

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

A solution of chlorine in water is acidic. Swimming pool managers maintain pool water at a constant pH by using a buffer. They do so by adding sodium hydrogencarbonate and sodium carbonate.

- (a) Hydrogen carbonate ions (HCO_3^-) act as a weak acid in aqueous solution. Write an equation for this equilibrium.

(1)

- (b) Use the equation in part (a) to explain how a solution containing sodium hydrogencarbonate and sodium carbonate can act as a buffer when small amounts of acid or small amounts of alkali are added.

(3)

(Total 4 marks)

Q2.

This question is about alkalis and carboxylic acids.

In this question, all data are quoted at 25 °C.

- (a) Carboxylic acids are weak acids.

State the meaning of the term **weak** as applied to carboxylic acids.

(1)

- (b) Write an equation for the reaction of propanoic acid with sodium carbonate.

(1)

- (c) Calculate the pH of a $0.0120 \text{ mol dm}^{-3}$ solution of calcium hydroxide.
The ionic product of water $K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$.
Give your answer to 2 decimal places.

(3)

- (d) The value of the acid dissociation constant K_a for benzenecarboxylic acid ($\text{C}_6\text{H}_5\text{COOH}$) is $6.31 \times 10^{-5} \text{ mol dm}^{-3}$.

- (i) Write an expression for the acid dissociation constant K_a for benzenecarboxylic acid.

(1)

- (ii) Calculate the pH of a $0.0120 \text{ mol dm}^{-3}$ solution of benzenecarboxylic acid.
Give your answer to 2 decimal places.

(3)

- (iii) A buffer solution with a pH of 4.00 is made using benzenecarboxylic acid and sodium benzenecarboxylate.

Calculate the mass of sodium benzenecarboxylate ($M_r = 144.0$) that should be dissolved in 1.00 dm^3 of a $0.0120 \text{ mol dm}^{-3}$ solution of benzenecarboxylic acid to produce a buffer solution with a pH of 4.00

The value of the acid dissociation constant K_a for benzenecarboxylic acid ($\text{C}_6\text{H}_5\text{COOH}$) is $6.31 \times 10^{-5} \text{ mol dm}^{-3}$.

(5)

- (e) Two solutions, one with a pH of 4.00 and the other with a pH of 9.00, were left open to the air.

The pH of the pH 9.00 solution changed more than that of the other solution.

Suggest what substance might be present in the air to cause the pH to change.
Explain how and why the pH of the pH 9.00 solution changes.

Substance present in air _____

Explanation _____

(3)

(Total 17 marks)