2017

CHEMISTRY

[Honours]

(CBCS)

[First Semester]

PAPER – C2T

Full Marks : 40

Time : 2 hours

The figures in the right hand margin indicate marks

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

Illustrate the answers wherever necessary

GROUP – A

1. Answer any *five* questions : 2 × 5

(*a*) At what temperature Maxwell's speed distribution plot of Cl_2 will be identical to that of N_2 at 27 °C ?

(*b*) Express the van der Waals constant $a = 0{\cdot}751$ atm lit^2 mol^{-2} and $b = 0{\cdot}0226$ lit mol^{-1} in SI unit.

(*c*) Show that for a van der Waal's gas

$$\left(\frac{\partial C_v}{\partial v}\right)_T = 0.$$

(*d*) Heat of neutralization of any strong acid and strong base is same. Explain the statement.

(*e*) Show that :

$$\left(\frac{\partial S}{\partial P}\right)_T + \left(\frac{\partial V}{\partial T}\right)_P = 0.$$

(*f*) Arrhenius factor is the high temperature limiting value of rate constant. Explain.

(*g*) Draw the plot of $\log K$ *vs.* pH for a specific H^+ catalysed reaction. Comment on the intercept on $\log K$ axis.

(*h*) Find the numerical value of the compressibility factor of a gas that obey the equation

of state $P(V - nb) = nRT$. The pressure and temperature are such that

$$\frac{V}{n} = 10b.$$

GROUP – B

Answer any **four** questions : 5×4

2. (*a*) Derive the expression of most probable velocity of gas molecules moving in space. 3

   (*b*) What is Michaelis constant ? What is its unit ? 2

3. (*a*) Convert van der Waals' equation of n mole gas into virial form. 3

   (*b*) Define autocatalyst with an example. 2

4. (*a*) The efficiency of a Carnot engine is $\frac{1}{6}$. On decreasing the temperature of the sink by 65°, the efficiency becomes double. Calculate initial temperature of source and sink. 3

(*b*) Give example for the process where : 2

(*i*) $\Delta G < 0,\ \Delta S < 0$

(*ii*) $\Delta G = 0,\ \Delta S > 0$

5. (*a*) Define zero order reaction. Draw (*i*) concentration *vs*. time and (*ii*) rate *vs*. time plot for a zero order reaction. 1 + 2

(*b*) 2 moles of an ideal monatomic gas expands isothermally and reversibly from 5 lit to 10 lit at 300 K. Calculate ΔS and ΔG for the process. 2

6. (*a*) A reactant 'A' gives two products 'B' and 'C'. The reaction is either consecutive or parallel. How will you confirm about the nature of reaction ? 3

(*b*) Write Dieterici and Berthelot equation of state for *n* mole gas. 2

7. (*a*) 'Unimolecular reactions are not always first order.' Justify the statement using Lindman's mechanism. 3

(*b*) 10 moles of He gas is heated from 0°C to 100 °C at constant pressure of 1 atmosphere. Calculate entropy change for the process. 2

GROUP – C

Answer any **one** question : 10 × 1

8. (*a*) State the principle of equipartition of energy. Calculate high temperature limiting value of molar heat capacity at constant volume for acetylene gas. 1 + 2

(*b*) Show that :

$$\frac{\partial(G/T)_P}{\partial(I/T)} = H.$$ 3

(*c*) The second order rate constant for alkaline hydrolysis of ester is given by the expression

$$\log K = \frac{-3163}{T} + 11{\cdot}9$$

(K is expressed in dm^{-3} mol min^{-1}). Calculate E_a and $t_{1/2}$ at 20 °C when initial consentration of base and ester are 0·008 (M) each. 4

9. (*a*) Define Joule Thomson coefficient. Derive its expression for a van der Waals' gas. Hence arive at the expression of inversion temperature. 1 + 3 + 1

(*b*) A gas cannot be liquified above $-122^{\circ}C$ and minimum pressure to be applied at this temperature for liquification be 48 atmosphere. Calculate the closest distance between two molecules. 3

(*c*) Discuss the effect of temperature on enzyme catalysed reaction. 2