Code No: 07A30802 **R07** **Set No. 2**

II B.Tech I Semester Examinations,November 2010
CHEMICAL PROCESS CALCULATIONS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define law of heat summation. How it is useful in finding the heats of reaction?
   (b) The heats of formation of H_2O(l), CO_2(g) and HCl(aq) are given as −68317, −94051 and −40023 cal/mol respectively. Calculate the heat of formation of $CHCl_3$(g) if the heat of combustion of $CHCl_3$(g) is given by the following equation:
   $CHCl_3(g) + 1/2\ O_2 + H_2O(aq) \rightarrow CO_2(g) + 3HCl(aq)$
   $\Delta H_c = -121800$ cal. [6+10]

2. The flow rate of gas mixture consisting of 60% ethane, 25% hydrogen and 15% carbondioxide is found to be 200 m^3/h at 300 K and 1.2 bar:
   (a) Determine the composition of the gas in weight percent
   (b) What is the flow rate in kg/h. [8+8]

3. (a) The vapor pressure of Ethyl Ether at 273 K is 25 kpa and its latent heat of vaporization is $4.185 * 10^2$ J/ kg. Using the Clausius - Clapeyron equation, estimate the vapor oressure at 293 K and 308 K.
   (b) Write short notes on Vapour pressure plots. [10+6]

4. In the chlorine manufacturing process, a dry mixture of hydrochloric acid gas and air is passed over a heated catalyst which promotes oxidation of the acid. Air is used in 40% excess of that theoretically required.
   (a) Calculate the weight of air supplied per kg of acid.
   (b) Calculate the composition by weight of the gas entering the reaction chamber.
   (c) Assuming that 50% of the acid is oxidized in the process. Calculate the composition by weight of the gases leaving the chamber. [5+5+6]

5. Methanol vapour can be converted into formaldehyde by the following reaction mechanism:
   $CH_3OH + 1/2\ O_2 \rightarrow HCHO + H_2O$
   $CH_3OH \rightarrow HCHO + H_2$
   The fresh feed to the process was 0.5 kmol/h of oxygen and an excess methanol. All of the oxygen reacts in the reactor. Formaldehyde and water are removed from the product stream first, after which hydrogen is removed from the recycled methanol. The recycle flow rate of methanol was 1 kmol/h. The ratio of methanol reacting by decomposition to that by oxidation was 2.5. Calculate the conversion per pass of methanol in the reactor. Calculate also the fresh feed rate of methanol. [16]

6. To avoid deterioration of drugs in a container, you remove all (0.93 kg.) of the H_2O from the container at 15 ^{0}C and 98.6 kPa by absorption in silica gel. The same air measures 1000 m^3 at 20 ^{0}C and 108.0 kPa when dry. What was the relative humidity of the moist air.
Antoine equation for water vapour pressure is given by $\log_{10}p=7.3092-\frac{1791.30}{T-35.05}$
Where p in kpa & T in k. [16]

7. How many kilograms of CO_2 are obtained by the decomposition of 100 kg of limestone containing 94.5% $CaCO_3$, 4.2% $MgCO_3$, and 1.3% inert material? What is the volume of CO_2 obtained at STP? [16]

8. 75000 cal of heat is removed from 2 mol of hydrogen gas which is initially at 1400^{0}C. What is the final temperature of hydrogen?
$C_p = 6.946 - 0.196 \times 10^{-3}$ T + 0.4757$\times 10^{-6}$ T^2
Here C_p is in Cal/(mol.K) and T is in K. [16]

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Code No: 07A30802 **R07** **Set No. 4**

II B.Tech I Semester Examinations,November 2010
CHEMICAL PROCESS CALCULATIONS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. In the chlorine manufacturing process, a dry mixture of hydrochloric acid gas and air is passed over a heated catalyst which promotes oxidation of the acid. Air is used in 40% excess of that theoretically required.
   (a) Calculate the weight of air supplied per kg of acid.
   (b) Calculate the composition by weight of the gas entering the reaction chamber.
   (c) Assuming that 50% of the acid is oxidized in the process. Calculate the composition by weight of the gases leaving the chamber. [5+5+6]

2. How many kilograms of CO_2 are obtained by the decomposition of 100 kg of limestone containing 94.5% $CaCO_3$, 4.2% $MgCO_3$, and 1.3% inert material? What is the volume of CO_2 obtained at STP? [16]

3. (a) The vapor pressure of Ethyl Ether at 273 K is 25 kpa and its latent heat of vaporization is $4.185 * 10^2$ J/kg. Using the Clausius - Clapeyron equation, estimate the vapor oressure at 293 K and 308 K.
   (b) Write short notes on Vapour pressure plots. [10+6]

4. Methanol vapour can be converted into formaldehyde by the following reaction mechanism:
   $CH_3OH + 1/2\ O_2 \rightarrow HCHO + H_2O$
   $CH_3OH \rightarrow HCHO + H_2$
   The fresh feed to the process was 0.5 kmol/h of oxygen and an excess methanol. All of the oxygen reacts in the reactor. Formaldehyde and water are removed from the product stream first, after which hydrogen is removed from the recycled methanol. The recycle flow rate of methanol was 1 kmol/h. The ratio of methanol reacting by decomposition to that by oxidation was 2.5. Calculate the conversion per pass of methanol in the reactor. Calculate also the fresh feed rate of methanol. [16]

5. (a) Define law of heat summation. How it is useful in finding the heats of reaction?
   (b) The heats of formation of $H_2O(l)$, $CO_2(g)$ and $HCl(aq)$ are given as −68317, −94051 and −40023 cal/mol respectively. Calculate the heat of formation of $CHCl_3(g)$ if the heat of combustion of $CHCl_3(g)$ is given by the following equation:
   $CHCl_3(g) + 1/2\ O_2 + H_2O(aq) \rightarrow CO_2(g) + 3HCl(aq)$
   $\Delta H_c = -121800$ cal. [6+10]

6. To avoid deterioration of drugs in a container, you remove all (0.93 kg.) of the H_2O from the container at 15 ^{0}C and 98.6 kPa by absorption in silica gel. The same air measures 1000 m^3 at 20 ^{0}C and 108.0 kPa when dry. What was the relative humidity of the moist air.
   Antoine equation for water vapour pressure is given by $\log_{10}p = 7.3092 - \frac{1791.30}{T-35.05}$
   Where p in kpa & T in k. [16]

7. The flow rate of gas mixture consisting of 60% ethane, 25% hydrogen and 15% carbondioxide is found to be 200 m^3/h at 300 K and 1.2 bar:
   (a) Determine the composition of the gas in weight percent
   (b) What is the flow rate in kg/h. [8+8]

8. 75000 cal of heat is removed from 2 mol of hydrogen gas which is initially at 1400^{0}C. What is the final temperature of hydrogen?
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Code No: 07A30802 **R07** **Set No. 1**

II B.Tech I Semester Examinations,November 2010
CHEMICAL PROCESS CALCULATIONS
Chemical Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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2. (a) The vapor pressure of Ethyl Ether at 273 K is 25 kpa and its latent heat of vaporization is 4.185 * 10^2 J/ kg. Using the Clausius - Clapeyron equation, estimate the vapor oressure at 293 K and 308 K.
   (b) Write short notes on Vapour pressure plots. [10+6]

3. To avoid deterioration of drugs in a container, you remove all (0.93 kg.) of the H_2O from the container at 15 ^{0}C and 98.6 kPa by absorption in silica gel. The same air measures 1000 m^3 at 20 ^{0}C and 108.0 kPa when dry. What was the relative humidity of the moist air.
   Antoine equation for water vapour pressure is given by $\log_{10}$p=7.3092-$\frac{1791.30}{T-35.05}$
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   $CHCl_3(g) + ½\ O_2 + H_2O(aq) \rightarrow CO_2(g) + 3HCl(aq)$
   $\Delta H_c = -121800$ cal. [6+10]

5. Methanol vapour can be converted into formaldehyde by the following reaction mechanism:
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(a) Determine the composition of the gas in weight percent

(b) What is the flow rate in kg/h. [8+8]

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Code No: 07A30802 **R07** **Set No. 3**

II B.Tech I Semester Examinations,November 2010
CHEMICAL PROCESS CALCULATIONS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. To avoid deterioration of drugs in a container, you remove all (0.93 kg.) of the H_2O from the container at 15 ^{0}C and 98.6 kPa by absorption in silica gel. The same air measures 1000 m^3 at 20 ^{0}C and 108.0 kPa when dry. What was the relative humidity of the moist air.
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3. The flow rate of gas mixture consisting of 60% ethane, 25% hydrogen and 15% carbondioxide is found to be 200 m^3/h at 300 K and 1.2 bar:
   (a) Determine the composition of the gas in weight percent
   (b) What is the flow rate in kg/h. [8+8]

4. 75000 cal of heat is removed from 2 mol of hydrogen gas which is initially at 1400^{0}C. What is the final temperature of hydrogen?
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