This question paper contains 7 printed pages.]

Your Roll No. .....

5192C

B.Sc. (Physical Sciences/Life Sciences) (Semester II) B

CHEMISTRY – Paper CHPT-202

(Physical Chemistry/Organic Chemistry)

(Admissions of 2010 and Onwards)

Time : 3 Hours **Maximum Marks : 75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

SECTION – A

Attempt **three** questions in **all** and question number 1 is compulsory.

1. Answer in brief : **5 × 2½ = 12 ½**

   (a) Explain the state functions and path functions. **2½**

   (b) No engine can be produced with 100% efficiency. **2½**

   (c) What you understand by Buffer solutions ? Discuss acidic and basic buffers with one example each. **2½**

(d) A mole of acetic acid and b mole of ethyl alcohol are allowed to react. If x mole of ester are formed at equilibrium, derive an expression K_c. 2½

(e) Explain the effect of change of pressure, temperature and concentration on the opposing processes using the Le-Chatelier principle. 2½

2. (a) Calculate $\Delta H°$ for the reaction : 4½

$$CO_{2(g)} + H_{2(g)} \rightarrow CO_{(g)} + H_2O_{(g)}$$

Given $\Delta H°_f$ for $CO_{2(g)}$, $CO_{(g)}$ and $H_2O_{(g)}$ are -39.5, -111.31 and 241.8 kJ mol^{-1}, respectively.

(b) What do you understand by heat capacity of a system ? Show from thermodynamics consideration that $C_p - C_v = R$. 4

(c) Calculate the pH of a 0.20 M $Ba(OH)_2$ solution. 4

$4½ + 4 + 4 = 12½$

3. (a) Derive Gibbs-Helmholtz equation in terms of free energy and enthalpy change at constant pressure. 4½

(b) What is a chemical equilibrium and give characteristics of chemical equilibrium. Find the relationship between K_p and K_c. 4

(c) Calculate the equilibrium constant at 25 °C for the reaction. 4

$$2NOCl_{(g)} \rightleftharpoons 2NO_{(g)} + Cl_{2(g)}$$

In an experiment, 2.0 mole of NOCl was placed in a 1.0 L flask and the concentration of NO after equilibrium was 0.66 mole/L. 4½ + 4 + 4 = 12½

4. (a) Derive the Henderson equation to calculate the pH of a Buffer solution. 4½

(b) Find out the pH of a Buffer solution containing 0.20 M CH_3COONa and 0.15 M of CH_3COOH and Ka for CH_3COOH is 1.8×10^{-5}. 4

(c) Calculate the equilibrium constant of a reaction at 300 K if ΔG at this temperature is 29.4 kJ mol^{-1}. 4

4½ + 4 + 4 = 12½

SECTION – B

Attempt any **three** questions

1. (a) Why nucleophilic substitution in Chlorobenzene occur under drastic condition ? How can it be facilitated ? Explain above reactions with suitable mechanism.

   (b) What is an ambidient ion ? How can you prepare (i) Nitrite and Nitro, (ii) Nitrile and iso nitrile from a given alkylhalide ?

   (c) What is base catalysed condensation reaction ? Explain with a suitable example.

3, 2, 4, 3½

2. (a) How do you affect the following conversions ?

   (i) $CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3 \rightarrow CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - OH$

   (ii) $CH_3 - CH = CH - CH_2OH \rightarrow CH_3 - CH = CH - CHO$

   (iii) $CH_3 - CH = CH - CHO \rightarrow CH_3 - CH = CH - CH_2 - OH$

(b) Write down different products formed when $CH_3 - CH_2 - CHO$ and

$$CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CHO$$ reacts with NaOH.

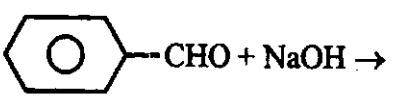
(c) Explain the mechanism of dehydration of ethanol.

(d) The melting point p-dichlorobenzene is exceedingly higher than ortho and meta dichlorobenzene. **4, 4½, 2, 2**

3. (a) Complete the following reactions

(i) $$CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - CHO + NaOH \rightarrow$$

(ii) $$\underset{\displaystyle CHO}{\overset{CHO}{|}} + NaOH \rightarrow$$

(iii)  $+ NaOH \rightarrow$

(b) How do you distinguish between following pairs ?

(i) $CH_3 - CH_2 - CH_2 - OH$ and

$$CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3$$

(ii) $CH_3 - CH_2 - CHO$ and $CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$

(c) Explain following reactions (any **two**)

(i) Reimer Tiemann reaction.

(ii) Schotten Baumann reaction

(iii) Oppenauer oxidation

(d) What do you understand by reaction *in Situ* ? Illustrate with an example.

4, 4, 3, 1½

4. (a) Give the steps involved in the commercial preparation of phenol from benzene.

(b) What is the limitation of Williamson synthesis ? Illustrate with suitable example.

(c) Reaction of Carbonyl compounds with ammonia derivative occur under control pH condition why ?

(d) Explain elimination addition (benzyne) mechanism for nucleophilic aromatic substitution. **4, 3, 2½ , 3**
