Ref No. Ex/CHE/CHEM/T/112/2019(OLD)

Bachelor of Engineering in Chemical Engineering Examination 2019(OLD)

(1st Year, 1st semester) Inorganic Chemistry

Time 3 hours Full Marks: 100

Answer any five questions

1. (a) Derive the necessary rate equation for a pure first-order reaction like where 'k' is the rate constant. [8]

(b) From (a) above, derive the expression for half-life. [6]

(c) What is acid rain? How it is formed? What are its adverse effects? [2+2+2]

2. (a) Which compound is called 'Inorganic Benzene'? Why? [1+6]

(b) In acid media, Fe^{2+} is very quickly oxidized by Ce^{4+}. Why the reaction is so fast? [6]

(c) What is activation energy of a chemical reaction? Is it temperature dependent? Explain. [2+5]

3 a) Which one is stroner acid or stronger base in each of the following cases? [5x3 =15]

i) 2° amine and 3° amine
ii) H_3PO_3 and H_3PO_4
iii) ammonia and phosphine
iv) $HClO_3$ and $HClO_4$
v) $ClCH_2COOH$ and FCH_2COOH

b) Write a short note on conjugate acid-base theory. [5]

4.a) What do you mean by differentiating solvent? Give examples.

b) Predict the direction of the reaction and give explanation in support of your answer.

$[Co(NH_3)_5(ONO)]^{2+} = [Co(NH_3)_5(NO_2)]^{2+}$

c) 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 10 mL of 0.01 (M) hydrochloric acid is added [4×5]

5 (a) Find the energy of bonding and anti bonding MOs in H_2 molecule [6]

(b) Draw the MO energy level diagram for N_2 and calculate the bond order [6]

(c) Two atomic orbitals, χ_A and χ_B, undergo inphase andout 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. [8]

6 (a) Draw molecular orbital energy level diagram of HF [3]

(b) Draw the MO energy level diagram of CO [3]

(c) Using Walsh Diagram comment on the structure of H_3^+ [3]

(d) Comment on the structure and shape of the following molecule. Draw the structure. Write the hybridization of the central atom (any three). XeF_4, XeF_6, NCl3, BrF_3 3x3=9