CBCS SCHEME

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18BT45

Fourth Semester B.E. Degree Examination, July/August 2022
Biochemical Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1   a. Define the following:
   i)   System and surrounding
   ii)   Homogeneous and heterogeneous system
   iii) Closed and isolated system
   iv)   Intensive and extensive properties. **(10 Marks)**

   b. A gas is confined in a 0.47m diameter cylinder by a piston, on which a weight is resting. Mass of piston and weight together is 150kg. Local acceleration due to gravity is $9.81 m/s^2$ and atmospheric pressure is 101.3kPa. Calculate:
   i)   What is the force in Newtons exerted on gas by atmosphere, (piston + weight)
   ii)   Assuming that no friction exists between piston and cylinder.
   iii) What is the pressure in kPa? **(10 Marks)**

OR

2   a. Define the first law of thermodynamics for non flow process, Zeroth law of thermodynamics, Heat reservoir and heat pump. **(10 Marks)**

   b. Derive the first law of thermodynamics for flow process. **(10 Marks)**

Module-2

3   a. Explain the PVT behavior of pure fluids. **(08 Marks)**

   b. Obtain PV^γ = constant for adiabatic process and obtain the expression for work done. **(12 Marks)**

OR

4   a. Explain the equations of state for real gases. **(14 Marks)**

   b. One kilomole of carbon dioxide occupies a volume of $0.381m^3$ at 313K. Compare the pressures by
   i)   Ideal gas equation
   ii)   Van-der-Waal's equation.
   Van-der-Waal's constant: $a = 0.365 Nm^4/mol^2$; $b = 4.28 \times 10^{-5} m^3/mol$. **(06 Marks)**

Module-3

5   a. Explain the methods of obtaining thermodynamic properties. **(08 Marks)**

   b. Derive the Maxwell equations. **(12 Marks)**

OR

6   a. Derive Clausius Clapeyron equation. **(06 Marks)**

   b. Show that for ideal gas $C_p - C_v = R$. **(06 Marks)**

   c. Derive the expression for Gibbs Helmholtz equation. **(08 Marks)**

Module-4

7 a. Explain the methods for the determination of partial molar properties. **(10 Marks)**
   b. Derive the expression for chemical potential for the changes in free energy of a solution and the effect of temperature. **(10 Marks)**

OR

8 a. Explain Lewis-Randall rule. **(06 Marks)**
   b. Define: i) Raoult's law   ii) Henry's law. **(04 Marks)**
   c. Alcohol solution containing 96% alcohol and 4% water is to be diluted to a solution containing 56% alcohol and 44% water (all are defined in weight basis) volume are as follows:
   96% alcohol solution:
   $\overline{V}_w = 0.816 \times 10^{-3}\,m^3/kg$; $\overline{V}_E = 1.273 \times 10^{-3}\,m^3/kg$
   56% alcohol solution
   $\overline{V}_w = 0.953 \times 10^{-3}\,m^3/kg$; $\overline{V}_E = 1.243 \times 10^{-3}\,m^3/kg$
   density of water is $0.997 \times 10^3 kg/m^3$.
   i)   How much water would be added to $2 \times 10^{-3}\,m^3$ of laboratory alcohol?
   ii) What is the volume of dilute alcohol obtained? **(10 Marks)**

Module-5

9 a. Explain the criteria for chemical reaction equilibrium and the factors affecting chemical equilibrium. **(10 Marks)**
   b. Derive the Vant Hoff equation and the effect of temperature. **(10 Marks)**

OR

10 a. Obtain the expression for the relation between K and $\Delta G°$. **(10 Marks)**
    b. Derive the expression for effect of temperature on K. **(10 Marks)**

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