**Acids and Bases – Homework 2**

1. a) What is meant by the term "buffer solution"?

b) Calculate the pH of a buffer solution which contains the weak monoprotic acid, propanoic acid (CH3CH2COOH), in concentration 0.1 moldm-3 and sodium propanoate in concentration 0.05 moldm-3. Ka of propanoic acid is 1.26 x 10-5 moldm-3.

c) Give equations to show how the above solution fulfills its buffer function.

d) Calculate the pH of the solution after 0.01 moles of NaOH are added to 500 cm3 of the solution.

e) Calculate the pH of the solution after 0.01 moles of HCl are added to 500 cm3 of the solution.

f) Calculate the pH after 0.01 moles of NaOH is added to 500 cm3 of water.

g) Comment on your answers to (d) and (f).

1. a) Calculate the pH of 0.12 moldm-3 ethanoic acid (Ka = 1.7 x 10-5 moldm-3).

b) Calculate the mass of sodium ethanoate (CH3COONa) which must be added to 500 cm3 this solution to give a buffer solution of pH = 4.60.

c) Calculate the pH of this solution after 0.01 moles of HCl are added.

d) Calculate the pH of this solution after 0.01 moles of NaOH are added.

1. Calculate the pH of a buffer which is 0.2 moldm-3 with respect to ammonium sulphate and 0.1 moldm-3 with respect to ammonia. (Ka of NH4+ = 5.6 x 10-10 moldm-3)
2. Methanoic acid, HCOOH, has a Ka value of 1.58 x 10-4 moldm-3. What ratio of methanoic acid and sodium methanoate would give a buffer of pH = 4?
3. a) Calculate the pH of a buffer solution which is 0.1 moldm-3 with respect to HCN (Ka = 4.9 x 10-10 moldm-3) and 0.8 moldm-3 with respect to sodium cyanide.

b) Calculate the pH after 0.05 moles of HCl are added to 1 dm3 of this buffer.

c) Calculate the pH after 0.05 moles of NaOH are added to 1 dm3 of this buffer.

d) Calculate the pH after 0.2 moles of NaOH are added to 1 dm3 of this buffer.

e) Comment on your answer to (d).

6. 20 cm3 of methanoic acid (Ka = 1.8 x 10-4 moldm-3) of concentration 0.10 moldm-3 is titrated against sodium hydroxide of concentration 0.05 moldm-3.

1. Calculate the pH of the solution:
2. initially
3. after 10 cm3 of the alkali has been added
4. after 20 cm3 of the alkali has been added
5. after 30 cm3 of the alkali has been added
6. after 50 cm3 of the alkali has been added
7. Sketch a pH titration curve to show this reaction
8. Explain why the pH at the end-point is greater than 7.

7. Calculate the pH after the following solutions are mixed together:

a) 15 cm3 of 0.1 moldm-3 HCl and 10 cm3 of 0.1 moldm-3 NaOH

b) 10 cm3 0.1 moldm-3 HCl and 15 cm3 of 0.1 moldm-3 NaOH

8. Sketch pH curves for the following titrations:

1. 20 cm3 0.10 moldm-3 NH3 against 0.1 moldm-3 HCl
2. 20 cm3 0.10 moldm-3 NaOH against 0.2 moldm-3 HCl
3. 20 cm3 0.10 moldm-3 CH3COOH against 0.06 moldm-3 NaOH
4. 20 cm3 0.10 moldm-3 CH3COOH against 0.15 moldm-3 NH3

9. Given the following pKIn values:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Indicator | pKIn |  |
|  | Methyl red | 5.1 |  |
|  | Phenolphthalein | 9.3 |  |

State, with a reason, which of the indicators would be suitable for each of the titrations in question 3.

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