VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
SESSION 2016 - 17 (ODD SEMESTER)

Total Pages—6

(Set-T_1)

B.Tech - 3rd
Metallur. Thermody. and Kinetics

Full Marks : 70

Time : 3 hours

Answer **six** questions including **Q. No. 1** which is compulsory

The figures in the right-hand margin indicate marks

Symbols is carry usual meaning

1. Answer *all* the questions : 2 × 10

(*a*) How does thermodynamics differ from kinetics ?

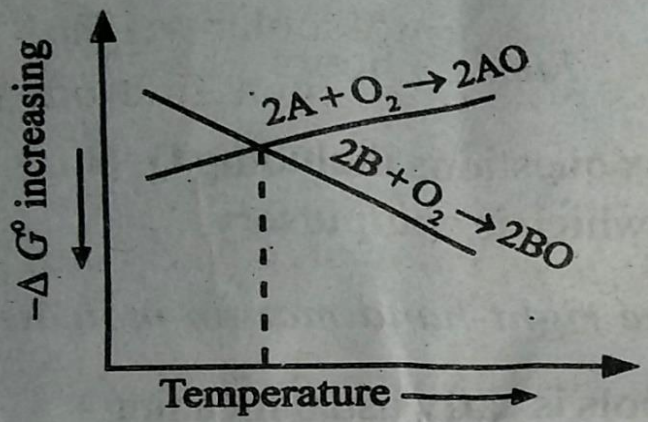
(*b*) For a reaction

$$Fe_2O_3(s) + 3C(s) \Leftrightarrow 2Fe(s) + 3CO(g)$$

What will be the heat of reaction at 298°K, if heat contents of Fe_2O_3 (s) and CO(g) at that temperature are x and y kcal per mole ?

(Turn Over)

(*c*) For Ellingham diagram, where, *A* and *B* are metals and *AO* and *BO* are their oxides respectively. At any temperature less than *T* °C, _____ can reduce _____.



(*i*) *A* can reduce *BO*

(*ii*) *B* can reduce *AO*

(*iii*) Neither *A* nor *B* can reduce the oxide of others.

(*d*) Differentiate between state and path functions.

(*e*) State Henry's law.

(*f*) What is the relation between internal energy, heat and work ?

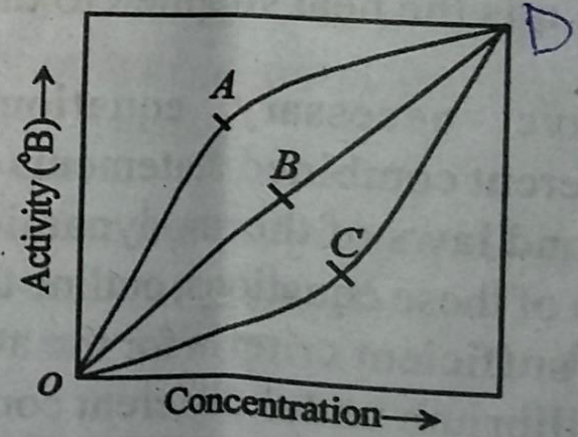
(*g*) Write down the equilibrium constant (K) for the reaction :

A (pure solid) + B (gas) = AB(pure solid)

(*h*) If x% of any solute (molecular weight W) is dissolved in pure iron, then find out the molar concentration of solute.

(*i*) For real gases, the value of $(C_p - C_v)$ is _____ gas constant R.
(*i*) Equal to, (*ii*) More than, (*iii*) Less than.

(*j*) The figure represents a graph of the activity-concentration relationship. The line _____ follows Raoult's law and the line _____ shows negative deviation from Raoult's law.



(*i*) OAD
(*ii*) OBD
(*iii*) OCD
(*iv*) none of these.

2. (*a*) Discuss briefly the enthalpy changes associated with : 5

(*i*) Change in state of the substance and

(*ii*) Solid state phase transformation in iron.

(*b*) Prove that for an ideal gas, under isothermal condition. 5

$$q = RT \ln(V_f/V_i)$$

where,

V_f is the final volume of the system

V_i is the initial volume of the system

q is the heat supplied to the system.

3. (*a*) Derive necessary equations for the different combined statements of first and second laws of thermodynamics. With the help of these equations, outline the necessary and sufficient criteria for the attainment of equilibrium under different conditions. 5

(*b*) Derive necessary equation for the variation of entropy with temperature under constant volume condition. How can this equation be utilized in calculation of entropy at a particular temperature ? 5

4. (*a*) How does the value of free energy change predict about the feasibility of a reaction/ process ? How do the magnitudes of ΔH and ΔS affect the values of ΔG and direction of propagation of a chemical reaction/process ? 5

(*b*) Derive different forms of Gibbs-Helmholtz equation and outline their importance in metallurgy. 5

5. (*a*) In an isothermal process enthalpy of an ideal is independent of pressure, justify from Maxwell's relation. 5

(*b*) Comment on the entropy change associated with the following processes :

(*i*) Reversible and irreversible processes,
(*ii*) Graphitization of petroleum coke. 5

6. (*a*) What is fugacity ? Raoult's law appears to be a special case of Henry's law for pairs of closely related substance. justify. 5

(*b*) Describe the Ellingham diagram. Explain carbothermic reduction of metal oxide with the help of Ellingham diagram. 5

7. (*a*) Derive and explain the concept of Johnson-Mehl equation. 5

(*b*) Explain heterogeneous reaction kinetics of gas-solid, solid-liquid, liquid-liquid and solid-solid system. 5

8. Write short notes on any *two* : 5 × 2

(*i*) Regular solution

(*ii*) Chemical Potential

(*iii*) Thermodynamics of electrochemical cells

(*iv*) Thermal analysis.