22406

23242

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 answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define system and surrounding.

b) Differentiate state function and path function.

c) Define standard entropy.

d) Write down Van der Waals equation for real gases.

e) State Zeroth law of thermodynamics.

f) Define Internal energy.

g) Define Le-Chatelier's principle.

2. Attempt any THREE of the following: **12**

a) Define extensive and intensive property with example.

b) Define Isothermal process, Isobaric process, Isochoric process and Adiabatic process.

c) State 1^{st} Law of thermodynamics with mathematical expression.

d) State the sign convention used for work and heat.

P.T.O.

Marks

3. Attempt any THREE of the following: **12**

a) Explain Joule-Thomson Porous Plug experiment.

b) Draw the phase diagram for sulphur system with appropriate labelling.

c) Derive the relation between 1st Law and 2nd Law of thermodynamics.

d) Calculate Kp for ammonia synthesis at a total pressure of 30 atm at 400°C. Reaction is $N_2 + 3H_2 \rightarrow 2NH_3$. Percentage of ammonia at equilibrium is 10%.

4. Attempt any THREE of the following: **12**

a) Explain T-V diagram for a pure substance.

b) Derive the relation between Kp and Kc.

c) Draw the P-H diagram.

d) Calculate the entropy change for the following gas phase reaction occuring at 1 bar and 298 K. $CO + Y_2O_2 \rightarrow CO_2$. The absolute entropies of CO, O_2 and CO_2 are respectively. 198 J/molK, 205.2 J/molK and 213.8 J/molK.

e) Show that for an equimolar mixture consisting of 2 distinct ideal gases, the entropy change during isothermal mixing is R ln 2.

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

a) Derive the relationship between conversion and thermodynamic equilibrium constant for 1st order reversible reaction $A \rightleftharpoons R$.

b) One mole of an ideal mono atomic gas expands reversibly from a volume of 10 liter and temp. 298 K to a volume of 20 litres and temp. 250 K. Assuming Cv_2 3/2 R. Calculate entropy change for the process.

c) Explain the phase diagram for CO_2 system.

Marks

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

a) For the reaction, $2NaHSO_4 \leftrightarrow Na_2S_2O_7 + H_2O$
ΔH at 298 K = 19800 cal. ΔGat 298 K = 9000 cal.
Assuming ΔH to be constant, calculate the dissociation pressure of the reaction at 700 K.

b) State Gibbs phase rule. Define degree of freedom. A binary mixture of benzene and toluene is in equilibrium with its own vapour. Determine the number of degrees of freedom.

c) Calculate ΔU and ΔH in kJ for 1 kmol water as it is vaporised at temperature of 373 K and constant pressure of 101.3 kPa. The specific volume of liquid and vapour at these conditions are 1.04×10^{-3} and 1.675 m^3/kmol respectively. 1030 kJ of heat is added to water for this change.