate the pH of the resulting solution at 25 °C when 49.1 cm^3 of 0.100 mol dm^{-3} sodium hydroxide solution has been added to 50.0 cm^3 of **i.** 0.100 mol dm^{-3} hydrochloric acid solution and **ii.** 0.100 mol dm^{-3} ethanoic acid solution. pK_a of ethanoic acid = 4.76 at 25 °C.

2. Calculate the pH of the resulting solution at 25 °C when 50.1 cm^3 of 0.100 mol dm^{-3} sodium hydroxide solution has been added to 50.0 cm^3 of **i.** 0.100 mol dm^{-3} hydrochloric acid solution and **ii.** 0.100 mol dm^{-3} ethanoic acid solution. (pK_a of ethanoic acid = 4.76 at 25 °C)

3. Deduce the pH of the resulting solution obtained at 25 °C when 25.0 cm^3 of 0.100 mol dm^{-3} potassium hydroxide solution has been added to 50.0 cm^3 of 0.100 mol dm^{-3} methanoic acid solution, HCOOH(aq). (pK_a of methanoic acid = 3.75 at 25 °C)

4. Sketch the graph of pH against volume of alkali added that would be obtained when 50.0 cm^3 of 0.100 mol dm^{-3} hydrochloric acid is titrated with 100.0 cm^3 of 0.100 mol dm^{-3} ammonia solution.

5. Acid-base titration is a technique used to find the concentration of an acid or a base where the concentration is unknown.

i. Explain why titrating a weak acid with a weak base will not give a reliable result.

ii. Explain why titrating a weak acid with a weak base is not necessary in order to find an unknown concentration.

6. Explain the difference between *equivalence point* and *end point* when applied to acid-base titrations.

7. Explain why the equivalence point for the titration of ethanoic acid with sodium hydroxide does not occur at pH 7.

8. An aqueous solution of sodium carbonate is alkaline. Give the equations for the reactions taking place when solid sodium carbonate is dissolved in water to explain this fact.

9. Cyanide ions are very poisonous if swallowed or breathed in as hydrogen cyanide gas. Explain why it is dangerous to dissolve solid sodium cyanide crystals, NaCN(s), in hot water (even though you have no intention of drinking the solution).

10. From Section 22 in the IB data booklet it can be seen that methyl red has a pK_a value of 5.1 and is red in acid solution and yellow in alkaline solution.

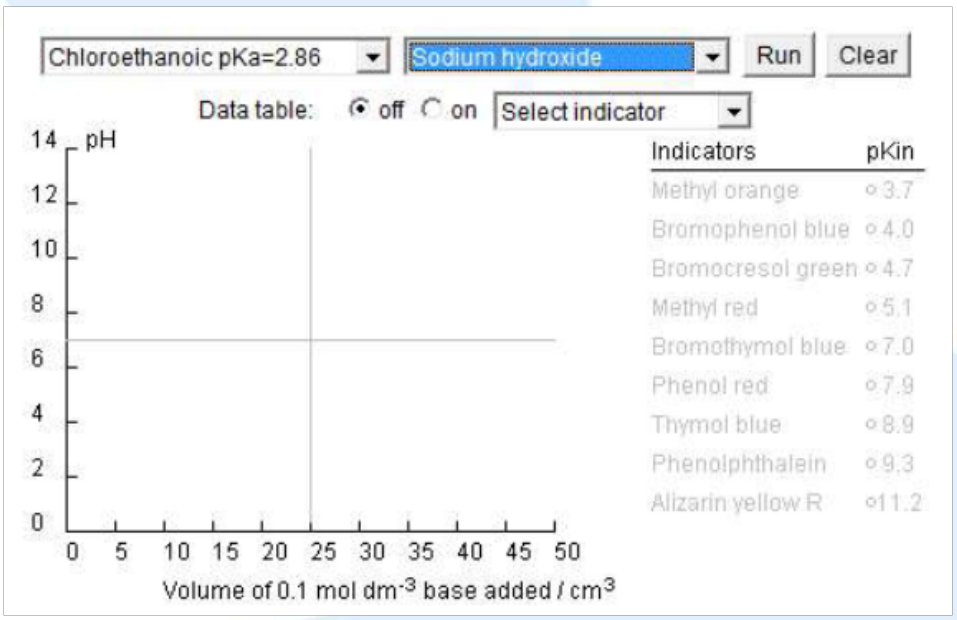
i. If methyl red is represented as HIn(aq) and it dissociates to $H^+(aq)$ and $In^-(aq)$ in water then identify the colours of HIn(aq) and $In^-(aq)$.

ii. Explain why the pH range of methyl red is listed as 4.4 – 6.2.

iii. Explain whether methyl red would be a suitable indicator to use for the titration of ethanoic acid solution (pK_a = 4.76) with sodium hydroxide solution.

11. A student used phenolphthalein as the indicator when titrating 25.00 cm^3 of 1.00×10^{-2} mol dm^{-3} hydrochloric acid with 1.00×10^{-2} mol dm^{-3} aqueous ammonia solution. Use information given in Section 22 of the data booklet to explain what will be observed when one drop of the 1.00×10^{-2} mol dm^{-3} ammonia solution is added after the equivalence point has been reached.

12. The screen-shot shows an acid–base simulation when 25.0 cm^3 of 0.1 mol dm^{-3} chloroethanoic acid is titrated with 0.1 mol dm^{-3} sodium hydroxide solution before it is run:



i. Describe the main features of the graph that would be expected to be shown after it has run.
ii. Select **two** indicators from the list that would be suitable to use for this titration.