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2038375(038)

Diploma in Engg. (Third Semester) Examination, Nov.-Dec. 2020

(New Scheme)

(Metallurgy Engg. Branch)

METALLURGICAL THERMODYNAMICS and KINETICS

Time Allowed : Three hours

Maximum Marks : 70

Minimum Pass Marks : 25

Note : *All questions are compulsory, unless mentioned otherwise.*

Unit-I

1. (a) Differentiate between endothermic and exothermic reactions. 2

(b) Differentiate between Reversible and Irreversible process. 2

(c) Far the reaction $CO(g) + 1/2\ O_2\ (g) = Co_2\ (g)$.

Calculate the standard enthalpy change for the above reaction at 473 K, given that the standard enthalpy change at formation at 298 K are – 110·5 kJ/mol for $Co_2\ (g)$ and – 393·5 kJ/mol for. $Co_2\ (g)$

Molar heat capacities are as follows

for $Co\ (g) = 30 \cdot 0 + 0 \cdot 0041\ T\ J/K/mol$

$O_2\ (g) = 28 \cdot 5 + 0 \cdot 0042\ T\ J/K/mol$

$Co_2\ (g) = 44 \cdot 2 + 0 \cdot 0088\ T\ J/K/mol$ 5

Or

The bond dissociation energy of gaseous H_2, Cl_2 and HCl are 104, 58, 103 kcal mol^{-1} respectively. Calculate the enthalpy at formation after HCl gas.

(d) For a reaction

$$Fe_2O_3\ (s) + 3\ C\ (s) \rightarrow 2\ Fe\ (s) + 3\ Co(g)$$

What will be the heat at reaction at 298 K if heat content of Fe_2O_3 (s) and Co (g) at that temperature are x and y cal per mole? 5

Unit-II

2. (a) Calculate the standard enthalpy and entropy change at 25° C for the reaction

$$2\,Cu + 1/2\,O_2 = Cu_2O$$

$$\Delta G^\circ = -169{\cdot}452 - 16{\cdot}40\,T \log T + 123{\cdot}43\,T \cdot J \quad 5$$

Or

Prove that :

$$\left[\frac{\partial(\Delta G/T)}{\partial T}\right]_P = \frac{-\Delta H}{T^2}.$$

(b) The standard enthalpy and entropy changes for the reaction in equilibrium for the forward direction are given below

$$Co\,(g) + H_2O\,(g) \rightleftharpoons Co_2\,(g) + H_2\,(g)$$

$$\Delta H^\circ_{300\,K} = -41{\cdot}16\ kJ\ mol^{-1}$$

$$\Delta S^\circ_{300\,K} = -4{\cdot}24 \times 10^{-2}\ kJ\ mol^{-1}$$

$$\Delta H^\circ_{1200\,K} = -32{\cdot}93\ kJ\ mol^{-1}$$

$$\Delta S^\circ_{1200\,K} = -2{\cdot}96 \times 10^{-2}\ kJ\ mol^{-1}$$

Calculate K at each temperature and predict the

direction of reaction at 300 K and 1200 K when

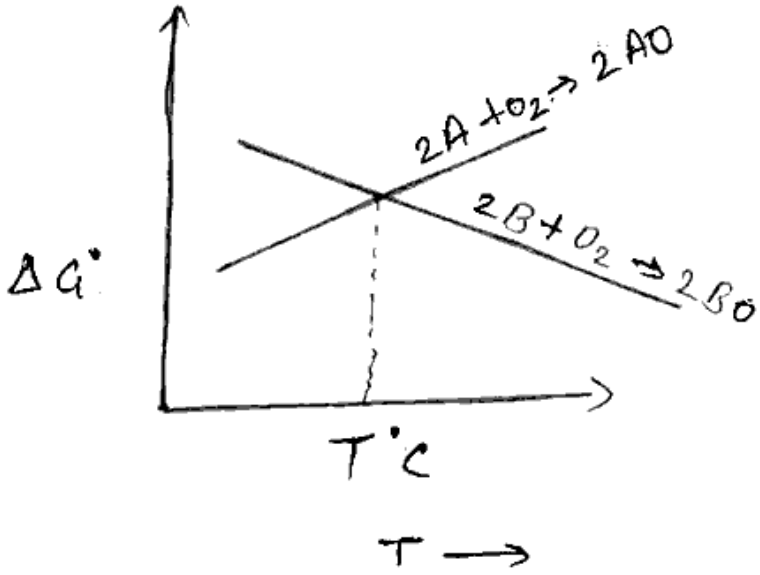
$P_{Co} = P_{CO_2} = P_{H_2} = P_{H_2O} = 1$ atm at initial state. 5

(c) Derive all the combined equations of 1st and 2nd of thermodynamic's in term's of G, A, H, E. 4

Unit-III

3. (a) Define the term activity. 2

(b) For ellinghum diagram, where A and B are metals and A_0 and B_0 are their oxides respectively. At any temperature less than T°C. 2



(c) With the help of ellinghum comment on carbothermic reduction of metal oxide. 5

(d) Derive relation between gibbs free energy and equilibrium constant. 5

Unit-IV

4. (a) Write down the factor's affecting rate of reaction. 3

(b) Assume that Sievert law holds for solubility at hydrogen dissolved in a thin metal foil. If the partial press of hydrogen in contact with the foil is increased by a factor of 4, the solubility increases by a factor of ..... https://www.csvtuonline.com 5

Or

State Roult's law and explain (+) ve and (–) ve deviation from Roult's law.

(c) From the following data from the reaction between A and B : 6

[A]	[B]	Initial Rate (mol l^{-1} S^{-1})	
mol/L	mol/L	300 K	320K
$2{\cdot}5 \times 10^{-4}$	$3{\cdot}0 \times 10^{-5}$	$5{\cdot}0 \times 10^{-4}$	$2{\cdot}0 \times 10^{-3}$
$5{\cdot}0 \times 10^{-4}$	$6{\cdot}0 \times 10^{5}$	$4{\cdot}0 \times 10^{-3}$	—
$1{\cdot}0 \times 10^{-3}$	$6{\cdot}0 \times 10^{-5}$	$1{\cdot}6 \times 10^{2}$	—

Calculate :

(i) The order of reaction w.r.t. A and B

(ii) The rate constant at 300 K

(iii) The energy of activation

Unit - V

5. (a) Define the term : 2

(i) Black Body Radiation

(ii) Gray Body Radiation

(b) Define the term Diffusion. 2

(c) Explain the term diffusivity with formula and write down fick's 1st and 2nd law of diffusion. 5

(d) The wall of an industrial furnace is constructed from 0.15 m thick fire clay brick having a thermal conductivity of 1.7 w/m.K. Measurement made during steady state operation reveal temprature of 1400 and 1150 K at inner and outer surface respectively. What is the rate of heat loss through a wall that is 0·5 m by 1·2 m on a side? 5