Subject name: MATERIAL & ENERGY BALANCE COMPUTATIONS **SUBJECT CODE:3130508**
Course Outcome: CO3130508.1
CHEMCIAL ENGINEERINGDEPARTMENT
L. E COLLEGE, MORBI

TUTORIAL-01

1. The flow rate of water through a pipe is reported as 20 ft^3/ min. Convert the volumetric flow rate into the mass flow rate in kg/sec. Density of water is 1 gm/cc.
2. A force equal to 192.6 N is applied on a piston with a diameter of 5 cm. Find the pressure exerted by the piston in kPa, bar and psi.
3. Pressure drop across a Venturi scrubber can be calculated using the following equation, $\Delta P = (5 * 10^{-5}) v^2 L$ where, ΔP= pressure drop in WC, L= liquid flow rate, US gal/1000 ft^3 gas v = gas velocity in the Venturi throat, ft/s. Convert the equation in SI units.
4. 1. What is molality?
   2. 1 atmospheric pressure = ----- Psi.
   3. What is the equivalent weight of $Al_2(SO_4)_3$.
5. In double effect evaporator plant the second effect is maintain under vacuum of 475torr (mmHg). Find the absolute pressure in kgf/cm^2, kpa, atm, bar.

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CHEMCIAL ENGINEERINGDEPARTMENT

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TUTORIAL-02

1. A mixture of nitrogen and carbon dioxide at 298 K and 101.325 kPa has an average molecular weight of 31. Calculate the partial pressure of nitrogen.
2. A sample of well water contains 140 gm/m^3 Ca^+ ions and 345 gm/m^3 Na^+ ions. Express the hardness of the water sample in terms of equivalent of CaCO3 in gm/m^3. (Atomic weight of Ca = 40, Na = 23, C = 12 and O = 16)
3. A solution of NaCl in water contains 15 % NaCl (by mass) at 335 K. The density of the solution is 1.127 kg/lit. Determine the molarity, normality and molality of the solution.
4. A gaseous mixture has the following composition by volume. SO_2 = 6 %, O_2 = 9%, CO = 1.5% and CO_2 = 4.5 % and remaining is nitrogen. Calculate (a) the density of gas mixture at a temperature of 425 K and at a pressure of 202.65 kPa g and (b) Composition by weight.
5. A solution of sodium chloride in water contains 20% NaCl (by mass) at 333 K. The density of the solution is 1.127 kg/L. Find the molarity, normality and molality of the solution.
6. The analysis of a sample of glass yields 7.8% Na2O, 7.0% MgO, 9.7% ZnO, 2.0% Al2O3, 8.5% B2O3 and 65.0% SiO2 (By mass), Convert this composition into mole %.
7. Sodium chloride weighing 600 kg is mixed with 200 kg of potassium chloride. Find the composition of the mixture in mass % and mole%.
8 A saturated solution of salicylic acid in methanol contains 64 kg salicylic acid per 100 kg methanol at 25oC. Find (a) the mass %, and (b) mole % composition of the solution.
9. A gas mixture has the following composition by volume:
   Ethylene-30.6 %, Benzene-24.5%, Oxygen-1.3%, Methane-15.5%, Ethane - 25.0 % and Nitrogen-3.1%. Find (a) the average molar mass of the gas mixture, (b) the composition by mass, and (c) the density of the mixture in kg/m^3 at NTP.
10. Cracked gas from a petroleum refinery has the following composition by volume Methane45%, Ethane10%, Ethylene25%, propane7%, propylene8%, n-Butane5%. Find (a) the average Mol.wt. Of gas Mixture. (b) The composition by wt. and (c) Specific gravity of the gas mixture.
11. Calculate the weight of 1 m^3 of chlorine gas at a temperature of 25^{o}C and a pressure of 745mmHg.

Subject name: MATERIAL & ENERGY BALANCE COMPUTATIONS **SUBJECT CODE:3130508**
Course Outcome: CO3130508.2
CHEMCIAL ENGINEERING DEPARTMENT
L.E COLLEGE, MORBI

TUTORIAL-03

1. Describe the material balance of drying operation.
2. Describe the material balance of liquid – liquid extraction
3. List out the classification of material balance problems
4. The spent acid from a nitrating process contains 15% HNO_3, 65% H_2SO_4 and 20% H_2O by weight. This acid is to be concentrated to contain 25 % HNO_3 and 58 % H_2SO_4 by addition of concentrated sulphuric acid containing 93% H_2SO_4 and concentrated nitric acid containing 90% HNO_3. Calculate the weights of spent acid, concentrated sulphuric acid and concentrated nitric acid that must be combined to obtain 100 kg of the desired mixture
5. A multiple-effect-evaporator system has a capacity of processing one tone per day of solid caustic soda when it concentrates weak liquor from 4 to 25 % (both on weight basis). When the plant is fed with 5% weak liquor and if it is concentrated to 50% (both on weight basis), find the capacity of the plant in terms of solid caustic soda, assuming water evaporating capacity to be same in both the cases.
6. Explain importance of process flow sheet in Chemical Engineering Industry with a typical example.
7. The average molar mass of a flue gas sample is calculated by two different engineers. One engineer uses the correct molar mass of 28 for N2 and determines the average molar mass to be 30.08, the other engineer, using an incorrect value of 14, calculates the average molar mass to be 18.74. (i) Calculate the volume % of nitrogen in the flue gases, (ii) If the remaining components of the flue gases are CO2 and O2, Calculate the volume % each of them.
8. With a neat sketch show the material balance for the following unit operation: (i)distillation (ii) evaporation.
9. In a textile mill, a double-effect evaporator system concentrates weak liquor containing 4% (by mass) caustic soda to produce a lye containing 25% solids (by mass), Calculate the evaporation of water per 100 kg feed in the evaporator.
10. It is required to make 1000 kg of mixed acid containing 60% H_2SO_4, 32% HNO_3 and 8% water by blending (i) the spent acid containing 11.3% HNO_3, 44.4% H_2SO_4 and 44.3% H_2O, (ii) aqueous 90% HNO_3, and (iii) aqueous 98% H_2SO_4. All percentages are by mass. Calculate the quantities of each of the three acids required for blending.
11. Soybean seeds are extracted with n-hexane in batch extractors. The flaked seeds contain 18.6% oil, 69.0% solids and 12.4% moisture. At the end of the extraction process, de-oiled cake (DOC) is separated from the n- hexane-oil mixture. DOC analysis yields 0.8% oil, 87.7% solids and 11.5% moisture. Find the percentage recovery of oil. All the percentages are by mass.
12. The feed water to reverse osmosis plant has dissolved solids to the extent of 5000 mg/L. The feed to product ratio (by mass) is 4:3. The treated water from the plant contains 600 mg/L of solids. Find the dissolved solids in the reject stream.

13. Discuss methods of solving material balance problems with chemical reaction.
14. Explain the following terms with reference to chemical process
    (1) Process flow sheet
    (2) P & I diagram
    (3) Degree of freedom

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CHEMCIAL ENGINEERINGDEPARTMENT
L.E COLLEGE, MORBI

TUTORIAL-04

1. In a production of chlorine gas by oxidation of hydrochloric acid gas, air is used 30 % in excess of that theoretically required. Based on 4 kmol HCl, Calculate; (a) The weight ratio of air to HCl gas in feed. (b) If oxidation is 85 % complete, calculate the composition off product stream on mole basis.
2. Define terms: Excess Reactant, Conversion, Yield
3. Differentiate between intensive property and extensive property.
4. Define: limiting reactant, yield, and selectivity.
5. Tallow is essentially glyceryl triturate. It is desired to saponify the tallow with caustic soda. For 100 kg of tallow, calculate (i) the theoretical requirement of caustic soda, and (ii) the amount of glycerine liberated.
6. In the BSF oil quench process to manufacture acetylene, pure oxygen and pure methane are fed to the acetylene burner. The cracked gas from the burner has the following composition:
   H_2-56.5%, CH_4- 5.2%, C_2H_4-0.3%, C_2H_2-7.5%, C_3H_6-0.5%, CO-25.8%, CO_2-4.0% and O_2-0.2% (mole% dry basis). Assume that formation of other compounds, such as aromatics, is negligible. For 100 kmol cracked gas, calculate (i) methane requirement (ii) Oxygen requirement (iii) conversion of methane and yield of acetylene production.
7. A pilot plant reactor was charged with 50 kg of naphthalene and 200 kg (98% by mass) of H_2SO_4. The reaction was carried out for 3 hours at 160^oC. The reaction goes to near completion. The product distribution was found to be 18.6% monosuphonate naphthalene (MSN) and 81.4% disulphonate naphthalene (DSN). Calculate (i) the quantities of MSN and DSN products, and (ii) the complete analysis of the product.
8. Discuss about recycling operations.
9. The gaseous reaction A = 2B + C takes place isothermally in a constant pressure reactor. Starting with a mixture of 75% A and 25% inerts (by volume), in a specified time the volume double. Calculate the conversion achieved.
10. Pure methane is completely burned with air in a combustor. The outlet gas from the combustor is passed through a cooler where some of the moisture is removed. The gas leaving the cooler contains 0.8335 mol. fraction of Nitrogen. The combustion reaction taking place is:
    $CH_4 + 2O_2 \Rightarrow CO_2 + 2\ H_2O$. Calculate:
    (i) analysis of gas leaving the cooler
    (ii) weight of water condensed per mole of methane burnt.

Subject name: MATERIAL & ENERGY BALANCE COMPUTATIONS **SUBJECT CODE:3130508**
Course Outcome: CO3130508.3
CHEMCIAL ENGINEERING DEPARTMENT
L.E COLLEGE, MORBI

TUTORIAL-05

1. Calculate the standard heat of reaction of the following reaction using std. heat of formation data.
$C_5H_{12}(l) + 8\ CO_2(g) \rightarrow 5\ CO_2(g) + 6H_2O(l)$

Component	**ΔH_f^0 = kJ/mol @25°C**
C_5H^{12} (l)	-173.49
CO_2 (g)	-393.51
H_2O (l)	-285.83

2. Pure CO is mixed with 100 % excess air and burnt. Only 80% of CO is burns. The reactants are at 100 °C and the products are at 300 °C. Estimate the amount of heat added or removed per kmol of CO fed to the reactor. Data: Mean molal specific heat between 25 °C and T °C in kJ/kmol K are as follows.

Gas	**T= 100^0 C**	**T= 300^0 C**
CO	29.22	30.61
CO_2	-	43.77
O_2	29.64	43.77
N_2	29.17	29.66

Standard heat of formation at 25 °C are:
CO = -110524 kJ/kmol and CO_2 = -393514 kJ/kmol

3. Calculate the enthalpy change (std. heat of reaction) between reactants and products if both are at 298.15 K and if 10 mol of formaldehyde is produced according to the following reaction.
$CH_4\ (g) + O_2\ (g) \rightarrow HCHO(g) + H_2O(g)$

Component	**ΔH_c^0 = kJ/mol @25°C**
CH_4(g)	-890.65
HCHO	-563.46

4. A gas mixture has the following composition on mole basis. CH4 = 84, C2H6 = 13% and N2 = 3%. Calculate the energy to be added to heat the 15 kmol of gas mixture from 298 K to 523 K using heat capacity data given below.
   $C_P^0 = a + bT + cT^2 + dT^3$
   where C_p^0 is in kJ/kmol K or J/mol K.

Component	a	b x 10^3	c x 10^6	d x 10^9
$CH_4(g)$	19.25	52.11	11.97	-11.32
$C_2H_6(g)$	5.41	178.19	-67.38	8.72
$N_2(g)$	29.59	-5.41	13.18	-4.97

5. Define. (1) Heat capacity (2) Calorie (3) Humidity
6. Using Antoine equation calculate the vapor pressure of Aniline at 380 K.
   Data: A=6.4450 B= 1731.50 C= -67.05
7. Define terms: Heat of formation, Heat of combustion, Heat of reaction.
8. For o-xylene, calculate latent heat of vaporization at 298.15 K using Watson equation.
   Latent heat of o-xylene at 417.5 K= 36819 kJ/kmol,
   Critical temperature of o-xylene = 630.30 K.
9. Pure methane is heated from 303 K to 523 K at atmospheric pressure. Calculate the heat added per kmol methane, using given data.
   a=19.2494, b=52.1135x10^{-3}, c=11.973x10^{-6}, d=-11.3173x10^{-9}
10. Define: (i) Stand. Heat of reaction (ii) Stand. Heat of Combustion (iii)Calorific value.
11. Heat capacity data for gaseous SO2 are given by equation:
    C^o_{mp}= 43.458 + 10.634*10^{-3} T-5.945*($10^5/T^2$). Calculate the heat required to raise the temperature of 1 kmol pure sulphur dioxide from 300 to1000 K,
12. Define: (i) Dry blub temperature (ii) wet bulb temperature (iii) Dew point.
13. Using Antoine equation, Calculate vapour pressure of Acetaldehyde (C_2H_4O) at 250K
    Antoine constants for acetaldehyde are A = 7.134, B = 1600, C = 18.65.
14. Calculate the heat of reaction of the following reaction.
    $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$
    Data : Component ΔH_f^Ocal/ gmol
    $NH_3(g)$ -11020
    NO(g) 21570
    $H_2O(g)$ -57796
15. Calculate the heat of formation of glycerol liquid ($C_3H_8O_3$) at 298 K from its elements using Hess's law. Data: Heat of formation of CO_2 (g) = (-393.51 kJ/mol), Heat of formation of H_2O (l) = (-285.83 kJ/mol), Heat of combustion of glycerol liquid at 298 K= (-1659.10 kJ/mol).
16. Temperature of pure Oxygen is raised from 350 to 1500K. calculate the amount of heat to be supplied for raising the temperature of 1 kmol oxygen using the following C_p^o
    Data $C_p^o = a + bT + cT^2 + dT^3$KJ/Kmol K
    a b x 10^3 c x 10^6 d X 10^9
    26.0257 11.7551 – 2.3426 -0.5623

17. Using Watson equation, calculate latent heat of vaporization of acetone at 353 K.
    Data: Latent heat of acetone at 329.4 K = 29121 kJ/kmol
    Critical temperature of acetone = 508.1 K.
18. Temperature of pure oxygen is raised from 350 to 1400 K. Calculate the amount of heat to be supplied for raising temperature of 1 kmol oxygen using the following C_P^0
    data.
    $C_p^0 = a + bT + cT^2 + dT^3$ KJ/Kmol K

a	b x 10^3	c x 10^6	d x 10^9
26.0257	11.7551	-2.3426	-0.5623

19. Obtain the expression relating the heat of reaction and the temperature of reaction.
    $SO_2(g) + 1/2\ O_2(g) = SO_3(g)$
    Also calculate the heat of reaction at 800K using the following
    C_p^0data. $C_p0 = a + bT + cT^2$ KJ/Kmol K

	$\Delta H^0_f 298$ (KJ/gmol-K)	a	b x 10^3	c x 106
SO_2	-296.81	24.77	62.95	-44.26
O_2	0.0	26.026	11.755	-2.3426
SO_3	-395.72	22.04	121.6	-91.87

Subject name: MATERIAL & ENERGY BALANCE COMPUTATIONS **SUBJECT CODE:3130508**
Course Outcome: CO3130508.4
CHEMCIAL ENGINEERING DEPARTMENT
L.E COLLEGE, MORBI

TUTORIAL-06

1. A liquid fuel is found to contain 83% C, 15% hydrogen and 2% Sulphur. Calculate the net calorific value (NCV) of liquid sample at298 K. Data: Gross calorific value of fuel at 298 K is 45071 kJ/kg of liq fuel.
   Latent heat of water vapour at 298K =2442.5 kJ/kg.
2. Discuss classification of fuels and define calorific values of fuels.
3. Calculate the calorific value at 298K of a sample of fuel oil having C/H ratio of 9.33 (by weight) and containing sulphur to the extent of 1.3 % by weight.
   Data:
   The Gross calorific value (GCV) of fuel oil at 298 K = 41785 kJ/kg.
   Latent heat of water vapour (25 °C) = 2442.5 kJ/kg
4. Discuss Ultimate analysis and proximate analysis of coal.
5. Why excess air is provided for combustion process?
6. Write a short note on Orsat analysis.
7. A fuel gas constitutes of CO_2-3.4%, C_2H_2-3.7%, C_6H_6-1.5%, O_2-0.3%, CO-17.4%, H_2-36.8%, CH_4-24.9% and N_2-12% (on mole basis). It is burnt with air in a furnace. The Fyrite analyser indicated 10 mole % CO_2 (on dry basis) in the flue gases. Find (i) the percent excess air used, and (ii) the complete Orsat analysis.
8. The Orsat analysis of the flue gases from a boiler house chimney gives CO_2 11.2%, O_2:4.2% and N_2 84.4 % (mole %). Assuming that complete combustion has taken place, (a) calculate the % excess air and (b) find the C: H ratio in the fuel.

Subject name: MATERIAL & ENERGY BALANCE COMPUTATIONS **SUBJECT CODE: 3130508**

Course Outcome:CO3130508.1

CHEMCIAL ENGINEERING DEPARTMENT

L.E COLLEGE, MORBI

ASSIGNMENT-01

1. An aqueous solution of monoethanolamide contains 20% MEA (by mass). It is utilised for the absorption of CO_2 Rich solution from the absorber contain 30 volume CO_2 calculate CO_2 loading in term of moles CO_2 dissolved per mole MEA assuming that the density of the solution is 1.011 kg/L.
   [Hint: - 30 volume CO_2 concentration means that a litre solution will liberate 40 L CO_2 at 101.325 kpa and 273.15 K (0°C).]
2. The strength of an aqueous hydrogen peroxide solution is 60 volumes. Its density is measured to be 1.075 kg/L at 293 K (20° C). Find the mass % of H_2O_2, in the solution.
   [Hint: A quantity of 1 L of 60 volume hydrogen peroxide will liberate 60 L oxygen at 101.325 kPa and 288.75 K(15.6°C)].
3. A gas mixture has the following composition by volume:

Ethylene	30.6%
Benzene	24.5%
Oxygen	1.3%
Methane	15.5%
Ethane	25.0%
Nitrogen	3.1%

   Find, (a) the average molar mass of the gas mixture, (b) the composition by mass and (c) the density of the mixture in kg/m³ at NTP.
4. The analysis of a sewage gas sample from a municipal sewage treatment plant is given below
   on a volume basis:

Methane	68%
Carbon dioxide	30%
Ammonia	2%

   H, S, SO, etc… traces. Find (a) the average molar mass of the gas; and (b) the density of the trace gases at NTP.
5. Calculate the density of chlorine gas at 503.15 K. (230°C) and 15.2 bar a using
   a) The Ideal gas law and;
   b) The van der walls equation.
6. In the manufacture of nitric acid, ammonia and air are mixed at 7.09 bar (g) and 923 K (650°K). The composition of the gas mixture (by volume) is as follows.

Nitrogen	70.5%
Oxygen	18.8%

Water	1.2%
Ammonia	9.5%

Find (1) The density of the gas mixture using, a) Ideal gas equation b) van der walls equation

(2) The specific gravity of the gas.

Subject name: MATERIAL & ENERGY BALANCE COMPUTATIONS **SUBJECT CODE:3130508**

Course Outcome: CO3130508.2

CHEMCIAL ENGINEERING DEPARTMENT

L. E COLLEGE, MORBI

ASSIGNMENT-02

1. Explain PFD in detail along with appropriate diagram.
2. Explain Block Diagram (BD) in detail along with appropriate diagram.
3. Explain P&I in detail along with appropriate diagram.
4. Differentiate PFD, BD and P&I in detail along with proper diagrams.
5. Express various types of symbols used in PFD and PI diagrams.
6. A sample of coal from Andrew Yules colliery, West Bengal, is found to contain 67.2% carbon and 22.3% ash (mass basis). The refuse obtained at the end of combustion is analysed to contain 7.1% carbon and the rest ash. compute the % of the original carbon burnt int the refuse.
7. Crystals of MgCl2.6H2O have a solubility of 190 g per 100 g ethanol at 250C (298.15 K). it is desired to make 1000kg of saturated solution. calculate the quantities of the crystals and ethanol required to make the above solution. Also find the composition of the saturated solution by mass
8. In refining mineral oils, a technique of mixed solvent extraction is employed. In a particular method, acetic acid is used as a principal solvent and chloroform is used as an auxiliary solvent. A particular oil having a viscosity gravity constant (VGC) 0f 0.8553 first treated with acetic acid. The acetic acid -oil mixture (a complex) has a composition 63.4% acetic acid and 36.6% oil. At 25^0C (298.15K) the complex separated into two coexisting liquid phases having the composition shown below

Composition of an Acetic Acid – oil Mixture

	Composition, mass %		VGC of solvent
	acetic acid	oil	free oil
Complex	63.4	36.6	0.8553
Upper layer	9.62	90.38	0.8418
Lower layer	93.03	6.97	0.9532

To the above complex, chloroform is added., the resultant mixture (a new complex) is separated again in two at 25^0 C (298.15 K), having the compositions given in the below table

Composition of the Complex Plus Chloroform

	Composition, mass %		VGC of solvent
	acetic acid	oil	free oil
New Complex	57.8	9.7	0.8553
Upper layer	14.5	18.93	0.8424
Lower layer	87.5	3.62	0.9

Calculate (a) the mass ratio of two layers given in the table 1 (b) the mass ratio of the two layers given in table 2, and (c) the amount of chloroform added to the original complex.

9. (a)For carrying out nitration reaction, it is desired to have a mixed acid containing 39% HNO3, 42% H2SO4 (mass). Nitric acid of 68.3% (mass) is readily available (azeotropic composition). Calculate the required strength of sulphuric acid to obtain the above mixed acid. (b)In question 7, aqueous 98% H_2SO_4 is used for blending. If, instead of this, 1% oleum is used, find the quantities of each of the three acids required to be blended. which blending should be preferred?

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Course Outcome: CO3130508.2

CHEMCIAL ENGINEERING DEPARTMENT

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ASSIGNMENT-03

1. Explain limiting component, excess reactant, degree of conversion, selectivity and yield.
2. Recycling and bypassing operation discuss in to the importance.
3. The flue gas mixture is known to contain CO_2, O_2 and N_2 along with water vapour. In order to analyses the mixture, the gas is first passed through silica gel which absorbs the moisture. Later, the dry gas is passed through 1 L of caustic potash solution. Thus, CO_2 is preferentially
   -absorbed in it. Finally, the mixture containing O_2 and N, is collected in 1 L flask at 101.325 kPa and 298.15 K (25°C). The increase in the mass of the silica gel due to moisture absorption was found to be 0.362 g. The caustic potash solution was analysed for carbonate formation. A volume of 10 mL of the solution was titrated against 0.012 N HCI solution. It was found that the phenolphthalein reading was 35.4 mL, while the total titration reading (with methyl orange indicator) was 38 mL. The increase in the mass of the flask was 1.16 kg. Bases on these observations, find:
   (a) the concentration of KOH and K_2CO_2 in the solution.
   (b) the Orsat (dry basis) analysis of the gas, and;
   (c) the mass percentage composition of the wet gas.
4. The analysis of limestone gives 60% $CaCO_3$, 35.5% $MgCO_3$ and rest inerts. It is treated with 12% aqueous sulphuric acid (by mass) to obtain pure CO_2. An excess of 15% of the acid over the stoichiometric amount is used to ascertain that the reaction goes to completion based on the treatment of 500 kg lime stone. Calculate:
   a) The amount of 100% (by mass) sulphuric acid required.
   b) The amount of the residue.
   c) The amount of the residue left in the vessel and,
   d) The moles of CO_2 produced.

Subject Name: Material and Energy Balance Computations **Subject Code: 3130508**

Course outcome: CO3130508.3

Chemical Engineering Department

L. E .College of Morbi

Assignment-4

1 Define : Heat Capacity and Specific Heat

2 Calculate vapour pressure of the n-hexane at 305K and water at 395K. Using Antoine constant given in Data.
Data:
For n-haxane at 305K : A= 5.9951, B=1168.7, C= 48.95
For Water at 395K : A=14.0568, B=2825.42, C=42.7089

3 A heat exchanger for cooling a hot hydrocarbon liquid uses 10000kg/h of cooling water, which enters the heat exchanger at 294K. The Hot Oil at the rate of 50000kg/h enter at 423K and leaving at 338K and has an average heat capacity of 2.51kJ/(kg.K). Calculate the outlet temperature of water.

4 Naphthalene is evaporated in a jacketed closed vessel. Pure Naphthalene is fed to the vessel at 303K and is vapourised at atmospheric pressure by condensing the eutectic mixture of diphenyl-diphenyl oxide vapour in jacketed at 171kPa a. Assume no subcooling of the condensed per 100kg Naphthalene evaporated.
Data of Naphthalene :
Formula : $C_{10}H8$ Molar mass = 128.1735
Melting Point : 491K(218°C)
Latent heat of Fusion = 150.7 kJ/kg
Latent heat of valorization= 316.1 kJ/kg
Heat capacity of solid Naphthalene ,
C_s = -0.092 + 0.00460 T kJ/(kg.K)
Where T is temperature in K .
Heat capacity of liquid Naphthalene

Temperature, K(°C)	C1, kJ/(kg. K)
353(80)	1.738
473(200)	2.135

Assume linear relationship of C_1 with T and the same for evaluating the heat load .

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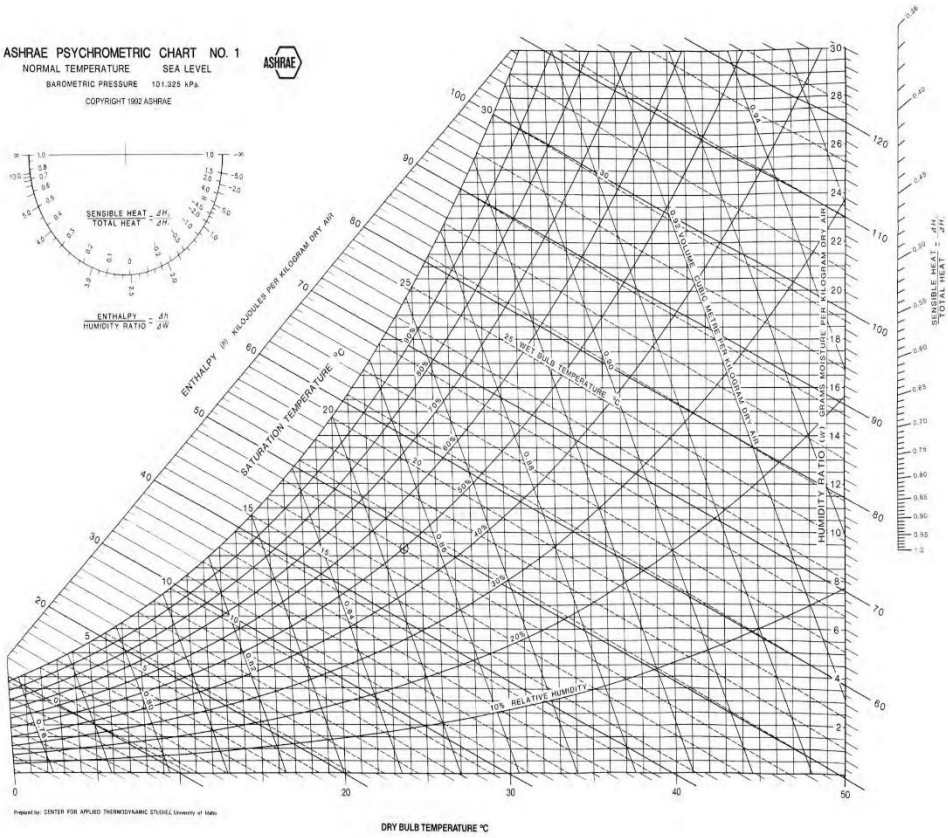
Course Outcome:CO3130508.1

CHEMCIAL ENGINEERING DEPARTMENT

L.E COLLEGE, MORBI

ASSIGNMENT-05

1.	Read the below given psychrometric chart and locate various thermodynamic parameters on it appropriately.



Please locate the following parameters on the graph,
(1) Relative Humidity
(2) Specific Humidity
(3) Dew Point Temp
(4) Specific Volume
(5) Enthalpy
using Dry Bulb temperature and wet Bulb temperature 25 ^{o}C and 30 ^{o}C respectively.