

B.TECH/AEIE/CSE/ECE/IT/1ST SEM/ CHEM 1001/2017

**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 any 5 (five) from Group B to E, taking at least one 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 P - V representation of expansion of an ideal gas, the slopes of the isothermal and adiabatic curve would be respectively
(a) $-P/V$ and $\gamma(P/V)$ (b) $-P/V$ and $-\gamma(P/V)$
(c) P/V and $\gamma(P/V)$ (d) P/V and $-\gamma(P/V)$.
- (ii) If the temperature of both the source and the sink is lowered by 10°C then the efficiency of a Carnot engine would
(a) increase (b) decrease (c) remain unaltered
(d) depend on the nature of the working substance.
- (iii) Which one of the following compounds exhibits both Schottky and Frenkel defect?
(a) NaCl (b) AgCl (c) AgBr (d) AgI.
- (iv) For a weak acid with α as its degree of dissociation, the value of dissociation constant (K_a) 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) $K_a = C^2\alpha^2$.
- (v) Which of the following contains maximum number of lone-pairs of electrons on the central atom?
(a) ClO_3^- (b) XeF_4 (c) SF_4 (d) I_3^- .
- (vi) The dissociation energy of N_2 and N_2^+ are E_1 and E_2 respectively, the relationship between them E_1 and E_2 is
(a) $E_1 > E_2$ (b) $E_2 > E_1$
(c) $E_1 = E_2$ (d) not easy to predict.

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- (vii) A galvanic cell is used for the conversion of
(a) chemical to heat energy (b) chemical to electrical energy
(c) chemical to light energy (d) electrical to chemical energy.
- (viii) PVC can be reused and reshaped because it is a
(a) copolymer (b) thermosetting resin
(c) thermoplastic resin (d) isotactic polymer.
- (ix) A conducting polymer is
(a) Polyethylene (b) Polypropylene
(c) Polyaniline (d) Bakelite.
- (x) The compound with antiknock value 100 is
(a) iso-octane (b) n - octane
(c) 2 - methyl heptane (d) 2,2 - dimethyl hexane .

Group - B

- 2.(a) Obtain the expression for the efficiency of a reversible Carnot engine and show how this expression leads to an important statement of the second law of thermodynamics.
(b) Define chemical potential.
(c) Mention two important applications of IR spectroscopy.
(6 + 2) + 2 + 2 = 12
- 3.(a) Derive Gibbs-Helmoltz equation relating ΔG with its temperature coefficient.
(b) What is heat capacity? What is enthalpy? Derive the expression for change in enthalpy for ideal gas.
(c) Explain the term 'chromophore' with example. State the Lambert-Beer's law of light-absorption of medium.
4 + (1 + 1 + 2) + (2 + 2) = 12

Group - C

4. (a) By drawing energy level diagrams explain why H_2^+ and H_2^- ions have the same bond order but H_2^+ ions are more stable than H_2^- .
(b) Predict the hybridization and shape of XeF_4 , ICl_2 , CO_2^- .

(c) Calculate the pH value of 0.15M solution of ammonium chloride if the dissociation constant of ammonia is 1.8×10^{-5} .

(d) What is semiconductor? Give an example. Discuss about the n type semiconductor.

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

5. (a) Explain why p-nitrophenol has much higher boiling point than o-nitrophenol?

(b) Why is O - O bond length in KO_2 greater than that in molecular O_2 ?

(c) Calculate the pH of a buffer solution containing 0.1 (M) acetic acid and 0.2 (M) sodium acetate. ($K_a = 1.8 \times 10^{-5}$)

(d) "ZnO is white when cold and yellow when hot" - explain.

(e) Write a short note on metal excess defects in solid.

(f) Why is normal aliphatic alcohol less acidic than phenol?

$$2 + 2 + 2 + 2 + 3 + 1 = 12$$

Group - D

6. (a) How does a homogeneous catalyst increase the rate of a reaction? Explain with an example.

(b) What are the assumptions of the collision theory?

(c) State, with reason whether it is possible to store 1M $AgNO_3$ solution in iron vessel. Given $E^0_{Fe^{2+}/Fe}$ and $E^0_{Ag^+/Ag}$ are -0.44V and 0.799V respectively.

(d) Draw the conductometric titration curve for weak acid (eg. CH_3COOH) vs strong base (eg. $NaOH$) and explain the salient features of the curve.

(e) What are the differences between an electrolytic cell and an electrochemical cell?

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

7. (a) Deduce the expression for the rate constant of a second order reaction where the initial concentrations of the two reactants are not same and from that expression show that if concentration of one of the reactants is much higher than the other, it follows a first order rate equation.

(b) What is calomel electrode? In which condition, the cell potential (E) will be equal to the standard cell potential (E^0)?

(c) What is meant by transport number of a cation? How is it related to ionic mobility?

Calculate the standard free energy change of the cell reaction:

$Fe^{2+} + Ag^+ \rightarrow Fe^{3+} + Ag(s)$ and give the representation of the cell. (Given: the standard reduction potentials of the electrodes $Fe^{3+}/Fe^{2+} = 0.77V$ and $Ag^+/Ag = 0.80V$)

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

Group - E

8. (a) What do you mean by proximate analysis and ultimate analysis?

(b) Write the structural unit and two important applications of any two of the following polymers i) LDPE ii) Nylon 6,6 iii) Dacron

(c) What is octane rating for petrol?

(d) Calculate the gross and net calorific value of a coal sample having the following composition: carbon=82%, hydrogen=8%, oxygen=5%, sulphur=2.5%, nitrogen=1.4% and the ash=2.1%.

$$3 + 4 + 2 + 3 = 12$$

9. (a) Define T_m and T_g and indicate how these are affected by the structure of polymers.

(b) 100 gm of a polymer of molecular weight 1000gm/mole is mixed with 1000 gm of another polymer of molecular weight 105 gm/mole. What is the value of polydispersity index (PDI)?

(c) Deduce a relation between GCV and NCV of a coal sample.

(d) What do you mean by knocking? Discuss the function of TEL in IC engine.

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