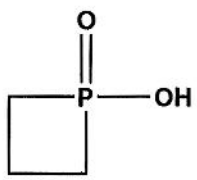


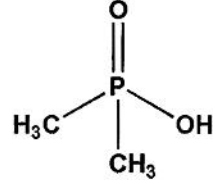
Ref No. Ex/CHE/CHEM/T/112/2018
Bachelor of Engineering in Chemical Engineering Examination 2018
(1st Year, 1st semester)
Inorganic Chemistry

Time 3 hours

Full Marks: 100

Answer any five questions

1. (a) The initial part of the plot of concentration of reactant versus time for a first-order reaction is linear. Prove it. What are the advantages of this to the chemists or relevant people? Marks (5 + 5)
- (b) The rate of a first-order reaction at this moment is 240 in a proper first-order unit. One hour later the rate becomes 30 in the same unit and at the same temperature. What is the half-life of the reaction? Marks 5
- (c) Write a short explanatory note on Acid Rain. Marks 5
2. (a) What do you mean by complementary and non-complementary redox reactions? Give one example of each (no explanation needed). Marks (4 + 4)
- (b) For a consecutive reaction $A \rightarrow B \rightarrow C$ where both the steps (A to B and B to C) are first-order with rate constants k_1 and k_2 respectively, find the value [C] at any time during the reaction if [B] remains constant throughout the reaction. Marks 8
- (c) What are the similarities between Borazine and Benzene? Marks 4
- 3 a) Arrange the following with increasing order of acidity/basicity and give explanation in support of your answer [3×6]
- i) 1° amine, 2° amine and 3° amine
ii) H_3PO_2 , H_3PO_3 and H_3PO_4
iii) ammonia and phosphine
iv) $HClO$, $HClO_2$, $HClO_3$ and $HClO_4$
v)
- 


- vi) CH_3COOH , $(CH_3)_2CHCOOH$, $ClCH_2COOH$ and FCH_2COOH
- b) What do you understand by conjugate acid-base pair? Give example. [2]

[Turn over

- 4.a) What do you mean leveling and differentiating solvent? Give examples.
- b) Predict the direction of the reaction and give explanation in support of your answer.
- i) $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+} = [\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ ii) $\text{CsF} + \text{LiI} = \text{CsI} + \text{LiF}$
- c) How can you determine pH of very dilute solution of a strong base? Calculate pH of 1×10^{-7} M NaOH solution.
- d) Derive the expression of pH when a salt of weak acid and weak base is hydrolyzed.
- e) Calculate pH of 10 mL of 0.01 (M) NaOH solution when (i) 10 mL of 0.01 (M) acetic acid and (ii) 10 mL of 0.01 (M) hydrochloric acid is added separately.
Given: K_a of acetic acid is 1.75×10^{-5} . [4×5]
- 5 (a) Use Secular Determinant to calculate the energies of the molecular orbitals in linear H_3^+ system. [6]
- (b) Draw the MO energy level diagram for CO and hence show that C is the ligating atom in transition metal carbonyls. Calculate the bond order of CO [6]
- (c) Two atomic orbitals, χ_A and χ_B , undergo out of phase overlap to form the bonding and antibonding MOs. Find out the normalization constants and hence calculate the energy of both the normalized MOs. Show that the stability of a bonding orbital is less than the instability of an antibonding orbital. [8]
- 6 (a) Draw molecular orbital energy level diagram of HF and hence comment on the polarity of HF. [3]
- (b) Draw the MO energy level diagram of N_2 and hence show that the bond length of N_2 increases on ionization. [5]
- (c) He_2 does not exist. Comment. [3]
- (d) Using Walsh Diagram comment on the structure of H_3^+
- (e) Comment on the structure and shape of the following molecule. Draw the structure. Write the hybridization of the central atom (any two). XeF_6 , SF_4 , IBr_3 [6]