CBCS SCHEME

USN

17BT42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Distinguish the following with examples.
   i) System and surrounding
   ii) Open and closed system
   iii) Intensive and extensive properties
   iv) State and path function. **(08 Marks)**

b. What is Zeroth law of thermodynamics? How it is useful in measuring temperature? **(04 Marks)**

c. Explain in detail about Heat reservoir, Heat engine and Heat pump. **(08 Marks)**

OR

2 a. Derive equation for first law of thermodynamics for non-flow process. **(08 Marks)**

b. Heat is transferred to 10kg of air which is initially at 100KPa and 300k until its temperature reaches 600K. Determine change in internal energy, the change in enthalpy and heat supplied, and the work done in the following processes.
   i) Constant volume process
   ii) Constant pressure process

   Assume that air is ideal gas for which P-V-T relationship in PV = nRT, where n is the number of moles, R = 8.314 kJ/K mol K ; C_p = 29.029 kJ/K mol ; C_v = 20.785 kJ/K mol ; mol.wt of air = 29. **(12 Marks)**

Module-2

3 a. With neat sketch explain PVT behavior of fluids and pure metals. **(10 Marks)**

b. Explain in detail constant volume process and constant pressure process. **(10 Marks)**

OR

4 a. One Kilo mole CO_2 occupies a volume of 0.381m^3 at 313k. Compare the pressure given by i) Ideal gas equation ii) Vander Waals equation. **(06 Marks)**
   Take a = 0.365 Nm^4/Mol^2 ; b = 4.28×10^{-5} m^3/mol.

b. i) Standard heat of reaction
   ii) Standard heat of combustion
   iii) Standard heat of formation
   iv) Hess law. **(08 Marks)**

c. Calculate the het of formation of methane gas from the following heat of combustion data :
   i) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(\ell)}$; $\Delta H^\circ_{298} = -890.94$ kJ
   ii) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H^\circ_{298} = -393.79$ kJ
   iii) $H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(\ell)}$; $\Delta H^\circ_{298} = -286.03$ kJ **(06 Marks)**

Module-3

5 a. How do you classify thermodynamic properties? **(06 Marks)**

b. From basics derive and discuss work function. **(06 Marks)**

c. Develop equation for evaluating change in internal energy and change in enthalpy for process involving ideal gases. **(08 Marks)**

OR

6 a. Write a note on fugacity and fugacity coefficient. **(08 Marks)**

b. Discuss various methods of determining fugacity of pure gas. **(12 Marks)**

Module-4

7 a. Derive equation for partial molar properties and properties of solution. **(10 Marks)**

b. Discuss the effect of temperature and pressure on chemical potential. **(10 Marks)**

OR

8 a. Derive the most useful form of Gibbs – Duhem equation. **(08 Marks)**

b. Mixture of n-Heptane (A) and n-octane (B) are expected to behave ideally. The total pressure over the system is 101.3KPa. Using the vapour pressure data is given below

i) Construct the B.P diagram

ii) Deduce and equation for the equilibrium diagram using arithmetic average and valves

T, K	371.4	378	38.3	388	393	398.6
P_A, KPa	101.3	125.3	140.0	160	179.9	205.3
P_B, KPa	44.4	55.6	64.5	74.8	86.6	101.3

(12 Marks)

Module-5

9 a. Discuss the effect of temperature on equilibrium constant. **(10 Marks)**

b. N-Butane is isomerized to i-butane by the action of catalyst at moderate temperature. It is found that the equilibrium is attained at the following compositions

Temperature, K	Mol% n-butane
317	31.00
391	43.00

Assuming that activities are equal to the mole fractions. Calculate the standard free energy of the reaction at 317K and 391K and average value of heat of reaction over this temperature range. **(10 Marks)**

OR

10 a. Discuss the factor that affect equilibrium conversion. **(10 Marks)**

b. A gas mixture containing 25% CO, 55% H_2 and 20% inert gas is to be used for methanol. The gases issue from the catalyst chamber in chemical equilibrium with respect to the reaction.

$CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(g)}$

At a pressure of 300 bars temperature of 625K. Assume that the equilibrium mixture forms an ideal solution and K_f and $K\phi$ are 4.5×10^{-5} and 0.35 respectively. What is the percent conversion of CO?. **(10 Marks)**

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