GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
CHEMICAL STOICHIOMETRY
CH401

TIME ALLOTTED: 3 HOURS **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 heat capacity at constant pressure of a single component system consisting of liquid and vapour phase in equilibrium is (a) Infinite (b) Zero (c) Positive (d) negative	1	CO4
	(ii)	The proximate analysis of coal gives (a) carbon, hydrogen and ash (b) volatile matter, moisture, ash and fixed carbon (c) carbon, hydrogen, sulpher and nitrogen (d) volatile matter, moisture, nitrogen and carbon	1	CO4
	(iii)	Graphical integration is more accurate when using – (a) Rectangular rule (b) Trapezoidal rule (c) Simpson's rule (d) None of these	1	CO3
	(iv)	Standard enthalpy of reaction is measured at – (a) 303K and 10KPa (b) 303K and 100 KPa (c) 298K and 1atm (d) all of the option	1	CC
	(v)	Enthalpy change in a chemical reaction is independant of steps through which the reaction proceeded. This is consequence of (a) Boyle' slaw (b) Van't Hoff's Law (c) Hess's law (d) None of the options	1	CO1
	(vi)	Which of the following is not a reason of occurrence of change in enthalpy? (a)Temperature change (b) Change of phase (c) Mixing or solution (d) None of the options	1	CO5

(vii)	Which of the following is a state function? (a) Temperature (b) pressure (c) density (d) enthalpy	1	CO1
(viii)	Prandtl Number is the ratio of (a) momentum diffusivity to thermal diffusivity (b) viscosity to momentum diffusivity (c) momentum diffusivity to viscosity (d) none of the options	1	CO2
(ix)	For ideal gases, $\Delta H = \int Cp\, dT$ is valid (a) For constant volume process (b) For constant pressure process (c) Irrespective of the nature of the process (d) The statement is never true	1	CO5
(x)	The number of atoms of oxygen present in 500gm oxygen is (a) 9.41×10^{23} (b) 0.941×10^{23} (c) 94.10×10^{23} (d) 941×10^{23}	1	CO2
(xi)	Slope of straight line in the Semi log Plot can be expressed as (a) Y2-Y1/ (log X2-logX1) (b) (logY2-logY1)/ (X2-X1) (c) (Y2-Y1)/(X2-X1) (d) None of thèse	1	CO3
(xii)	Specific heat of water is (a)2093.4J/kg.k, (b) 4186.8J/kg.k, (c) 1J/kg.k, (d) 0.5J/Kg.k	1	CO1

GROUP – B
(Short Answer Type Questions)

Answer any ***three*** from the following: **3×5=15**

			Marks	CO No
2.	(a)	What do you understand by adiabatic reaction, adiabatic reaction temperature, and adiabatic flame temperature?	5	CO1
3.	(a)	Showing the different steps, stoichiometrically represent the effect of temperature on the heat of reaction.	5	CO4
4.	(a)	When 16 gm of $CuSO_4$ were dissolved in 384gm of water, the tempe rose by 3.95°. Determine the enthalpy of formation of $CuSO_4$. $5H_2O$ from anhydrous salt and water, if the enthalpy of solution of the crys hydrate is 11.7 kJ/mol and C_p of the solution is -4.18kJ/kg K.	5	CO4

5.	(a)	Sketch a composition triangle to represent composition of ternary alloy and locate the alloys having following composition a) 20%A,40%B,40% C b)60%A,20%B,20%C.	5	CO3
6.	(a)	Explain Buckingham pi theorem.	3	CO2
	(b)	Explain Nusselt and prandtl number.	2	CO2

GROUP – C
(Long Answer Type Questions)
Answer any ***three*** from the following: **3×15=45**

			Marks	CO No.
7.	(a)	A spherical storage tank of 3 m in diameter is half-filled with 12500 kg of an organic liquid at 7000 kPa. If the total internal energy in the tank is 5.3X 10^6 kJ, what is the specific enthalpy of the fluid tank?	5	CO5
	(b)	1000kg/h of a thermic fluid, to be used as heat transfer medium, is being indirectly heated in a heater from 380K to 550 K. Calculate the heat load on the heater in kW. The heat capacity equation for the thermic fluid is $C_p = 1.436 + 2.18 \times 10^{-3} T$ Where, C_p is in kJ/(kg.K) and T is in K .	5	CO4
	(c)	Calculate the enthalpy change for one mole of a gas when it is heated from 400K to 1500 K at 1 atmosphere pressure, given that the mean specific heat of the gas at the reference temperature of 273 K are 35 kJ/kmol K at 400 K and 50 kJ/kmol K at 1500 K.	5	CO5
8.	(a)	What is heat of mixing?	2	CO4
	(b)	How you can derive enthalpy of a binary mixture?	3	CO5
	(c)	Calculate the mean heat capacity of 20-Mole percent solution of alcohol in water at 323 K. Heat capacity of water is 4.18 X 10^3 J/kg K and for ethanol is 2.58 X 10^3 J/kg K. Heat of mixing of 20 mole percent ethanol-water at 298 K and 323K are -758 J/mol and -415 J/mol respectively. Assume that the heat capacities of pure liquids are constant between 298 K and 323 K.	9	CO4
9.	(a)	The liquid effluent from a processing unit is discharged into a stream. The flow rate and BOD of the stream before the discharge point are respectively 6 m^3/sec and 3×10^{-5} g/L. The measurement made immediately below the discharge point indicated a BOD of 5×10^{-3} h/L. If the plant discharges the effluent at a rate of 16×10^3 m3/day, what is the BOD of the effluent from the point?	7	CO4
	(b)	An aqueous solution of Na_2Co_3 contains 15% carbonate by weight.80% of the carbonate is recovered as Na_2CO_3 .10 H2O by evaporation of water and adequate cooling 278K. The solubility of $Na_2 CO_3$ at 278K is 9%(Weight).On the basis of 100kg of solution treated, determine the following: a. The quantity of crystal formed. b. The amount of water Evaporator.	8	CO4
10.	(a)	A crystallizer is charged with 100kg of the solution containing 25 % $Ba(NO_3)_2$ in water. On cooling, 10% of the original water present evaporates. Calculate the yield of crystals when the solution is cooled to 283K. The solubility at 283K is 7.0 kg $Ba(NO_3)_2$/100 Kg of total water.	8	CO1

	(b)	Isopropyl alcohol and water can be separated by extraction with ethylene tetrachloride .100 kg of a solution containing 30% (weight) isopropyl alcohol and the rest water are mixed with the solvent ethylene tetrachloride. After extraction, the raffinate phase analysed 71% water, 28.1% isopropyl alcohol and 0.9 % ethylene tetrachloride. The extract phase analysed 94% ethylene tetrachloride, 5.2 % isopropyl alcohol & rest water. Calculate- a) The amount of solvent b) The quantities of raffinate & extract phases c) The% extraction of isopropyl alcohol.	7	CO1
11.	(a)	Acetone is recovered from acetone–water mixture containing 25% acetone by scrubbing with water. Assuming the air is insoluble in water, determine the % of acetone in the entering gas that is absorbed if the gas is leaving the scrubber analyses 5% acetone.	8	CO1
	(b)	A continuous distillation column is used to regenerate solvent for use in a solvent extraction unit. The column treats 200 kmol/h of the feed containing 10% C_2H_5OH and the rest is water. The overhead product is 89% alcohol and the bottom product is 0.3% alcohol (C_2H_5OH). The overhead product is sent to the extraction unit and the bottom is wasted. What is the daily requirement of make-up alcohol in the solvent extraction unit?	7	CO4