Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-IV Examination June- 2010

Subject code: 140502

Subject Name: Chemical Engineering Thermodynamics- I

Date: 18 / 06 / 2010 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain P-V-T behavior of pure fluids with suitable diagram? **07**

(b) Derive Constant Tc,Pc, Vc, Zc , a & b of Van Der Waal's Equation $(P + a / V^2)*(V – b) = RT$? **07**

Q.2 **(a)** Define Hess's Law of Constant Heat Summation? Using Hess's Law calculate the heat of formation of Chloroform($CHCL_3$) with the following given data : **07**

1) $CHCL_3(g) + ½\ O_2(g) + H_2O_{(L)} \rightarrow CO_2(g) + 3HCL\ (g)$; $\Delta H°_{298} = -509.93$ KJ
2) $H_2(g) + 1/2\ O_2(g) \rightarrow H_2O_{(L)}$; $\Delta H°_{298} = -296.03$ KJ
3) $C(s) + O_2(g) \rightarrow CO_2\ (g)$; $\Delta H°_{298} = -393.78$ KJ
4) $1/2H_2(g) + 1/2CL_2(g) \rightarrow HCL(g)$; $\Delta H°_{298} = -167.57$ KJ

(b) Explain: Third law of Thermodynamics? It is Known that the molar heat capacity of a substance at low temperature can be approximated by the relation $Cp = a*T^3$, where 'a' is constant. Determine the molar entropy of a metal at 10 K if the molar heat capacity at this temperature is 0.45 J/ mol.K **07**

OR

(b) Explain Heat Engine & Heat pump with necessary Diagram? **07**

Q.3 **(a)** Write a short note on virial equation of state? **07**

(b) Define first law of thermodynamics? Explain its limitations? **07**

OR

Q.3 **(a)** Write a short note on clapeyron Equation? **07**

(b) Using Maxwell's equation prove that : **07**

$dH = CpdT + V(1 – \beta T)dP$

$dS = CpdT/T - \beta VdP$.

Where β = Volume expansivity.

Q.4 **(a)** Explain: Maxwell's Equation? **07**

(b) Derive an expression of entropy change involving ideal gas for following process? **07**

1) Constant volume process.
2) Constant pressure process.
3) Isothermal process.

Also find the change in entropy when 2 Kg of a gas at 277 K is heated at constant volume to a temperature of 368 K. given Cv = 1.42 KJ/Kg.K.

OR

Q.4 **(a)** Write about characteristics of flow for nozzle? **07**

(b) An ideal gas undergoes the following sequence of mechanically reversible processes: **07**

1) From an initial state of 70° C and 1 bar, it is compressed adiabatically to 150° C.
2) It is then cooled from 150 to 70° C at constant pressure.
3) Finally, it is expanded isothermally to its original volume.

Calculate W, Q, ΔU, and ΔH for each of three processes and for the entire cycle. Take Cv = (3/2)*R and
Cp = (5/2)* R.

Q.5 **(a)** Explain Vapor-compression Cycle with suitable diagram? **07**

(b) List the important property of refrigerant? **07**

A refrigeration machine operating at a condenser temperature of 290 K needs 1 KW of power per ton of refrigeration. Determine the following :

1) The coefficient of performance.
2) The heat rejected to the condenser.
3) The lowest temperature that can be maintained.

OR

Q.5 **(a)** Explain Absorption refrigeration cycle with suitable diagram? **07**

(b) Write about the various methods of liquefaction of gases in brief? **07**

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