BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Fall) Examination 2022: Jan-Feb 2023

Student Group: 0<Earned Credit Hours ≤ 36

Subject: EWCE 105, Environmental Chemistry

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Draw the Log C vs pH diagram for the aqueous carbonate system not exposed to atmosphere along with necessary derivations for all of the chemical species present in the equilibria. **20**

b. In addition to carbonate system, the following phosphoric equilibria is present in an aquatic system: **10**

$H_3PO_4 \longrightarrow H^+ + H_2PO_4^- (pk_{A1} = 2.12)$

$H_2PO_4^- \longrightarrow H^+ + HPO_4^{2-} (pk_{A2} = 7.21)$

$HPO_4^{2-} \longrightarrow H^+ + PO_4^{3-} (pk_{A3} = 12.32)$

Deduce the expressions for total alkalinity and carbonate alkalinity along with the characteristic pH and PRL.

Question 2

a. 10^{-4} mol of phenol (C_6H_5OH) is added to sufficient amount of water to make 1 liter solution at 25°C. Estimate the equilibrium concentration of all species involved. Apply graphical approach and ignore activity corrections. Given $K_A = 1.2 \times 10^{-10}$. **20**

b. Explain the Langmuir and the Frendlich Isotherms for adsorption with relevant mathematical expressions and plots of the respective isotherms. **10**

Question 3

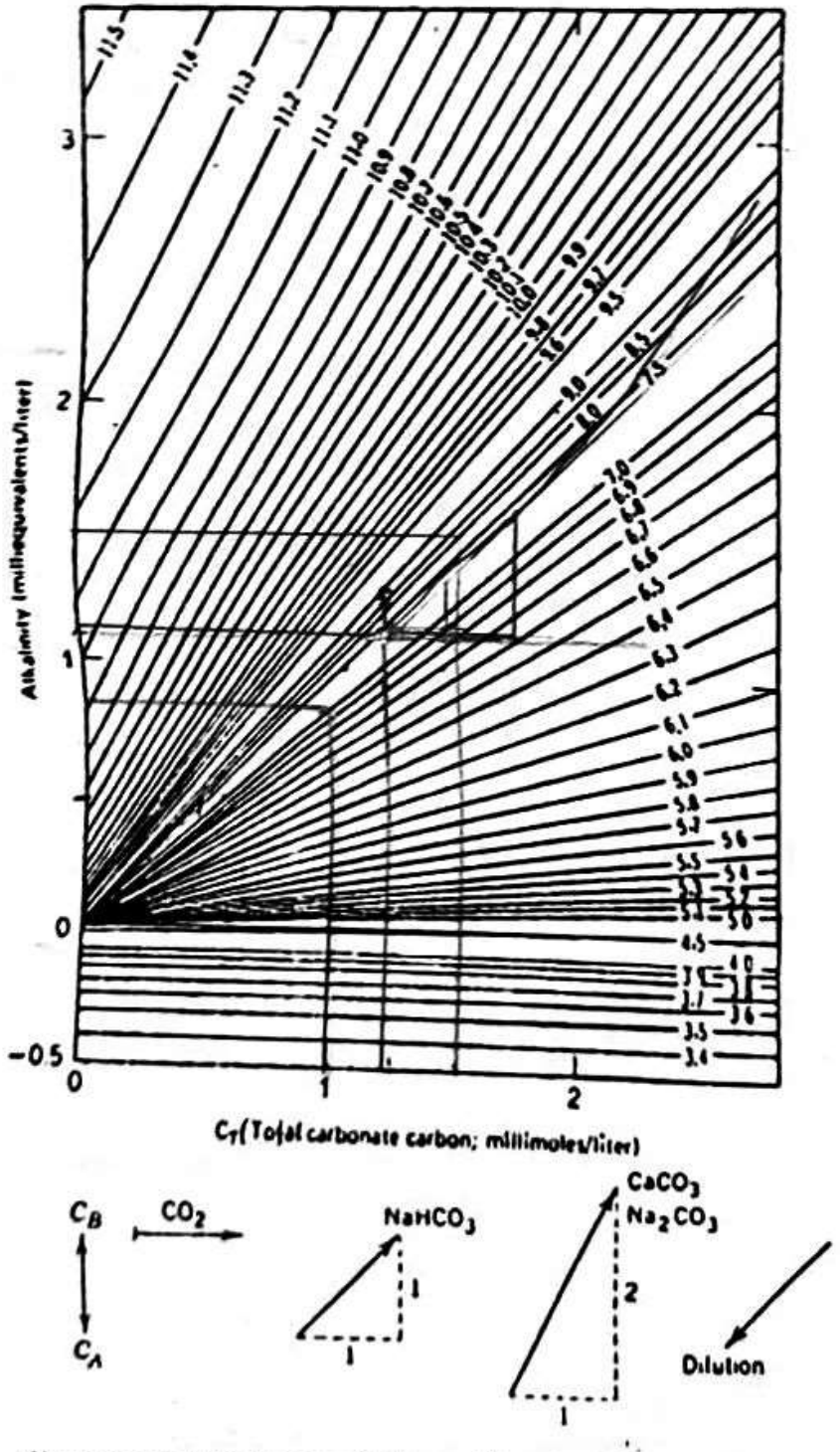
a. Total carbonate concentration of two water samples are given as 1 mM and 1.5 mM. pH of the samples are 7.0 and 8.0 respectively. Using the capacity diagram shown in figure 3(a), evaluate the alkalinity and pH of the mixture of the samples. To increase the pH of the mixture by 1.5 unit, estimate i) how much base is to be added, ii) how much HCO_3^- is to be added, and iii) how much CO_3^{2-} is to be added? **20**

b. Briefly explain the characteristics of pops? From the dissolution equilibrium condition of $CaSO_4$ (s) in water, determine the equilibrium concentration of the ionic species derived from the salt, Given $pk_{so} = 4.6$. **10**

Question 4

a. Determine the equilibrium concentration of all species involved in 10^{-2} M aqueous solution of Hypochlorous acid (Hocl) at 25°C. Use numerical solution approach and ignore activity corrections, Given $K_A=2.9\times10^{-8}$. **20**

b. Explain how pH affects the dissolution and precipitation processes of metal oxides and hydroxides in an aquatic system along with relevant mathematical derivations and diagrams. How these effects can control the mechanism of lime-soda softening process? **10**



pH contours in alkalinity-versus C_T diagram. The point defining the solution composition moves as a vector in the diagram as a result of the addition (or removal) of CO_2, $NaHCO_3$, and $CaCO_3$ (Na_2CO_3) or C_B and C_A. (After K. S. Defleyes [2])

Figure 3(a) for question number 3(a)

SECTION-B

Question 5 (Compulsory)

a. It is stated that greenhouse gases are not entirely undesirable. Explain your position on this claim. **04**

b. Describe what characteristics of CFCs make them harmful to the environment. **06**

c. Explain how ozone is formed in the Troposphere. What happens when ozone is identified in the lower atmosphere? **10**

d. The official level of the annual NO_2 standard is 53 ppb. Express the standard in mg/m^3. **10**

Question 6

a. Define Biotic and Abiotic factors. How do they interact in the ocean ecosystem explain? **4+6**

b. Explain with examples, how all the spheres are closely connected. **10**

c. What are the most common type of indoor air pollutants? The effect of indoor air pollution is much worse if spaces inside the home are poorly ventilated. What can be the remedy for cases like this? **4+6**

Question 7

a. Describe the solid waste management hierarchy. **08**

b. Why do you think the air fuel ratio should be stoichiometric? **08**

c. What causes incomplete combustion and why do you think incomplete combustion is dangerous? **10**

d. What are short lived climate pollutants? **04**

Question 8

a. Describe the particulate matter deposition mechanism in our respiratory system. **08**

b. Why do you think the Antarctic Ozone hole is more prominent in spring? **08**

c. When it comes to Ozone layer depletion, why do you think UV-B gets more attention? **06**

d. Explain the effects of SO_2 on human health and materials. **08**