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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, June 2021

Course: Chemical Energetics, Equilibria & Functional Group Organic Chemistry I Semester: II
Program: B. Sc. (Hons.) Geology and B. Sc. (Hons.) Mathematics Time 03 hrs.
Course Code: CHEM 1008G Max. Marks: 100

SECTION A
1. Each question will carry 5 marks
2. Instruction: Complete the statement/ Select the correct answer

S. No.	Question	Marks	CO
Q 1	(i) The heat change at constant volume is equal to …………. (ii) ΔH for a reaction is independent of a. T b. the path followed c. the initial and final states d. ΔV (iii) ΔH^o_f is non-zero for a. $Br_2(l)$ b. $O_2(g)$ c. C(graphite) d. NO(g)	5	CO1
Q 2	(i) At equilibrium, ΔG is a. Positive b. Negative c. Zero d. none of the above (ii) For the equilibrium $2N_2O(g) + N_2H_4(g) \rightleftharpoons 3N_2(g) + 2H_2O(g)$, K_p/K_c is a. RT b. 1/RT c. 1 d. $(RT)^2$	5	CO1
Q 3	(i) The pH of an aqueous solution is 4. Its $[OH^-]$ is a. 10 b. 10^{-4} c. 10^{-10} d. 10^{-8}	5	CO1

	(ii) The solubility product of a sparingly soluble salt AB is 1.21×10^{-6} M^2 at room temperature. Its molar solubility is
	  a. 1.21×10^{-6} M
	  b. 1.1×10^{-4} M
	  c. 1.1×10^{-3} M
	  d. 1.21×10^{-12} M		

Q 4	a) Arrange the following in order of reactivity towards halogenation. Support your answer with suitable reason
	  i) Benzene, toluene, nitrobenzene
	b) Giving suitable reason, arrange the halo alkanes in the increasing order of reactivity towards S_N2 reaction
	
	  ($CH_3)_2CHBr$, $(CH_3)_3Br$, CH_3CH_2Br
		2.5
		
		2.5
			CO3

Q 5	Why – a) Benzene undergoes electrophilic substitution reaction whereas alkenes undergo addition reactions. b) Complete racemization is not observed in SN1 Mechanism.	2.5 2.5	CO2
Q 6	In a dicarboxylic acid , the first dissociation constant, K1, is higher than the second one K2.	5	CO2

<div align="center">SECTION B</div>

1. **Each question will carry 10 marks**
2. **Instruction: Write short / brief notes**

Q 1	(i) 25 ml of 0.01 M $AgNO_3$ solution is mixed with 25 ml of 0.0005 M NaCl solution. Determine if the precipitation of AgCl will be formed. Given $K_{sp}(AgCl) = 1.7 \times 10^{-10}$ M^2. (ii) Calculate the pH of (a) 0.0001 M HCl solution and (b) 0.04 M HNO3 solution, assuming complete dissociation in each case.	10	CO1
Q 2	What are buffer solutions? Explain giving example, how a solution of weak acid and its salt behave as a buffer? Derive the relation between pH of the solution and the relative amounts of acid and salt present in it.	10	CO1
Q 3	Derive the relation between the equilibrium constants K_p, K_c and K_x. Under what condition, $K_p = K_c = K_x$?	10	CO1
Q 4	a) Discuss Lucas test to distinguish 1^0, 2^0 and 3^0 alcohol. b) Giving mechanism , explain what will be obtained on heating 2,3-Diphenylbutane-2,3-diol (pinacol) in acidic medium.	5 5	CO3

| Q 5 | a) Why is o-nitrophenol more volatile compared to p-nitrophenol?
b) Giving reason, arrange the following in order of increasing acidic strength
    i)   Bromoacetic acid, chloro-acetic acid, fluoro-acetic acid Iodo-acetic acid
    ii)   HCOOH, CH_3CH_2COOH, $CH_3CH_2CH(Cl)COOH$, $CH_3CH(Cl)COOH$ | 5

5 | CO2 |

SECTION-C

1. **Each question carries 20 marks**
2. **Instruction: Write long answers**

| Q 1 | a. Calculate the degree of hydrolysis of decimolar solution of ammonium acetate at 25°C. Dissociation constants of acetic acid and ammonium hydroxide are 1.75×10^{-5} and 1.81×10^{-5}, respectively at 25°C. K_w at 25°C = 1.008×10^{-14}.

OR

What would be the pH of 0.01 M solution of NH_4Cl in water at 25°C? (K_b for $NH_4OH = 1.81 \times 10^{-5}$).

b. Calculate ΔH_f for methane, for the reaction

$C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$ from the following data:

$C(s) + O_2(g) \longrightarrow CO_2(g)$, $\Delta H = -393.5$ KJ

$H_2(g) + 1/2 O_2(g) \longrightarrow H_2O(l)$, $\Delta H = -285.9$ KJ

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$, $\Delta H = -890.3$ KJ

OR

Estimate the value of enthalpy of combustion for Ethene (C_2H_4) and Butene (C_4H_8). Given the bond energies in KJ/mole respectively

C-H   : 416.2   O=O :   493.7
C=O : 711.3   H-O :   464.4
C=C : 615.0 | 10
10 | CO1 |