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University Examinations 2023/2024

FIRST YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE PUBLIC HEALTH

HPP 3113: ENVIRONEMTAL CHEMISTRY

DATE: DECEMBER 2023 **TIME:2 HOURS**

INSTRUCTIONS: *answer question one and any other two questions*

QUESTION ONE (30 MARKS)

a) (i) Define a weak acid. (2 marks)

(ii) Select two weak acids from the list below. (2 marks)

HNO_3 $HC_2H_3O_2$ H_2SO_4 $HClO_4$ H_2CO_3

b) (i) Write equation of the reaction between sodium hydroxide and hydrochloric acid. (l mark)

(ii) Name the type of reaction in (i) above. (1 mark)

(iii) Calculate the pH of 0.002 M hydrochloric acid. (2 marks)

c) (i) Identify the conjugate acid and base in the following reaction. (2 marks)

$$C_6H_5NH_3^+ + OH^- \rightleftharpoons C_6H_5NH_2 + H_2O$$

(ii) What is a buffer solution? (2 marks)

d) (i) Explain the meaning of a primary standard? (2 marks)

(ii) State two properties of a primary standard. (2 marks)

e) (i) Calculate the weight of Mn present in 2.58 g of Mn304 precipitate. (Mn = 55, O =16 (2 marks)

(ii) State two factors that influence solubility of a precipitate. (2 marks)

f) The water solubility of cadmium hydroxide Cd(OH)2, is 0.00026 g/ 100mL.

i. Calculate the molar concentration of cadmium hydroxide? (2 marks)
(Cd=112, O = 16, H =1)

ii. What is the value of Ksp for $Cd(OH)_2$? (2 marks)

g) Write equilibrium constant expressions Kc, for the following reactions. (2 marks)

(i)

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$$

(ii)

$$2NaHCO_{3(s)} \rightleftharpoons Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$$

h) Draw and name the chemical structures of the first and third alkanes. (4 marks)

QUESTION TWO (20 MARKS)

a) What is the difference between saturated and unsaturated organic compounds? (2 marks)

b) Explain three reactions of alkanes. (9 marks)

c) Describe polycyclic aromatic hydrocarbons as follows:

i. Structure (2 marks)

ii. Occurrence (2 marks)

iii. Environmental effect (2 marks)

d) State three applications of alcohols. (3 marks)

QUESTION THREE (20 MARKS)

a) What is volumetric analysis? (2 marks)

b) Explain four methods of volumetric analysis. (8 marks)

c) (i) State Le Chatelier's principle (2 marks)

(ii) The Deacon process is used to make chlorine gas from hydrogen chloride, especially in situation, where a large amount of by—product HCl is available from other chemical processes.

$$4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)} + 2Cl_{2(g)} \qquad \Delta H^\circ = -114kJ$$

A mixture of HCI, 0_2, H_2O, and $C1_2$ is brought to equilibrium at 400 ^oC. Explain the effect on the equilibrium amount of $C1_2$ (g) If:

I. H20 is removed from the reaction mixture at constant volume? (2 marks)

II. The mixture is transferred to a vessel of twice the volume as the original equilibrium mixture? (2 marks)

III. A catalyst is added to the reaction mixture? (2 marks)

IV. Temperature is raised to $500^{o}C$? (2 marks)

QUESTION FOUR (20 MARKS)

a) What is gravimetric analysis? (2 marks)

b) Highlight the steps followed in gravimetric analysis. (7 marks)

c) Which conditions minimise relative supersaturation to obtain large crystals? (4 marks)

d) Give three disadvantages of gravimetric analysis. (3 marks)

e) Explain the following terms.

i. Occlusion (2 marks)

ii. Precipitation from homogeneous solution. (2 marks)