B.M.S. COLLEGE OF ENGINEERING, BENGALURU

DEPARTMENT OF CHEMICAL ENGINEERING

Process Principles & Calculations

(19CH3DCPPC)

Tutorial Questions

Prepared by Faculty Coordinator

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Process Principles & Calculations (19CH3DCPPC)

Unit 1

Assignment 1

1. Pure water and alcohol are mixed to get a 60% (weight) alcohol solution. The densities (kg/m^3) of water, alcohol and the solution may be taken to be 998, 798 and 895 respectively at 293 K.
   Calculate the following:
   a) The volume percent of ethanol in the solution at 293 K
   b) The molarity
   c) The molality

2. The solubility of NaCl in water at 290 K is 35.8 kg/100g of water. Express the solubility as the following
   a) Mass Fraction and mass percent of NaCl (Ans: 0.2636 and 26.36 %)
   b) mole Fraction and mole percent of NaCl (Ans: 0.0994 and 9.94 %)
   c) kmol NaCl per 1000kg of water (Ans: 6.125 kmol)

3. The gas contained in a closed vessel at a pressure of 1.2 atm and 299 K is heated to a temperature of 1250 K. Calculate the pressure to which a closed vessel should be designed. (Ans:5.01 atm)

4. A cylinder contains 14.2 kg of liquid propane. What volume in m^3 will propane occupy if it is released and brought to NTP condition? Ans: 7.223 m^3

5. The analysis of the gas sample is given below (volume basis): CH_4 =66% , CO_2 = 30 %, NH_3 = 4%. Calculate: (i) The average molecular weight of the gas. (ii) The density of the gas at 2 atm and 303 K.
   Ans: (a) 24,44 & density of the gas is 1.967 kg/m^3

6. By electrolyzing a mixed brine, a gaseous mixture is obtained at the cathode having the following composition by weight:
   Cl_2 = 67 %, Br_2= 28%, O_2= 5%
   Calculate :
   1. Composition of the gas by volume.
   2. Average molecular weight
   3. Density of gas mixture at 298 K and 1 atm.

   ANS: (a) Table (b) 78.43 (c) 3.20 kg/m^3

7. A mixture of CH_4 and C_2H_6 has the average molecular weight 22.4. Find mole% of CH_4 and C_2H_6 in the mixture.

8. Calculate the total pressure and composition of vapour in contact with the solution at 100° C containing 35% benzene , 40% toluene and 25% o-xylene by weight .
   Data:

Component	Vapour pressure at 100°C (mmHg)	Molecular weight
Benzene	1340	78
Toulene	560	92
O-xylene	210	106

9. A solution containing 55% benzene , 28% toluene and 17 % xylene by weight is in contact with the vapour at 373 K. Calculate the total pressure and molar composition of the liquid and vapour. (Ans: Total Pressure: 1.292 atm
   Mole % of benzene: 82.19; Mole % of toluene : 14.86; Mole % of xylene: 2.95)

10. A component whose molecular weight is 103 , analyses C-81.5% , H_2-49% and N_2-13.6%.What is its molecular formula ? Hint : g atom of element = weight in gram / atomic weight (Ans: C_7H_5 N)
11. Derive the empirical formula of the following : Ag = 9.09%, N= 20.77 %, O= 7.013% Ans: Ag N_2 O
12. 1000m^3 of a mixture H_2, N_2 and CO_2 at 150°C was found to have the following ratio of partial pressure of gases p_{H2}:p_{N2}:p_{N2}:: 1:4:3. If the total pressure is 2 atmosphere absolute, find the molefraction, weight percentage of these gases, Average MW and weight of CO_2 in kilograms
13. A mixture of CH_4 and C_2H_6 has density 1.0kg/m^3 at 273K and 101.325kPa. Calculate the mole percentage and weight percentage of CH_4 and C_2H_6 in the mixture.(Ans: 38.8 % and 61.2 %)
14. 10 kg of liquid A of specific gravity 1.17 is mixed 5 kg of liquid B of specific gravity 0.83. Assuming there is no change on mixing. What is the specific gravity of the mixture? ρ_{water} =1000kg/m^3 Ans: 1.029
15. 250kg of wet ammonium sulphate containing 50kg moisture is sent to a dryer in order to remove 90% of the moisture in feed. Calculate for the entrance and exit of the dryer the following
    a. The weight of the fraction of water
    b. The weight ratio of water
    c. The weight percentage of moisture on a wet basis
    d. The weight percentage of moisture on a dry basis
16. An automobile tyre is inflated to a pressure of 195 kPa at 273K. If the pressure inside the tyre is not to exceed 250KPa. What is the maximum temperature to which the tyre may be heated? Ans: 350K
17. How many gram of C are present in 264 g of CO_2? Ans: 72 g of C
18. Two thermometers are to the verified against the standard thermometer, which are calibrated in °C and K. The standard reads -22°F. What should the other two thermometers read?
19. Silver nitrate (lunar caustic) is a white crystalline salt, used in marking inks, medicine and chemical analysis. How many kilograms of silver nitrate ($AgNO_3$) are there in :
    a. 13.0 lb mol $AgNO_3$
    b. 55.0 g mol $AgNO_3$
20. Phosphoric acid is a colourless deliquescent acid used in the manufacture of fertilizers and as a flavouring agent in drinks. For a given 10 wt % phosphoric acid solution of specific gravity 1.10 determine:
    a. the mol fraction composition of this mixture.
    b. the volume (in gallons) of this solution which would contain 1 g mol H_3PO_4
21. A liquified mixture of n-butane, n-pentane and n-hexane has the following composition in percent. n - C_4H_{10} → 50 ; n - C_5H_{12} → 30; n - C_6H_{14} → 20
    Calculate the weight fraction, mol fraction and mol percent of each component and also the average molecular weight of the mixture.

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Unit 2

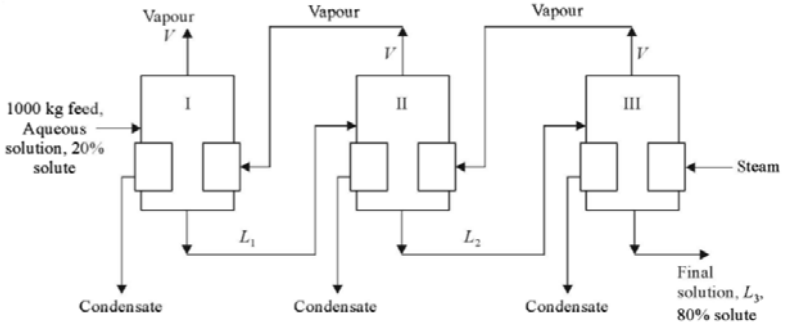
Tutorial Questions

1. A single effect evaporator is fed with 10000 kg/h of weak liquor containing 15% caustic by weight and is concentrated to get thick liquor containing 40% by weight caustic (NaOH). Calculate
   (i) kg/h of water evaporated and (Ans: 6250kg/h)
   (ii) kg/h of thick liquor obtained (Ans: 3750kg/h)

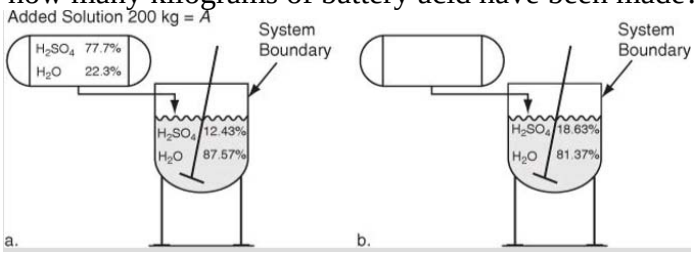
2. An evaporator is fed with 15,000 kg/h solution containing 10% NaCl, 15 % NaOH and rest water. In the operation, water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator contains 45% NaOH, 2%NaCl and reset water.
   Calculate
   (i) kg/h of water evaporated
   (ii) kg/h salt precipitated and
   (iii) kg/h of thick liquor obtained

3. 1000 kg of mixed acid of composition 40% H_2SO_4, 45 % HNO_3 and 15% H_2O is to be produced by strengthening waste acid of composition 30% H_2SO_4, 36 % HNO_3 and 34% H_2O by weight. Concentrated H_2SO_4 of strength 95 % and concentrated HNO_3 containing 80% acid are available for this unit operation. How many kilograms of spent acid and concentrated acids are to be mixed together?

4. A triple effect evaporator (below Figure) is used to concentrate 1000kg of aqueous solution from a concentration of 20% solute to 80% solute. Assuming an equal amount of vaporization in each effect, calculate the composition and weight of the solution entering the second and third effect



5. You are asked to prepare a batch of 18.63% battery acid as follows: A mixing vessel of old weak battery acid (H_2SO_4) solution contains 12.43% H_2SO_4 (the remainder is pure water). If 200 kg of 77.7% $H_2SO_4$is added (not too fast!) to the vessel, and the final solution is to be 18.63% H_2SO_4, how many kilograms of battery acid have been made?



6. The ground nut seeds containing 45% oil and 45% solids are fed to the expeller, the cake coming out of expeller is found to contain 80% solids and 5% oil. Find the percentage recovery of oil.
(Ans: 94%)

7. The NH_3 air mixture containing 0.2 kg NH_3 per kg of air enters into an absorption system where ammonia is absorbed in water. The gas leaving the system is found to contain 0.004kg of NH_3 per kg of air. Calculate the percentage recovery of NH_3.
(Ans: 98%)

8. Soyabean seeds are extracted with hexane in batch extractors. The flaked seeds are found to contain 18.6 %Oil, 69% solids, and 12.4 % moisture (by weight). At the end of the extraction process, cake (meal) is separated from hexane-oil mixture. The cake is analyzed to contain 0.8% oil, 87.7% solids and 11.5% moisture (by weight). Find the percentage recovery of oil.
(Ans: 96%)

9. 2500 kg of wet solids containing 70% solids by weight are fed to tray drier and dried using hot flue gas. The product finally obtained is found to contain 1% moisture by weight.
Calculate (i) Amount of water (in kg) removed from wet solids
(ii) Amount of water (in kg) of desired product obtained

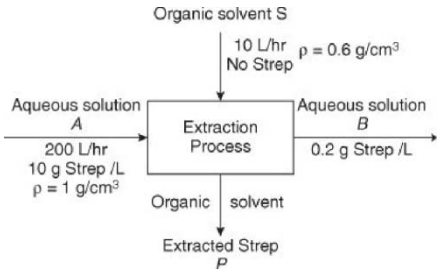
10. 5000 kg of mixture of Benzene and Toluene containing 50 mole % benzene distilled to get overhead product containing 95 mole % benzene and a residue containing 90 mole % toluene. Calculate the weight of benzene and toluene in feed, distillate and residue.

11. The waste acid from a nitrating process containing 20% HNO_3, 55% H_2SO_4 and 25% water by weight is to be concentrated by addition of concentrated sulphuric acid containing 95% H_2SO_4 and concentrated nitric acid containing 90% HNO3 to get desired mixed acid containing 26% HNO_3 and 60% H2SO4. Calculate the quantity of waste acid and concentrated acids required for 1000 kg of desired mixed.

12. 100 kg mole/ h of 40 mole % solution of ethylene dichloride in toluene is fed to a distillation column. The distillate contains 95% by mole of ethylene di chloride and bottom contains 90% by volume of toluene. What is the rate of flow of each stream?

13. It is required to prepare 1250 kg of a solution composed of 12 wt.% ethanol and 88 wt.% water. Two solutions are available, the first contains 5 wt.% ethanol, and the second contains 25 wt.% ethanol. How much of each solution are mixed to prepare the desired solution?

14. Streptomycin is recovered by contacting the fermentation broth with an organic solvent in an extraction process. The extraction process is able to recover the Streptomycin because Streptomycin has a greater affinity for dissolving in the organic solution than in the aqueous solution. Figure.1 shows the overall process. Determine the mass fraction of Streptomycin in the exit organic solvent assuming that no water exits with the solvent and no solvent exits with the aqueous solution. Assume that the density of the aqueous solution is 1 g/cm^3 and the density of the organic solvent is 0.6 g/cm^3.



15. A gaseous mixture (F) consists of 16 mol% CS2 and 84 mol% air are fed to the absorption column at a rate of 1000 Ibmole/hr. Most of the CS2 input are absorbed by liquid benzene (L) which is fed to the top of the column. 1 % of benzene input are evaporated and out with the exit gas stream which consists of 96 mol% air, 2 mol% CS2 and 2 mol% benzene. The product liquid stream (P) consists of benzene and CS2. Calculate the mole flow rates of (G), (L) and (P) and the compositions.

16. In the processing of the fish, after the oil is extracted, the fish cake is dried in rotary drum dryers, finely ground, and packed. The resulting product contains 65% protein. In a given batch of fish cake that contains 80% water (the remainder is dry cake), 100 kg of water is removed, and it is found that the fish cake is then 40% water. Calculate the weight of the fish cake originally put into the dryer.

17. A tank holds 10,000 kg of a saturated solution of Na2CO3 at 30°C. You want to crystallize from this solution 3000 kg of Na2CO3.10H20 without any accompanying water. To what temperature must the solution be cooled? The solubility data of Na2CO3 as a function of the temperature is given as below

Temp. (°C)	Solubility (g Na_2CO_3 / 100 g H_2O)
0	7
10	12.5
20	21.5
30	38.8

18. You are asked to measure the rate at which waste gases are being discharged from a stack. The gases entering contain 2.1 % carbon dioxide. Pure carbon dioxide is introduced into the bottom of the stack at a measured rate of 4.0 lb per minute. You measure the discharge of gases leaving the stack, and find the concentration of carbon dioxide is 3.2 %. Calculate the rate of flow, in lb mol/minute, of the entering waste gases.

19. A laundry can purchase soap containing 30.0 wt % water at a price of $ 7.00 per kg. The same manufacturer offers a soap containing 5.0 wt % water. If the freight rate is $ 6.00 per 100 kg, what is the maximum price that the laundry should pay the manufacturer for the soap containing 5.0 wt % water ? Note that the buyer has to pay the freight

20. A crystallizer contains 6420 lb of aqueous solution of anhydrous sodium sulfate (concentration 29.6 wt %) at 104 °C. The solution is cooled to 20 °C to crystallize out the desired Na2SO4. 10 H2O. The remaining solution (the mother liquor) is found to contain 16.1 % anhydrous sodium sulfate. What is the weight of this mother liquor.

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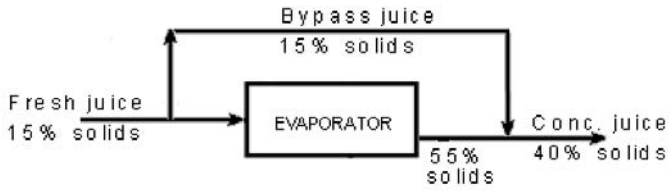
1. Fresh juice contains 15% solids and 85 % water by weight and is to be concentrated to contain 40 % solids by weight. In a single evaporation system, it is found that volatile constituents of juice escape with water leaving the concentrated juice with a flat taste. In order to overcome this problem, part of the fresh juice bypasses the evaporator. The operation is shown schematically in figure given below:

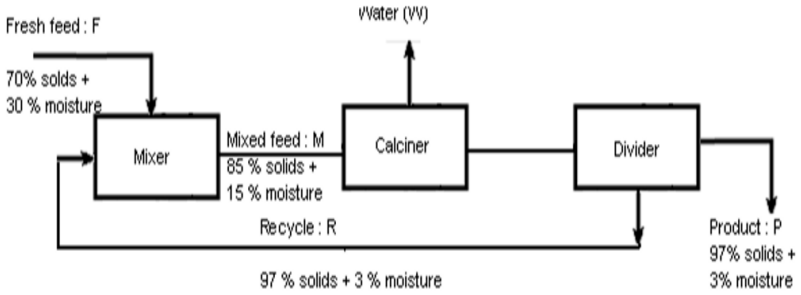


Calculate:

(a) The fraction of juice that bypasses the evaporator.

(b) The concentrated juice produced (containing 40 % solids) per 100 kg of fresh juice fed to the process

2. In a particular drying operation, it is required to have the moisture content of feed to a calciner at 15 % by weight in order to prevent lumping and sticking. This is achieved by mixing the feed having 30 % by weight moisture with a recycle stream of dried material having 3% by weight moisture. The drying operation is shown in figure. Find the fraction of the dried product that must be recycled.



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Unit 3

Tutorials Questions

1. In a Deacon process for the manufacture of chlorine, dry mixture of HCl and air is passed over a heated catalyst. Air is used 30% in excess of theoretical requirement. Calculate
   a. Amount of air supplied per kg of acid (Ans: 32.5 mole & 122.3. mole)
   b. Assuming 60% acid is oxidized, calculate the composition of gasses leaving by weight form the chamber

2. Formaldehyde is produced from methanol in a catalytic reactor ($CH_3OH \rightarrow HCHO + H_2$) The production rate of formaldehyde is 1 ton/h. If the conversion of methanol is 65%. Calculate the required feed rate of methanol.

3. In the manufacture of the nitric acid, pure dry sodium nitrite is treated with 95% (weight) of sulphuric acid $2NaNO_3 + H_2SO_4 \rightarrow 2\ HNO_3 + Na_2SO_4$. Acid is supplied in excess to ensure that the resulting nitre cake is liquid containing 35% sulphuric acid by weight. The cake contains 1.5% water by weight. In addition, 2% of the nitric acid formed will remain with the cake. For a basis of 100 kg of sodium nitrate treated, Calculate the following
   a. The weight and composition of the nitre cake
   b. The weight of sulphuric acid to be used.
   c. The weight of the nitric acid product obtained
   d. The water vapor that is distilled from the nitre cake

4. Phosphorous is prepared by heating a mass of calcium phosphate [$Ca_3(PO_4)_2$], sand SiO_2 and charcoal [C]. the reaction takes place as

   $Ca_3(PO_4)_2 + 3SiO_2 + 5C \rightarrow 3CaSiO_3 + 5CO + 2P$

   The amount of sand used is15 weight % excess and charcoal used is 35 weight % excess of that theoretically required. Calculate.
   i. Percentage composition of the original charge
   ii. Amount of phosphorous produced if the reaction is 75% complete, per 100 kg of calcium phosphate charged

5. The clorination of methane occurs by the following reaction

   $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

   Determine the product composition if the conversion of the limiting reactant is 67%, and the feed composition in mole % is 40% CH_4, 50 % Cl_2 and 10% N_2

6. The reactions $C_2H_6 \rightarrow C_2H_4 + H_2$ & $C_2H_6 + H_2 \rightarrow 2CH_4$ take place in a continuous reactor at steady state. The feed contains 85.0 mole% ethane (C_2H_6) and the balance inert's (I). The fractional conversion of ethane is 0.501, and the fractional yield of ethylene is 0.471. Calculate the molar composition of the product gas and the selectivity of ethylene to methane production.

7. 10kg of PbS and 3kg of O2 react to yield 6kg of Pb and 1 kg of PbO2 according to the reaction.

   $PbS + O_2 \rightarrow Pb + SO_2$ and $PbS + 2O_2 \rightarrow Pb\ O_2 + SO_2$

   Calcuate (a) Amount of PbS that doesnot react (b) % excess of Oxygen based on the amount of PbS that actually react. (c) Amount of SO2 (d) Percentage Conversion of PbS to Pb.

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Unit 4

Tutorials Questions

1. Determine the volume of air needed for complete combustion of 1 m^3 of producer gas having the following composition by volume. H- 30%; CO-10%; CH_4-4% and N_2=56%
2. A furnace uses coke containing 80% C; 0.5 % H and 19.5% ash by weight. It operates with 50% excess air. The solid refuse (ash) contains 2% unburnt carbon. 95% of carbon burnt forms CO2 and balance is CO. Calculate
   (a) Orsat Analysis of the flue gas
   (b) the weight of ash produced per 100kg of coke burnt, and
   (c) the weight of the carbon lost per 100kg of coke burnt
3. Butane is burnt with 80% of theoretical air. Calculate the analysis of gases leaving, assuming that all the H present is butane is converted into water.
4. Natural gas containing 82.5% methane, 6.8 % ethane, 3.78% propane and the balance butane is burnt with 30% excess air. Calculate
   (a) Flue gas analysis
   (b) Volume of flue gases per cubic-meter of gas burnt
5. A gas containing 75% methane and 25% oxygen is burnt with 100 % excess air. 80% Methane goes to CO2, 10% to CO and the rest remains unburnt. Calculate the exit gas composition
6. A liquid fuel having 88 weight % of C and 12 weight % of H is burnt to a flue gas of the following composition by volume on dry basis.
   C-13.4%
   O2- 3.6%
   N2-83%.
   Calculate the amount of flue gas produced per kilogram of fuel. Also find the percentage of excess air.
7. Orthoxylene on oxidation gives the phthalic anhydride as per the following reaction

$$C_8H_{10} + 3\,O_2 \rightarrow C_8H_4\,O_3 + 3\,H_2O$$

   20% excess air is used. Conversion is 50% and the yield of phthalic anhydride is 90%. Calculate the requirement of orthoxylene and air for 100kmol of phthalic anhydride production

8. A pure hydrocarbon 220kg/h is fired in a furnace of the boiler at atmospheric pressure at 25°C. The flue gas analysis on dry basis at atmospheric pressure and 30°C is given below: CO_2= 13%, O_2=3.5, N_2= 83.5%. Estimate the formula of the fuel and the volumetric flow rate of the gas

9. In the production of Sulphur trioxide 100 kmol of SO_2 and 200kmol of O_2 are fed to a reactor. The product stream is found to contain 80kmol of SO_3. Estimate the percent conversion of SO_2

10. In the manufacture of sulphur trioxide, the feed to the reactor consists of 50kmol SO_2 and 150kmol of air. Estimate the percent excess air utilized.

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11. A combustion reactor is feed with 50kmol/h of butane and 2100 kmol/h of air. Estimate the percent excess air utilized.

12. In the manufacture of chlorine, feed containing hydrochloric acid gas and air are fed to an oxidizer. The product gasses leaving the oxidizer are found to contain 13.2% HCl and 6.2% O_2 , 42.9% N_2, 30% Cl_2, and 7.6% H_2O by weight.
Estimate
    a. the percent excess air utilized.
    b. The composition by weight of gasses entering the oxidizer
    c. The degree of completion of oxidation

13. The clorination of methane occurs by the following reaction
$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$
Determine the product composition if the conversion of the limiting reactant is 67%, and the feed composition in mole % is 40% CH_4, 50 % Cl_2 and 10% N_2

14. Metal phosphoric acid is obtained by dissolving P_2O_5 in cold water. If 50kg of P_2O_5 is dissolved in water, Estimate the amount of metal phosphoric acid (HPO_3) formed.

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Unit 5

Tutorials Questions

1. Calculate the standard heat of reaction for the following reaction.
   $C_2H_5OH + CH_3COOH \rightarrow C_2H_5COOCH_3 + H_2O$
   The standard heat of combustion of the compounds are
   C_2H_5OH= -326700 Cal
   CH_3COOH = -208340 Cal
   $C_2H_5COOCH_3$ = -538760 Cal

2. Calculate the heat of reaction for the following reaction $CO_2 + H_2 \rightarrow CO + H_2$
   The heat of formation of the reactions are as follows
   CO_2 $\Delta H_{f\,298}$ = -94.051 kCal
   CO $\Delta H_{f\,298}$ = -26.416 kCal
   H_2O $\Delta H_{f\,298}$ = -57.798 kCal

3. Calculate the theoretical flame temperature of a gas containing 20% CO and 80% N_2 when burnt with 150% excess air and gas being at 25°C. Average Specific heat = 50.16 J/gmol K
   Heat of formation data
   CO_2 = -393137 J/g mol
   CO = - 10402 J/ gmol
   O_2 = 33.02 J/gmol K
   N_2 = 31.56 J/gmol K

4. Calculate the standard heat of formation of n- propanol using the following data

$C(s) + O_2 \rightarrow CO_2$	ΔH_1 = -393.51 kJ/mol
$H_2 + O_2 \rightarrow H_2O$	ΔH_2 = -285.83 kJ/mol
$C_3H_7OH + 4.5\ O_2 \rightarrow 3CO_2 + 4H_2O$	ΔH_C = -2028.19 kJ/mol

5. Carbon monoxide reacts with water vapour to produce carbon dioxide and hydrogen. The standard heat of reaction for this reaction at 298 K is -410190 kJ. The reactants are used in the stoichiometric proportions and are at 298K. 75% of the CO is converted by the above reaction. The products leave the reactor at 800 K. Calculate the amount of heat to be added or removed in the reactor per 1000 kg of the hydrogen produced. The mean heat capacities in J/mol.K of the components are : CO = 30.35, CO_2 = 45.64, Water vapour = 36 and H_2 = 29.30

6. In a pilot plant, the toluene is heated form 300K to 340K at the rate of 46kg/s. Estimate the heat required to be added to toluene using the heat capacity data as given below. Molecular weight of toluene =92. 08

   $C_p^\circ = 1.8 + 812.21\times10^{-3}T - 1512.67\times10^{-6}T^2$, kJ/(kmol K)

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7. Estimate the enthalpy change between the reactants and products if both are at 298.15K and if 10moles of formaldehyde is produced according to the following reaction 08

$$CH_4(g) + O_2 \rightarrow HCHO(g) + H_2O(g)$$

Data:

Component	$\Delta H_c°$, kJ/mol
CH_4(g)	-890.65
HCHO(g)	-563.46

8. Obtain an empirical equation for calculating the heat of reaction at any temperature T for the following reaction. 10

$$CO(g) + 2\,H_2(g) \rightarrow CH_3OH(g)$$

Data

$\Delta H_R^\circ = -21.59$ kcal/mol

$C_p^\circ = a + bT + cT^2 + dT^3$, cal/(mol.K)

Component	a	b×10³	c×10⁶	d×10⁹
CO(g)	29.03	-2.82	11.64	-4.71
H_2(g)	28.61	1.02	-0.15	0.77
CH_3OH(g)	21.14	70.84	25.87	-28.50

9. Calculate the amount of heat to be supplied for raising temperature from 300K to 1400K of 1 kmole of oxygen using the Cp° (standard heat capacity) data given below 06

$C_{pO_2}^\circ = 26.01 + 11.76\times10^{-3}T$, kJ/(kmol.K)

10. Estimate the heat of reaction at 773K for the following reaction

$$CO_2(g) + 4H_2(g) \rightarrow CH_4(g) + 2H_2O(g) \qquad \Delta H_R^\circ = 165.1 kJ/mol$$

Heat Capacity data: $C_p^\circ = \alpha + \beta T + \gamma T^2 + \delta T^3$

Component	α	β×10³	γ×10⁶	δ×10⁹
CO_2(g)	21.3655	64.2841	-41.0506	9.7999
H_2(g)	28.6105	1.0194	-0.1476	0.7690
CH_4 (g)	19.2494	52.1135	11.973	-11.2173
H_2O(g)	32.4921	0.0796	13.2107	- 4.5474

11. Calculate the heat required to raise the temperature of 1kmol of pure SO_2 from 300 K to 1000K. Heat capacity data for gaseous SO_2 is given by the following equation

$Cp_{SO_2}^\circ = 43.46 + 10.64\times10^{-3}T - 5.95\times10^5T^{-2}$, kJ/(kmol.K)

12. Calculate the heat that must be removed in cooling 32 kg of Oxygen from 215 to 313K using

Heat Capacity data: $C_p^\circ = \alpha + \beta T + \gamma T^2 + \delta T^3$

Component	α	β×10³	γ×10⁶	δ×10⁹
O_2(g)	26.0257	11.7551	-2.3426	-0.5623

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