2018

CBCS

1st Semester

CHEMISTRY

PAPER—C2T

(Honours)

Full Marks : 40

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Physical Chemistry—I

Group—A

1. Answer any *five* questions : 5×2

(a) A gas obeys the equation of state $P(v - nb) = nRT$, where b = constant. Plot (i) V vs. T at constant P and (ii) P vs. T as constant V for the gas.

(b) Define compressibility factor of a gas. What is its value at critical state ?

(c) Critical temperature of CO_2 gas is 31.1°. If it obeys vander Waals equation what is its Boyle's temperautre ?

(d) During adiabatic expansion a gas cool down. Explain.

(e) A heat engine cannot be 100% efficient. Explain.

(f) Prove that Joule Thomson coefficient

$$\mu_{J.T.} = -\frac{1}{C_p}\left(\frac{\partial H}{\partial P}\right)_T$$

(g) For the reaction $2NO + Cl_2 \rightarrow 2NOCl$, it was found that on doubling concentration of both reactants the rate increases eight fold. What is the overall order of the reaction ?

(h) What are the characteristics of a zero order reaction ?

Group—B

Answer any *four* questions : 4×5

2. (a) The high temperature limiting value of heat capacity ratio (γ) of A_2B gas is 1.154. Judge whether A_2B molecule is linear or not. 3

(b) Heat of neutralisation between HCl and NaOH is 13.7 K. Cal and between HCN and NaOH is 3.0 K. Cal at 25°C. What is the heat of ionisation of HCN ? 2

3. Derive Maxwell's kinetic energy distribution equation from speed distribution equation in space. Hence derive the expression of most probable kinetic energy. 3+2

4. (a) The relation PV^{γ} = constant is valid for any addiabatic process. Comment on the statement. 2

(b) A gas is suspected to be Neon or Nitrogen. When a given sample of the gas at 25°C expanded adiabatically and reversibly from 5 litres to 6 literes, the temperature came down to 4°C. What was the gas ?

3

5. (a) Starting from G = H – TS derive gibs Helmholtz relation.

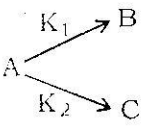
(b) The rate of hydrolysis of an ester, catalysed by strong acid is almost doubled when the pH is changed from 0.80 to 0.50. Jistify whether this is an example of homogeneous catalyst or not. 3+2

6. (a) Derive Michaelis Menten equation for enzyme catalysed reaction.

How Michelis constant is obtained from this equation ?

4+1

7. (a) Consider following parallel reaction :



Show that activation energy (E_a) for the disappearance of $A = \frac{K_1E_1 + K_2E_2}{K_1 + K_2}$ where E_1 and E_2 are activation energies for paths with rate constant K_1 and K_2. 3

(b) Show that for an ideal gas $\left(\frac{\partial u}{\partial v}\right)_T = 0$ 2

Group—C

8. Answer any *one* question : 1×10

(a) Derive vander Waals reduced equation of state for 1 mole gas. 3

(b) A gas contains 10^{15} molecules per litre. The mean free path of the molecules is $\frac{1}{\sqrt{2}\pi}$ metre. Calculate the molecular diameter. 3

(c) Calculate the change of entropy (ΔS) for the following transformation.

1 mole $H_2O(l, -10°C) \longrightarrow$ 1 mole $H_2O(S, -10°C)$

Specific heat of $H_2O(l)$ and $H_2O(S)$ is 1 Cal K^{-1} gm^{-1} and 0.5 Cal K^{-1} gm^{-1} respectively. Latent heat of fusion of ice is 80 Cal gm^{-1}. 4

9. (a) Draw S vs. T plot of Carnot cycle. What is the significance of the enclosed area of the plot? 4

(b) A certain first order reaction is 20% completed in 15 minutes at 20° C. How long will it take to complete 40% of the reaction at 40° C? Activation energy of the reaction is 23 K.Cal mol^{-1}. 4

(c) Prove that $\left(\frac{\partial P}{\partial T}\right)_v = \frac{\alpha}{\beta}$ where α is coefficient of thermal expansion and β is coefficient of compressibility. 2
