Chemistry

Time: 3 Hours **Total Marks: 70**

Note:

i. All questions are compulsory.
ii. Answer to the two sections are to be written in the same answer book.
iii. Figure to the right hand side indicate full marks.
iv. Write balanced chemical equations and draw neat and labelled diagrams wherever necessary.
v. Every new question must be started on a new page.
vi. Use of logarithmic table is allowed

SECTION – I

Q.1. Answer any ONE of the following: **[7]**

i. What is 'boiling point'?
Derive a relation between ΔH and ΔU for a chemical reaction.
Draw neat labelled diagram of calomel electrode.
Resistance and conductivity of a cell containing 0.001 M KCl solution at 298 K are 1500 Ω and 1.46×10^{-4} S. cm^{-1} respectively. What is the cell constant?

ii. Write molecularity of the following reaction:
$2NO_{(g)} + O_{2\,(g)} \longrightarrow 2NO_{2\,(g)}$
What is 'calcination'? How does it differ from 'roasting'?
Write resonating structures of ozone.
The decomposition of $N_2O_{5(g)}$ at 320 K according to the following equation follows first order reaction:

$$N_2O_{5(g)} \rightarrow 2NO_{2(g)} + \frac{1}{2} O_{2(g)}$$

The initial concentration of $N_2O_{5(g)}$ is 1.24×10^{-2} mol. L^{-1} and after 60 minutes, 0.20×10^{-2} mol. L^{-1}. Calculate the rate constant of the reaction at 320 K.

Q.2. Answer any THREE of the following: **[9]**

i. One mole of a gas expands by 3 L against a constant pressure of 3 atmosphere. Calculate the work done in:
a. L. atmosphere
b. Joules
c. Calories

ii. Calculate the amount of $CaCl_2$ (van't Hoff factor i = 2.47) dissolved in 2.5 L solution so that its osmotic pressure at 300 K is 0.75 atmosphere.
Given: Molar mass of $CaCl_2$ is 111 g. mol^{-1}.
$R = 0.082$ L. atm. K^{-1} mol^{-1}

iii. Describe anomalous behaviour of fluorine with the other elements of group 17 with reference to:
a. Hydrogen bonding
b. Oxidation state
c. Polyhalide ions

iv. Face centred cubic crystal lattice of copper has density of 8.966 g. cm^{-3}. Calculate the volume of the unit cell.
Given: Molar mass of copper is 63.5 g. mol^{-1} and Avogadro number N_A is 6.022×10^{23} mol^{-1}.

Q.3. Answer any SIX of the following: **[12]**

i. What is the action of the following reagents on ammonia:
   a. Nessler's reagent
   b. Sodium metal

ii. State the first and second law of electrolysis.

iii. Draw neat and labelled diagram of Bessemer converter used in the extraction of copper.

iv. Derive the relation between half-life period and rate constant for first order reaction.

v. Derive the relation between ΔG° and equilibrium constant (K) for the reaction,
$aA + bB \rightleftharpoons cC + dD$.

vi. Explain brown ring test with the help of chemical equation.

vii. Explain, why do aquatic animals prefer to stay at lower level of water during summer?

viii. Distinguish between:
Crystalline solids and Amorphous solids.

Q.4. Select and write the most appropriate answer from the alternatives given below each sub-question: **[7]**

i. To prepare n-type semiconductor, the impurity to be added to silicon should have the following number of valence electrons _____.
(A) 2 (B) 3
(C) 4 (D) 5

ii. Number of faradays of electricity required to liberate 12 g of hydrogen is _____.
(A) 1 (B) 8
(C) 12 (D) 16

iii. What is molecular formula of oleum?
(A) H_2SO_3 (B) H_2SO_4
(C) $H_2S_2O_7$ (D) $H_2S_2O_8$

iv. Purification of aluminium by electrolytic refining is carried out by _____.
(A) Hoope process (B) Hall Process
(C) Baeyer process (D) Serperck process

v. The rate of reaction for certain reaction is expressed as:

$$\frac{1}{3}\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = -\frac{d[C]}{dt}$$

The reaction is _____.
(A) $3A \longrightarrow 2B + C$ (B) $2B \longrightarrow 3A + C$
(C) $2B + C \longrightarrow 3A$ (D) $3A + 2B \longrightarrow C$

vi. A system absorbs 640 J heat and does work of 260 J, the change in internal energy of the system will be _____.
(A) + 380 J (B) – 380 J
(C) + 900 J (D) – 900 J

vii. Which of the following is 'not' a colligative property?
(A) Vapour pressure (B) Depression in freezing point
(C) Elevation in boiling point (D) Osmotic pressure

SECTION – II

Q.5. Answer any ONE: **[7]**

i. Write the structural formula and IUPAC names of all possible isomers of the compound with molecular formula C_3H_8O.

Write 'two' uses of phenol.

What happens when glucose is treated with:

a. Bromine water

b. Dilute nitric acid

c. Hydrogen cyanide (HCN)

ii. Write the molecular formula and structural formula of BHA and BHT.

What are thermoplastic polymers?

Write a note on aldol condensation.

Q.6. Answer any THREE: **[9]**

i. What is the action of the following reagents on aniline?

a. Bromine water

b. Acetic anhydride

c. Hot and conc. sulphuric acid

ii. Discuss the optical activity of lactic acid.

iii. Write balanced chemical equations for action of potassium permanganate on:

a. Hydrogen

b. Warm conc. sulphuric acid

Explain why Mn^{2+} ion is more stable than Mn^{3+} ?

(Given: Mn $\rightarrow$ Z = 25)

iv. What is effective atomic number (EAN)?

Calculate EAN of cobalt (Z = 27) in $[Co(NH_3)_6]^{+3}$ and of zinc (Z = 30) in $[Zn(NH_3)_4]SO_4$.

Q.7. Answer any SIX: **[12]**

i. What is a 'soap'? How is it prepared?

ii. Identify the compounds 'A' and 'B' in the following equation:

$$CH_3 - CH_3 + HNO_3 \xrightarrow{423-600K} \text{'A'} \xrightarrow{Sn/conc.HCl} \text{'B'} + H_2O$$

iii. Write a note on self oxidation-reduction reaction of aldehyde with suitable example.

iv. Write names and chemical formulae of monomers used in preparing Buna–S.

v. Define complex lipids. Mention 'two' functions of lipids.

vi. Distinguish between S_N^1 and S_N^2 mechanisms.

vii. What are lanthanoids? What is the position of actinoids in periodic table?

viii. How is methoxyethane prepared from:

a. Methyl iodide

b. Diazomethane

Q.8. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. IUPAC name of $K_4[Fe(CN)_6]$ is _____.
(A) tetrapotassium ferrocyanide (B) potassium ferricyanide
(C) potassium ferrocyanide (D) potassium hexacyanoferrate

ii. Carbon atom in methyl carbocation contains how many pairs of electrons?
(A) 8 (B) 4
(C) 3 (D) 5

iii. How many moles of acetic anhydride will be required to form glucose pentaacetate from 2 M of glucose?
(A) 2 (B) 5
(C) 10 (D) 2.5

iv. Identify the weakest base amongst the following _____.
(A) p-methoxyaniline (B) o-toluidine
(C) benzene-1,4-diamine (D) 4-aminobenzoic acid

v. Bakelite is the polymer of _____.
(A) Benzaldehyde and phenol (B) Acetaldehyde and phenol
(C) Formaldehyde and phenol (D) Formaldehyde and benzyl alcohol

vi. Formalin is 40% aqueous solution of _____.
(A) Methanal (B) Methanoic acid
(C) Methanol (D) Methanamine

vii. Which among the following pairs of elements is 'not' an example of chemical twins?
(A) Zr and Hf (B) Nb and Ta
(C) Mo and W (D) Ta and Re