18.2 Calculations Involving Acids & Bases

Question Paper

Course	DP IB Chemistry
Section	18. Acids & Bases (HL only)
Topic	18.2 Calculations Involving Acids & Bases
Difficulty	Easy

Time allowed: 40

Score: /33

Percentage: /100

Question 1a

a)
Hydrocyanic acid, HCN, is used in the synthesis of polymers and pharmaceuticals. It is a weak acid.
Write an equation to show the dissociation of hydrocyanic acid.

[1]

[1 mark]

Question 1b

b)
Pyridine is an organic compound with the chemical formula C_5H_5N. It is a weak base.
Write an equation to show how pyridine acts as a base.

[1]

[1 mark]

Question 1c

c)
Write an equation to show the reaction between hydrocyanic acid and pyridine and identify two conjugate acid-base pairs.

[2]

[2 marks]

Question 1d

d)
The pK_a of hydrocyanic acid, HCN, is 9.2 at 298 K. Using section 21 of the Data booklet, deduce which of the two acids, ethanoic, CH_3COOH, or hydrocyanic is the stronger acid.

[2]

[2 marks]

Question 2a

a)
Using section 21 of the Data booklet, determine the K_a of chloroethanoic acid, dichloroethanoic acid and trichloroethanoic acid and state which is the stronger acid.

[4]

[4 marks]

Question 2b

b)
Write the K_a expression for dichloroethanoic acid, $CHCl_2COOH$.

[1]

[1 mark]

Question 2c

c)
Methylamine, CH_3NH_2, is a substance used to synthesise many commercially available compounds. State the K_b expression for methylamine.

[1]

[1 mark]

Question 2d

d)
State the relationship between K_a and K_b for an acid and its conjugate base.

[1]

[1 mark]

Question 3a

a)
A solution of 0.01 mol dm^{-3} ethanoic acid has a pH of 3.37 at 298 K. Determine the K_a of ethanoic acid.

[4]

[4 marks]

Question 3b

b)
A solution of 0.10 mol dm^{-3} methylamine, CH_3NH_2, has a pH of 11.80 at 298 K. Determine the K_b at this temperature.

[5]

[5 marks]

Question 3c

c)
Determine the $[H^+]$ in a 0.10 mol dm^{-3} solution whose $K_a = 1.00 \times 10^{-8}$ at 298 K.

[2]

[2 marks]

Question 3d

d)
Determine the pOH of the solution in part c).

[2]

[2 marks]

Question 4a

a)
Use section 12 of the Data booklet to answer this question.

i)
Write the formula of the conjugate base of methanoic acid.

[1]

ii)
Determine the pK_b of the conjugate base

[2]

[3 marks]

Question 4b

b)
The pK_a of ethanoic acid is 4.76. Determine whether the conjugate base of methanoic acid is weaker or stronger than the conjugate base of ethanoic acid.

[1]

[1 mark]

Question 4c

c)
At 283 K the pK_w of pure water is 14.54. Determine the pH at this temperature.

[1]

[1 mark]

Question 4d

d)
Comment on the acid-base nature of water at 283 K in part c).

[2]

[2 marks]