CLASS: IMSc   SEMESTER : III
BRANCH: ALL   SESSION : MO/18

SUBJECT: IMC3001 CHEMISTRY III

TIME: 3.00 HOURS   FULL MARKS: 60

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a)   What is Kelvin-Planck statement of 2nd law of thermodynamics?   [2]
Q.1(b)   Prove the following process: [4]

$$dS > \frac{(dQ)}{T} irrev \quad and \quad dS = \frac{(dQ)}{T} rev$$

Q.1(c)   For a reversible Carnot's heat engine operating between a high temperature source at T_1 and a low   [6]
         temperature sink at T_2 derive the values for Q, W, ΔU and efficiency (η).

Q.2(a)   What is the ore of Scandium and Titanium?   [2]
Q.2(b)   What is lanthanide contraction?   [4]
Q.2(c)   Discuss the properties of Titanium grp in terms of physical & chemical properties.   [6]

Q.3(a)   Identify A, B and C: [2]

Methyl Bromide $\xrightarrow{\text{Mg / THF}}$ A $\xrightarrow{CH_3COCH_3}$ B $\xrightarrow{H_3O^{\oplus}}$ C

Q.3(b)   Briefly describe the methods to distinguish between primary, secondary and tertiary alcohols using   [4]
   Lucas Test with reaction sequence.
Q.3(c)   Explain the reaction mechanism of i) Wolf-Kishner Reduction and ii) Aldol Condensation.   [6]

Q.4(a)   What is Le Chatelier principle? Explain the effect of temperature on the following reaction.   [2]

$$N_2O_4 \xrightarrow{\Delta} 2NO_2$$
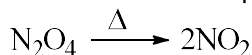
Q.4(b)   What is Vant' Hoff equation? Explain the effect of change in temperature on equilibrium constant.   [4]
Q.4(c)   Equilibrium constant (K_P) for the following reaction are 0.0266 and 0.0129 at 350 °C and 400 °C   [6]
         respectively. Calculate the heat of formation (ΔH) of gaseous NH_3.

$$\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightleftharpoons NH_3$$
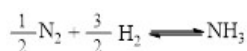
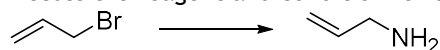Q.5(a)   Define oxidation.   [2]
Q.5(b)   Derive an expression for Nernst equation.   [4]
Q.5(c)   Discuss electrochemical series and its applications.   [6]

Q.6(a)   Discuss the reagent and condition for the following reaction.   [2]

$\diagup\!\!\diagup\diagdown Br \longrightarrow \diagup\!\!\diagup\diagdown NH_2$

Q.6(b)   Discuss the separation of primary, secondary and tertiary amines using Hinsberg method.   [4]
Q.6(c)   Explain the reaction mechanism for the formation of benzene diazonium salt followed by azo coupling   [6]
         with phenol.

Q.7(a)   [2]

$CH_3COCH_2CH_2CH_2COOCH_3 \xrightarrow[\text{ii) } H_3O^+]{\text{i) NaBH}_4} A$
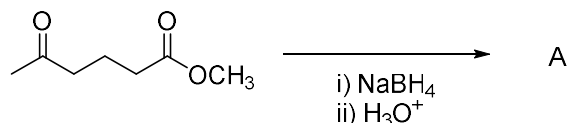
Q.7(b)   Discuss the characteristic features of f block elements? Why are they placed separately in different   [4]
         block from main periodic table?
Q.7(c)   What are heat capacities at constant pressure (C_P) and at constant volume (C_V)?   [6]
         For one mole of an ideal gas, prove that $C_P - C_V = R$