GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2022

THERMODYNAMICS AND KINETICS

FT301

TIME ALLOTTED: 3Hours **FULL MARKS:70**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

(Multiple Choice Type Questions)

Answer any *ten* from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No
1. i)	The dimensionless ratio fugacity coefficient is represented by a) f_i/P b) f_i/T c) f_i d) f_i XP	1	CO3
ii)	For refrigeration at a temperature of 278.15K & 303.15K in surroundings, the value of cop is a) 11.13 b) 13.13 c) 20.13 d) 15.13	1	CO1
iii)	For Isobaric process a) $G/\delta T = P$ b) $\delta G/\delta T = P$ c) $\delta G/\delta T = S$ d) $\delta G/\delta T = -S$	1	CO1
iv)	The values of P_1^{sat} and P_2^{sat} are obtained from a) Raoult's law b) Henry's law c) Antoine equation d) Modified Raoult's law	1	CO2
v)	At bubble point a) vapour phase ceases to exist b) liquid phase ceases to exist c) both liquid & vapour phases co-exist d) none of these	1	CO2
vi)	The vapour-liquid equilibrium of a binary system can be better represented by a) T-X-Y diagram b) P-X-Y diagram c) P-T diagram d) all of these	1	CO2

vii) An unripe mango placed in a concentrated salt solution to prepare pickle, shrinks because _____. 1 CO2

a) it gains water due to osmosis
b) it loses water due to reverse osmosis
c) it gains water due to reverse osmosis
d) it loses water due to osmosis

viii) A beaker contains a solution of a substance 'A'. Precipitation of substance 'A' takes place when a small amount of 'A' is added to the solution. The solution is 1 CO2

a) saturated
b) supersaturated
c) unsaturated
d) concentrated

ix) A catalyst alters, which of the following in a chemical reaction? 1 CO4

a) Entropy
b) Enthalpy
c) Internal energy
d) Activation energy

x) According to kinetic theory of gases, the absolute zero temperature is attained when... 1 CO2

a) Volume of gas is zero
b) Pressure of the gas is zero
c) Kinetic energy of the molecules is zero
d) Specific heat of gas is zero

xi) The specific volume of water when heated from 0^0C... 1 CO2

a) Increases steadily
b) Decreases steadily
c) First increases then decreases
d) First decreases then increases

xii) The expression for $t_{1/2}$ for 2^{nd} order reaction, where the two reactants are same is: 1 CO4

a) $t_{1/2} = 1/k$
b) $t_{1/2} = a/k$
c) $t_{1/2} = ka$
d) $t_{1/2} = 1/ka$

GROUP – B
(Short Answer Type Questions)

(Answer any *three* of the following) **3 x 5 = 15**

		Marks	CO No
2.	Prove that the chemical potential in different phases is equal at the same temperature and pressure.	5	CO2
3.	Explain bubble point and dew point with Raoult's Law.	5	CO3

4.	Explain the PVT behavior of pure substance in Pressure vs. Temperature diagram and Pressure vs. Volume diagram.	5	CO1
5.	With T-S curve define the different steps of vapour compression refrigeration cycle.	5	CO2
6.	Explain Collision theory with diagram.	5	CO4

GROUP – C
(Long Answer Type Questions)

(Answer any *three* of the following) **3 x 15 = 45**

		Marks	CO No
7. a.	With proper diagrams differentiate between Claude and Linde liquefaction process.	7	CO2
b.	Consider refrigeration at a temperature level of T_C=263.15K with a heat source available at atmospheric pressure (T_H=373.15K). Calculate the COPof the absorption refrigeration cycle if the temperature of the surrounding is 303.15K.	3	CO2
c.	Write the differences between vapour compression and absorption refrigeration cycle.	5	CO2
8. a.	Explain Antoine vapoure-pressure equation.	3	CO3
b.	Binary system acetonitrile (1)/ nitromethane (2) confirms closely to Raoult's law. Vapour Pressures for the pure species are given by the following Antoine equations: $\ln P_1^{Sat}=14.2724-2945.47/(T+224)$ $\ln P_2^{Sat}=14.2043-2972.64/(T+209)$ Prepare a graph showing P Vs. X_1 & P vs Y_1 for a temp of 348.15 K (75^{0}C) $P_1^{Sat}$and P_2^{Sat} are in kPa and T is in °C.	12	CO3
9. a.	Explain Henry's law.	5	CO3
b.	Assuming that carbonated water contains CO_2 (1) and H_2O(2).Determine thecomposition of the vapour and liquid phases in a sealed can of "soda" andthe pressure exerted on the can at 10 °C (283.15K). Henry's constant for CO_2 in water at 10°C is about 990 bar. (given P_2^{sat}=0.01227bar at 283.15K)	10	CO3
10. a.	What is the significance of K value in VLE?	3	CO3
b.	In a system of methanol(1)/ methyl acetate (2) the following equations are given: $\ln \gamma_1 = A\, x_2^2$, $\ln \gamma_2 = A\, x_1^2$, where A= 2.771-0.00523T and $\ln P_1^{Sat}=16.59158-3643.31/(T-33.424)$ $\ln P_2^{Sat}=14.25326-2665.54/(T-53.424)$ Calculate P and Y_i for T-318.15 K and x_i = 0.25	8	CO3
c.	Prove that, Cp - Cv = R	4	CO1
11. a.	The rate constant of a reaction at 400 and 200K are 0.04 and 0.02 s^{-1} respectively. Calculate the value of activation energy.	7	CO4
b.	The decomposition of Cl_2O_7 at 500K in the gas phase to Cl_2 and O_2 is a first-order reaction. After 1 minute at 500K, the pressure of Cl_2O_7 falls from 0.08 to 0.04 atm. Calculate the rate constant in s^{-1}.	8	CO4