FirstRanker.com
Firstranker's choice
www.FirstRanker.com www.FirstRanker.com

Roll No. | | | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(Petroleum Refinary Engineering) (2013 Batch) (Sem.–4)

CHEMICAL ENGINEERING THERMODYNAMICS

Subject Code : BTPC-404/BTCH-305

M.Code : 72427

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. **Answer briefly :**

   a) Find the density of nitrogen gas at NTP.

   b) State 2nd law of thermodynamics.

   c) What is throttling process? Give an example.

   d) What is the significance of H-x diagram?

   e) What do you understand by dew point and bubble point?

   f) What is the physical significance of partial molar properties?

   g) Define equilibrium constant. What is its significance?

   h) What is the effect of pressure on equilibrium constant in a gas phase reaction?

   i) Write two major applications of Gibb's Duhem equation.

   j) What do you understand by theoretical flame temperature?

SECTION-B

2. Calculate ΔU and ΔH in kJ for 1 kmol water, as it is vaporized at a constant temperature of 373 K and constant pressure of 101.3 kPa. The specific volumes 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.

FirstRanker.com
Firstranker's choice
www.FirstRanker.com

FirstRanker.com
Firstranker's choice
www.FirstRanker.com www.FirstRanker.com

3. Write the Clapeyron equation and hence find the melting point of mercury at 10 bar, where mercury has a density of 13.69×10^3 kg/m^3 in the liquid state and 14.193×10^3 kg/m^3 in the solid state, both measured at the melting point of 234.33 K and 1 bar. Heat of fusion of mercury is 9.7876 kJ/kg.

4. Find the volume of *n*-pentane at 500 K and 20 bar following Van der waals equation of state. Tc = 469.6 K, Pc = 33.7 bar

5. State Hess's law of constant heat summation. Calculate heat of formation of the gaseous ethyl alcohol at 298 K using following data :

   Standard heat of formation of CO_2 (g) = –393.51 kJ/mol

   Standard heat of formation of H_2O (l) = –285.83 kJ/mol

   Heat of combustion of gaseous ethyl alcohol at 298 K = –1410.09 kJ/mol

6. Derive the expression for effect of temperature on fugacity coefficient.

SECTION-C

7. Show that the fugacity of a gas obeying the van der waals equation of state is given by $\ln f = \frac{b}{V-b} - \frac{2a}{RTV} + ln\frac{RT}{V-b}$, where a and b are van der Waals constants.

8. Describe the criteria for chemical reaction equilibria. Calculate the equilibrium constant for the reaction $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ at 500 K assuming that the standard heat of reaction is constant in temp. range 298 K to 500 K. Standard heat of formation and standard free energy of formation of NH_3 at 298 K are – 46100 J/mol and –16500 J/mol respectively.

9. For a binary system of components (1) and (2), the vapour pressures are given by the Antoine's equations

$$ln\ P_1^{sat} = 13.818 - \frac{2477.07}{T - 40.00} \quad ; \quad ln\ P_2^{sat} = 13.859 - \frac{2911.32}{T - 56.56}$$

   P is in kPa and T in K. Assume the solution as ideal. Calculate :

   a) The composition of liquid and vapour in equilibrium at 95 kPa and 335 K.

   b) The composition of the vapour in equilibrium with a liquid containing 40% (mol) pentane and the equilibrium temperature at P = 95 kPa.

   c) The total pressure and the vapour composition in equilibrium with a liquid of composition $x_1 = 0.40$ at T = 333.2 K.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.

FirstRanker.com
Firstranker's choice
www.FirstRanker.com