JANUARY 2024
CHE 208SW
PHYSICAL CHEMISTRY II
1 HOUR 30 MINUTES

Candidate's Index Number
IE/MOS/STJ/22/0064
Signature:

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
SCHOOL OF EDUCATIONAL DEVELOPMENT AND OUTREACH
INSTITUTE OF EDUCATION

FIVE-SEMESTER BACHELOR OF EDUCATION (SANDWICH) PROGRAMME
LEVEL 400, END-OF-FIRST SEMESTER EXAMINATIONS, JANUARY 2024

10TH JANUARY 2024 PHYSICAL CHEMISTRY II 1:30 PM - 3:00 PM

SECTION B
(40 MARKS)

Answer any TWO questions from this Section.
Please, note that if you answer more than two questions, only the first two will be marked.

1. **[20 marks]**

a. Benzoic acid ($K_a = 6.3 \times 10^{-5}$), $HC_7H_5O_2$, and its salts are used as food preservatives. A sample of solution is known to contain 0.015 M sodium benzoate.
   i. What is the concentration of benzoic acid in this solution?
   ii. What is the the pH of the solution?

b. The pH of a 0.060 M weak monoprotic acid is 3.44. Calculate the K_a of the acid.

2. **[20 marks]**

a. Calculate the pH of 0.06 M aniline ($C_6H_5NH_2$)(a weak base) solution. (Given K_b ($C_6H_5NH_2$) = 3.8×10^{-10}). Assume the auto ionization of water has negligible effect on the pH of the solution.

b. For gaseous species in equilibrium, the vapour pressure equilibrium (Kp) and the concentration equilibrium (Kc) terms are not always the same at any given temperature. Derive an expression relating Kp and Kc at any given temperature.

3. **[20 marks]**

a. What is the equilibrium constant for the reaction

$HCN(aq) \rightleftharpoons H^+(aq) + CN^-(aq)$ $K = ?$

Given that

$HCN(aq) + OH^-(aq) \rightleftharpoons CN^-(aq) + H_2O(l)$ $K_1 = 4.9 \times 10^4$

$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$ $K_2 = 1.0 \times 10^{-14}$

b. For each of the following equations, state with explanations whether an increase in pressure will increase, decrease or have no effects on the amounts of products (species on the right side of the equation)

i. $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$

ii. $2\,H_2S(g) \rightleftharpoons 2\,H_2(g) + S_2(g)$

iii. $C(s) + S_2(g) \rightleftharpoons CS_2(g)$

$K_c =$

$K_p = \frac{P(B)^b}{P(A)^a}$ $PV = nRT$

$K_p = K_c(RT)^{\Delta}$ P $P = \frac{nRT}{V}$

$P = CRT$

$K_p = C$ K_c

$K_p = \frac{P(B)^b}{P(A)^a}$

$K_c = [B]^b$

K_c

K

K