

End Semester Examinations - 2015-16 Even Semester - May 2016

14BT2003 Principles of Chemical Engineering

Set A

Time : 3 hrs
Total Marks: 100

1. 1. Cracked gas from a petroleum refinery has the following composition by volume methane 45%, ethane 10%, ethylene 25%, propane 7%, propylene 8% and n-butane 5%. Find (a).the average molecular weight of the gas mixture (b).the composition by weight (c).specific gravity of the gas mixture [20 marks]

OR

2. Find the equivalent weight of a).HCl b).NaOH c).Na₂CO₃ and d).H₂SO₄ [20 marks]

3. A multiple effect evaporator system has a capacity of processing 10,000 kg/day of solid caustic soda. When it concentrates weak liquor from 4 to 25% by weight caustic soda. When the same plant is fed with 10% weak liquor and if it is concentrated to 50% (both in weight basis).find the capacity of the plant in terms of solid caustic soda? Assume that the water evaporating capacity to be same in both cases. [20 marks]

OR

4. Explain the material balance for distillation column and evaporation process [20 marks]
5. Nitrogen is reacted with hydrogen to produced Ammonia. From the reaction; calculate a). The molar flow rate of hydrogen corresponding to nitrogen feed rate of 25 kmol/hr, if they are fed in the stoichiometric proportion and b). The kg of ammonia produced per hour if percent conversion is 25 and nitrogen feed rate is 25 kmol/hr [20 marks]

OR

6. The carbon monoxide is reacted with hydrogen to produce methanol. Calculate from the reaction. a).the stoichiometric ratio of hydrogen to carbon monoxide b).kmol of methanol produced per kmol of carbon monoxide reacted c).weight ratio of carbon monoxide to hydrogen if both are fed to reactor in stoichiometric proportion. d).the quantity of carbon monoxide required to produce 1000 kg of methanol. [20 marks]
7. When liquid benzene is completely burned to carbon dioxide and liquid water, the standard heat of combustion is – 3267.6 kJ/mol. The standard heat of combustion of hydrogen to liquid water is – 285.83 kJ/mol and that of carbon to carbon dioxide gas is – 393.51 kJ/mol. Calculate the standard heat of formation of liquid benzene. [20 marks]

OR

8. .[i]Calculate the heat that must be removed in cooling 32 kg of oxygen from 488K to 313K using C_p° data:
 $C_p^\circ = a + bT + cT^2 + dT^3$, (kJ/kmol.K) [10 marks]

| Gas | a | b x 10 ³ | c x 10 ⁶ | d x 10 ⁹ |
|--------|---------|---------------------|---------------------|---------------------|
| Oxygen | 26.0257 | 11.7551 | - 2.3426 | - 0.5623 |

[ii].Calculate the heat of formation of gaseous n-heptane at 298.15 K using the following data:

Data:

Standard heat of formation of CO₂= - 393.51 kJ/mol

Standard heat of formation of H₂O = - 285.83 kJ/mol

Standard heat of combustion of C₇H₁₆ = - 4853.43 kJ/mol [10 marks]

9. The gases leaving the boiler at 523K have the following composition: CO₂ = 11.31%, H₂O=2.17%, O₂= 13.04% and N₂=73.48% by volume. Calculate the heat lost in 1 kmol of gas mixture above 298K,using the heat capacity data given below: $C_p^\circ = a + bT + cT^2 + dT^3$, (kJ/kmol.K)

| Gas | a | b x 10 ³ | c x 10 ⁶ | d x 10 ⁹ |
|------------------|---------|---------------------|---------------------|---------------------|
| CO ₂ | 21.3655 | 64.2841 | - 41.0506 | 9.7999 |
| H ₂ O | 32.4921 | 0.0796 | 13.2107 | - 4.5474 |
| O ₂ | 26.0257 | 11.7551 | - 2.3426 | - 0.5623 |
| N ₂ | 29.5909 | - 5.141 | 13.1829 | - 4.968 |

Wishing you All the Best
