BOARD QUESTION PAPER : MARCH 2015
CHEMISTRY

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

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

SECTION – I

Q.1. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. p-type semi-conductors are made by mixing silicon with impurities of _____.
(A) germanium (B) boron
(C) arsenic (D) antimony

ii. Amongst the following, identify the criterion for a process to be at equilibrium.
(A) $\Delta G < 0$ (B) $\Delta G > 0$
(C) $\Delta S_{total} = 0$ (D) $\Delta S < 0$

iii. Colligative property depends only on _____ in a solution.
(A) number of solute particles (B) number of solvent particles
(C) nature of solute particles (D) nature of solvent particles

iv. The charge of how many coulombs is required to deposit 1.0 g of sodium metal (molar mass 23.0 g mol^{-1}) from sodium ions?
(A) 2098 C (B) 96500 C
(C) 193000 C (D) 4196 C

v. What is the chemical composition of malachite?
(A) $CuO.CuCO_3$ (B) $Cu(OH)_2.CuCO_3$
(C) $CuO.Cu(OH)_2$ (D) $Cu_2O.Cu(OH)_2$

vi. The element that does NOT exhibit allotropy is _____.
(A) As (B) Sb
(C) Bi (D) N

vii. The integrated rate equation for first order reaction A $\rightarrow$ products is _____ .
(A) $k = 2.303\ t \log_{10} \frac{[A]_0}{[A]_t}$ (B) $k = -\frac{1}{t} \ln \frac{[A]_t}{[A]_0}$
(C) $k = \frac{2.303}{t} \log_{10} \frac{[A]_t}{[A]_0}$ (D) $k = \frac{1}{t} \ln \frac{[A]_t}{[A]_0}$

Q.2. Answer any SIX of the following: **[12]**

i. Define the following terms:
   a. Enthalpy of fusion
   b. Enthalpy of atomization

ii. Derive van't Hoff general solution equation.

iii. Explain impurity defect in stainless steel with diagram.

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

v. Draw neat and labelled diagram of dry cell.

vi. Explain the structure of sulphur dioxide.

vii. What is calcination? Explain it with reactions.

viii. Arrange the following reducing agents in the order of increasing strength under standard state conditions. Justify the answer.

Element	$Al_{(s)}$	$Cu_{(s)}$	$Cl^-_{(aq)}$	$Ni_{(s)}$
E^o	–1.66 V	0.34 V	1.36 V	–0.26 V

Q.3. Answer any THREE of the following: **[9]**

i. Determine whether the reactions with the following ΔH and ΔS values are spontaneous or non-spontaneous. State whether the reactions are exothermic or endothermic.
   a. $\Delta H = -110$ kJ, $\Delta S = +40$ J K^{-1} at 400 K
   b. $\Delta H = +40$ kJ, $\Delta S = -120$ J K^{-1} at 250 K

ii. 1.0×10^{-3} kg of urea when dissolved in 0.0985 kg of a solvent, decreases freezing point of the solvent by 0.211 K. 1.6×10^{-3} kg of another non-electrolyte solute when dissolved in 0.086 kg of the same solvent depresses the freezing point by 0.34 K. Calculate the molar mass of the another solute.
   (Given molar mass of urea = 60)

iii. Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law with $t_{1/2} = 3$ hours. What fraction of the sample of sucrose remains after 8 hours?

iv. Explain how does nitrogen exhibit anomalous behaviour amongst group 15 elements.

Q.4. Answer any ONE of the following: **[7]**

i. Niobium crystallises as body centred cube (BCC) and has density of 8.55 kg dm^{-3}. Calculate the atomic radius of niobium.
   (Given: Atomic mass of niobium = 93)
   Write one statement of first law of thermodynamics and its mathematical expression.
   Write the reactions involved in the zone of reduction in blast furnace during extraction of iron.

ii. Write molecular formulae and structures of the following compounds:
   a. Dithionic acid
   b. Peroxymonosulphuric acid
   c. Pyrosulphuric acid
   d. Dithionous acid

   Calculate E_{cell} and ΔG for the following at 28 °C:
   $Mg_{(s)} + Sn^{2+}$ (0.04 M) $\rightarrow Mg^{2+}$ (0.06 M) + $Sn_{(s)}$
   $E^o_{cell} = 2.23$ V
   Is the reaction spontaneous?

SECTION – II

Q. 5. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. Identify the product 'D' in the following sequence of reactions:

$H_3C - CH_2 - CH_2 - Cl \xrightarrow[\Delta]{Alc.KOH}$ 'B' $\xrightarrow{HBr}$ 'C' $\xrightarrow[Ether]{Na}$ 'D'

(A) 2,2-dimethylbutane (B) 2,3-dimethylbutane
(C) hexane (D) 2,4-dimethylpentane

ii. Which of the following complexes will give a white precipitate on treatment with a solution of barium nitrate?

(A) $[Cr(NH_3)_4SO_4]Cl$ (B) $[Co(NH_3)_4Cl_2]NO_2$
(C) $[Cr(NH_3)_4Cl_2]SO_4$ (D) $[CrCl_2(H_2O)_4]Cl$

iii. What is the geometry of chromate ion?

(A) Tetrahedral (B) Octahedral
(C) Trigonal planar (D) Linear

iv. Primary and secondary nitroalkanes containing α-H atom show property of _____.

(A) chain isomerism (B) tautomerism
(C) optical isomerism (D) geometrical isomerism

v. In phenol carbon atom attached to –OH group undergoes _____.

(A) sp^3 hybridisation (B) sp hybridisation
(C) sp^2 hybridisation (D) no hybridisation

vi. Identify the strongest acid amongst the following.

(A) Chloroacetic acid (B) Acetic acid
(C) Trichloroacetic acid (D) Dichloroacetic acid

vii. Which of the following vitamins is water soluble?

(A) A (B) D
(C) E (D) B

Q.6. Answer any SIX of the following : **[12]**

i. Write a note on Friedel Craft's acylation.
ii. How is ethylamine prepared from methyl iodide?
iii. What are antibiotics? Give 'two' examples.
iv. Explain, why are boiling points of carboxylic acids higher than corresponding alcohols.
v. How are proteins classified on the basis of molecular shapes?
vi. What are interstitial compounds? Why do these compounds have higher melting points than corresponding pure metals?
vii. Write the structures and IUPAC names of the following compounds:
   a. Adipic acid
   b. α-methyl butyraldehyde
viii. Explain with examples, branched and linear polymers.

Q.7. Answer any THREE of the following: **[9]**

i. On the basis of valence bond theory explain the nature of bonding in $[CoF_6]^{3-}$ ion.
Write the IUPAC name of $[Co(NO_2)_3(NH_3)_3]$.
ii. Define lanthanoid contraction. Explain its effects.
iii. Write mechanism of Aldol addition reaction.
iv. Define carbohydrates. What are reducing and non-reducing sugars?

Q.8. Answer any ONE of the following: **[7]**

i. Write a note on Gabriel phthalimide synthesis.
What are biodegradable polymers and non-biodegradable polymers? Write 'one example' of each.
Explain cationic detergents.

ii. How is carbolic acid prepared from the following compounds:
   a. Aniline
   b. Chlorobenzene and steam at 698 K?
Draw structure of DDT. Write its environmental effects.
Mention 'two' physical properties of carbolic acid.