AHL Worksheet – Chapter 8

1 Calculate the concentration of H^+ ions in each of the following solutions: [3]

a pH = 1.2 **b** pH = 5.8 **c** pH = 13.6

2 Give the expression for K_a for propanoic acid (CH_3CH_2COOH). [1]

3 HA, HB and HC are all weak acids:

Acid	pK_a
HA	4.36
HB	5.98
HC	7.68

Calculate the pH of the following solutions:

a a 0.100 mol dm^{-3} solution of HA [4]

b a 0.220 mol dm^{-3} solution of HB [4]

c a 0.150 mol dm^{-3} solution of HC [4]

4 **a** Write an equation for the ionisation of methylamine (CH_3NH_2) in aqueous solution. [1]

b Write the expression for K_b for methylamine. [1]

5 **a** Write an equation for the dissociation of water. [1]

b Write the expression for the ionic product constant, K_w. [1]

c The table shows the variation of pK_w with temperature:

Temperature / °C	pK_w
0	14.94
5	14.73
10	14.53
15	14.34
20	14.17
25	14.00

Temperature / °C	pK_w
30	13.83
35	13.68
40	13.53
45	13.40
50	13.26

i Work out the pH of pure water at 45 °C. [2]

ii Use the table to work out whether the following solutions are acidic, basic or neutral at the stated temperature. [4]

pH = 7.10 at 15 °C

pH = 7.46 at 35 °C

pH = 6.81 at 50 °C

pH = 7.47 at 0 °C

6 Calculate the pH of the following solutions:

a 0.10 mol dm^{-3} NaOH(aq) [2]

b 0.275 mol dm^{-3} KOH(aq) [2]

c 0.250 mol dm^{-3} $Ba(OH)_2$(aq) [3]

7 B_1, B_2 and B_3 are weak bases.

Base	**pK_b**
B_1	6.78
B_2	4.95
B_3	9.65

a Calculate the pH of each of the following solutions: [15]

i 0.400 mol dm^{-3} solution of B_1

ii 0.200 mol dm^{-3} solution of B_2

iii 0.150 mol dm^{-3} solution of B_2

b Arrange the bases in order of strength (weakest first). [1]

8 Predict, with reasons, whether the following solutions will be acidic, alkaline or neutral:

a 0.100 mol dm^{-3} CH_3CH_2COONa [3]

b 0.200 mol dm^{-3} $KHCO_3$ [3]

c 0.120 mol dm^{-3} NH_4Cl [3]

d 0.175 mol dm^{-3} KNO_3 [2]

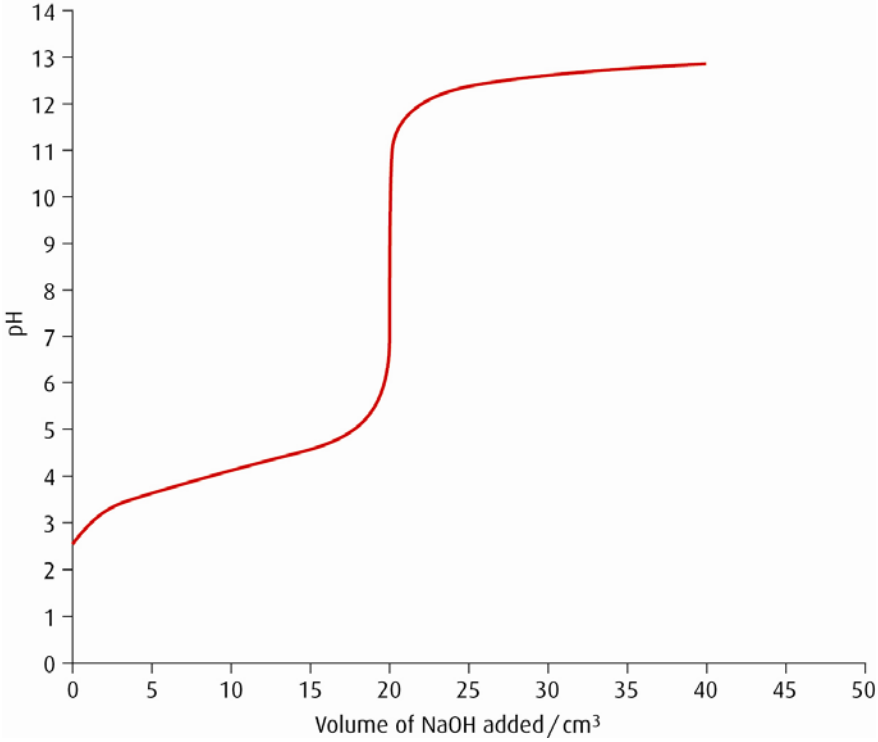
9 **a** When KCN is dissolved in water an alkaline solution is formed. Write an equation to illustrate this. [1]

b Calculate pH values for the following salt solutions:

i a 0.100 mol dm^{-3} solution of NaA given that pK_a for HA is 8.70 [7]

ii a 0.120 mol dm^{-3} solution of KX given that pK_a for HX is 6.35 [7]

10 The titration curve below shows the variation of pH as 0.100 mol dm^{-3} sodium hydroxide solution is added to 25.0 cm^3 of a solution of HA (a monoprotic acid).



a State the pH at the equivalence point. [1]

b Explain whether HA is a strong or a weak acid. [2]

c Calculate the concentration of the HA solution. [4]

d Use the graph to estimate the pK_a of HA. [1]

e Suggest a suitable indicator for this titration. [1]

11 Calculate the pH values for the following buffer solutions:

a a solution containing 0.0200 mol dm^{-3} ethanoic acid (pK_a = 4.76) and 0.0200 mol dm^{-3} sodium ethanoate [2]

b a solution containing 0.0400 mol dm^{-3} propanoic acid (pK_a = 4.87) and 0.0200 mol dm^{-3} sodium propanoate [2]

c a solution made up by mixing together 50.0 cm^3 of 0.500 mol dm^{-3} ethanoic acid (pK_a = 4.76) and 100.0 cm^3 of 0.300 mol dm^{-3} sodium ethanoate [4]

d a solution obtained when 20.0 cm^3 of 0.200 mol dm^{-3} sodium hydroxide is added to 40.0 cm^3 of 0.200 mol dm^{-3} ethanoic acid (pK_a = 4.76) [2]

e a solution obtained when 50.0 cm^3 of 0.200 mol dm^{-3} ammonia solution (pK_b = 4.75) is added to 150.0 cm^3 of 0.100 mol dm^{-3} ammonium chloride solution [5]