

# 314308

**12526**

**3 Hours / 70 Marks**

Seat No. 

--	--	--	--	--	--	--	--

- 
- Instructions* – (1) All Questions are *Compulsory*.
- (2) Answer each next main Question on a new page.
- (3) Illustrate your answer with neat sketches wherever necessary.
- (4) Figures to the right indicate full marks.
- (5) Assume suitable data, if necessary.
- (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
- (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

- 1. Solve any FIVE of the following: **10****
- a) Define system and surrounding with respect to thermodynamic process.
- b) State First law of thermodynamics with mathematical statement.
- c) State Second law of thermodynamics with mathematical statement.
- d) State ideal gas law and explain the term involved in it.
- e) State the law of mass action.
- f) State Zeroth law of thermodynamics with mathematical statement.
- g) State the relation between  $C_p$  and  $C_v$ .

P.T.O.

- 2. Solve any THREE of the following:** **12**
- Differentiate between Intensive and Extensive properties. (Any four points)
  - Derive an expression for work done for adiabatic process.
  - State Clausius inequality statement. Give the expression for reversible and irreversible process.
  - Explain P V T diagram.
- 3. Solve any THREE of the following:** **12**
- What is the change in the internal energy of a system when a total of 150.00 J is transferred by heat from the system and 159.00 J is done by work on the system.
  - Calculate the overall enthalpy change of  $\text{Na}^+ + \text{Cl}^- \rightarrow \text{NaCl}$  (Ionic sodium has an enthalpy) of  $-239.7$  kJ/mol, chloride ion has enthalpy  $-167.4$  kJ/mol and Sodium chloride (table salt) has an enthalpy of  $-411$  kJ/mol).
  - State Gibb's phase rule. A binary mixture of benzene and toluene is in equilibrium with its own vapour. Determine the number of degrees of freedom.
  - State Lechateliers principle. Based on Lechateliers principle, explain the effect of change in pressure on the dissociation reaction  $\text{N}_2\text{O}_4$  reversible with  $2\text{NO}_2$ .
- 4. Solve any THREE of the following:** **12**
- Explain the Thermal, Mechanical and Chemical equilibrium.
  - State Third law of Thermodynamics. Derive an equation for entropy change of an ideal gas in terms of temperature and volume.
  - Using Van der Waals equation, calculate the temperature of 20.0 mole of helium in a 10.0 litre cylinder at 120 atmosphere pressure.  
(Data:- Van der Waals constants for helium:  
 $a = 0.0341 \text{ L}^2 \text{ at mol}^{-2}$ ;  $b = 0.0237 \text{ L mol}^{-1}$ ]
    - Compare this value with the temperature calculated from the ideal gas equation.

- d) Derive Van't Hoff equation.
- e) Calculate the entropy change when 2 moles of water at 273 k is heated to steam at 473 k.  $C_p$  for water = 4.2 kJ/kg k. and  $C_p$  for steam = 1.9 kJ/kg k. Latent heat of vaporization at 373 k = 2257 kJ/kg.

**5. Solve any TWO of the following:** **12**

- a) Two mole of an ideal gas is heated from 90°K to 320°K. Calculate  $\Delta S$  if –
- i) the volume is kept constant.
- ii) The pressure is kept constant. Assume that  $C_v = 1.5 R$ .
- b) Ten kilograms of water at 375 k is mixed adiabatically with 30 kg of water at 275 k. Evaluate the change in entropy. Assume that specific heat of water is 4.2 kJ/kg k and is independent of temperature.
- c) Derive the relation between  $\Delta G$  and K.

**6. Solve any TWO of the following:** **12**

- a) The enthalpy changes for the following reactions at 298 K and 1 atmosphere pressure are given below :–
- i)  $\text{CH}_3\text{COOH (l)} + 2\text{O}_2 \text{(g)} \rightarrow 2\text{CO}_2 \text{(g)} + 2\text{H}_2\text{O (l)}$   $\Delta H = -874\text{KJ}$
- ii)  $\text{CH}_3\text{CO}_2\text{OH (l)} + 3\text{O}_2 \text{(g)} \rightarrow 2\text{CO}_2 \text{(g)} + 3\text{H}_2\text{O (l)}$   $\Delta H = -1363\text{KJ}$
- Calculate the internal energy changes for these reactions.
- b) Calculate the entropy change when 2 moles of water at 273 k is heated to steam at 473 k.  $C_p$  for water = 4.2 kJ/kg k. and  $C_p$  for steam = 1.9 kJ/kg k. Latent heat of vaporization at 373 k = 2257 kJ/kg.
- c) Draw P-H graph, H-T graph and H-S graph.
-