B.TECH/ BT/ CE/ CHE/ EE/ ME /2ND SEM/ CHEM 1001/2018

CHEMISTRY-I
(CHEM 1001)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) In a reaction A⟶Products, the rate constant is found to be equal to rate at all concentrations. What will be the order of reaction?

   (a) Zero   (b) One   (c) Two   (d) Three.

   (ii) Which of the following is always true for a spontaneous change at any temperature?

   (a) $\Delta H < 0$ and $\Delta S > 0$ (b) $\Delta H < 0$ and $\Delta S < 0$

   (c) $\Delta H > 0$ and $\Delta S < 0$ (d) $\Delta H > 0$ and $\Delta S > 0$.

   (iii) An essential condition for a molecule to be IR active is
   (a) molecule has an oscillating dipole moment
   (b) molecule should be polar
   (c) molecule has a permanent dipole
   (d) none of these.

   (iv) Which ion has greatest ionic mobility?
   (a) Na^+ (b) Li^+ (c) H_3O^+ (d) K^+.

   (v) The octane number of 2,2,4-trimethyl pentane is
   (a) 0   (b) 25   (c) 50   (d) 100.

   (vi) Which of the following radiations has the highest energy?
   (a) UV   (b) IR   (c) Microwave   (d) X-ray.

   (vii) For a weak acid with α as its degree of dissociation, the value of dissociation constant is given by (C is concentration of acid in moles per litre)
   (a) $K_a = C\alpha$ (b) $K_a = C\alpha^2$ (c) $K_a = C^2\alpha$ (d) $K_a = C^2\alpha^2$.

   (viii) The boiling point of p-nitrophenol is greater than o-nitrophenol because of
   (a) ionic bonding   (b) intramolecular H-bonding
   (c) van der Waals' attractive force   (d) intermolecular H-bonding.

   (ix) A metal deficient ionic compound acts as
   (a) n-type semiconductor   (b) p-type semiconductor
   (c) intrinsic semiconductor   (d) insulator.

   (x) Which of the following polymers is used for making switch board, heater handle etc.?
   (a) Polythene   (b) Rubber   (c) PET   (d) Bakelite.

Group – B

2. (a) What do you mean by a reversible & irreversible process? Prove that for a reversible adiabatic process $TV^{\gamma-1}$ = Constant.

   (b) Write down the statements of 2nd law of thermodynamics. Show that Joule-Thomson effect is an isoenthalpic process.

   (c) The absorption coefficient of a solution of glycogen-iodine complex is 0.20 at a light of 450 nm wavelength. Calculate the concentration of the solution when the transmittance is 40% in a cuvette of 2cm.
   (2 + 3) + (2 + 2) + 3 = 12

3. (a) Prove that $C_p - C_v = R$ for one mole of ideal gas.

   (b) What is heat capacity? Define Chemical potential.

   (c) An ideal monoatomic gas (1-mole) is heated from 27 °C to 227 °C and the volume expands from 10 lit. to 100 lit. What is the change in molar entropy? (Given $C_v = 3/2 R$)

   (d) Show, using labeled drawings of the carbon di-oxide molecule:
   i) symmetrical stretching ii) asymmetrical stretching. Among the two stretching modes which one is IR active and why?
   3 + (1 + 1) + 3 + (2 + 2) = 12

Group – C

4. (a) The bond angle in F_2O is 103°; while it is 110° in Cl_2O – explain using VSEPR theory.

(b) What do you mean by solubility product of salts? Solubility of Ag_2CrO_4 is $2.5 \times 10^{-2} gL^{-1}$. Calculate the solubility product (K_{sp}) of Ag_2CrO_4. (Given molecular weight of Ag_2CrO_4 is 332).

(c) Differentiate between Schottky and Frenkel defects with the help of diagram.

(d) Deduce the expression for pH of the solution containing salt of a weak base and strong acid.

$$2 + (1 + 2) + 4 + 3 = 12$$

5. (a) Write the electronic configuration of dioxygen molecule and calculate the bond order using molecular orbital theory. Find out the number of unpaired electrons in it.

(b) Write short note on impurity defect of solid?

(c) Prove that for an acidic solution pH<7 at 25°C.

(d) Show that reaction involved with mechanism when isobutyl chloride is treated with aqueous NaOH solution.

(e) Give a brief comparison of the salient features of S_N1 and S_N2 mechanism.

$$3 + 2 + 2 + 2 + 3 = 12$$

Group – D

6.(a) Write down Arrhenius equation for the temperature dependence of specific rate and explain the terms used. What is the unit of the frequency factor for a first order reaction? Plot logK vs 1/T and explain the significance of the slope of the plot.

(b) The rate constant for first order decomposition of N_2O_5 is $5.2 \times 10^{-3} s^{-1}$ at 338K. The initial concentration of N_2O_5 is 0.50 mole/lit. Calculate the concentration of remaining N_2O_5 after 700 second at 338K.

(c) Explain the effect of dilution on equivalent conductance for a strong and a weak electrolyte.

(d) The equivalence conductance at infinite dilution (Λ_o) of HCl, CH_3COONa and NaCl are 426.16, 91.0 and 126.45 $ohm^{-1}cm^2eq^{-1}$ at 25°C. Calculate Λo of CH_3COOH.

$$(1 + 1 + 2) + 2 + (2 + 2) + 2 = 12$$

7. (a) Deduce the integrated rate expression for second order reaction where the initial concentrations of the two reactants are same. Show that time for half decomposition of a second order reaction where two reactants are same is dependent on the initial concentration of the reactant.

(b) State the Kohlrausch's law of independent migration of ions.

(c) The transport number of silver in silver nitrate and silver sulphate solutions are different – why?

(d) What is salt bridge?

(e) A galvanic cell is constructed with Hg^{2+} / Hg and Fe^{3+} /Fe^{2+} electrodes. Calculate the concentration of Hg^{2+} at which the emf of the cell is zero at equimolar concentration of Fe^{2+} and Fe^{3+}. [Given, $E°_{Hg2+/Hg}$ = 0.85 and $E°_{Fe3+/Fe2+}$ = 0.77]

$$(2 + 2) + 2 + 2 + 1 + 3 = 12$$

Group – E

8.(a) Differentiate between addition and condensation polymerization processes.

(b) What are the main constituents of LPG? What are the sources of foul smell during the leakage of LPG?

(c) Define the terms: (i) Degree of polymerization, (ii) Tacticity.

(d) Outline the procedure and reaction involved in determination of % of sulphur of a coal sample.

(e) What is the composition of water gas? Mention two uses of water gas.

$$2 + (1 + 2) + 2 + 3 + (1 + 1) = 12$$

9. (a) Write down the differences between LDPE and HDPE.

(b) Write structural unit of natural rubber. Why natural rubber needs vulcanization?

(c) What is cracking and why it is considered as an important process? What is sweetening of petrol?

(d) What is the flash point of an engine?

(e) What are the advantages of CNG over gasoline?

$$2 + (1 + 2) + (2 + 1) + 2 + 2 = 12$$