CHE 302 (1st Semester 1431/1432 H)

All homeworks are to be submitted in the class (Sundays) to me (LATE SUBMISSION WILL NOT BE ACCEPTED). Keep a copy of your homework which will be discussed in the tutorial (following Tuesday). Your submitted homeworks will be graded and given back to you the following class.

Solve **All** questions by EZSOLVE (perform Degree of freedom for all questions)

HW 1 (due Sunday 02/11/1431)

Solve the following set of equations:

(I) $A + 3B - 3C = 1000$
$3A - B + C = 136$
$10A - 20B + C = 50$

(II) $x + 3y - z + 4d = 150$
$3x - 2y + 10z - 5d = 100$
$2x + 10y - 5z + 7d = 12$
$7x + 15y - 9z + 11d = 170$

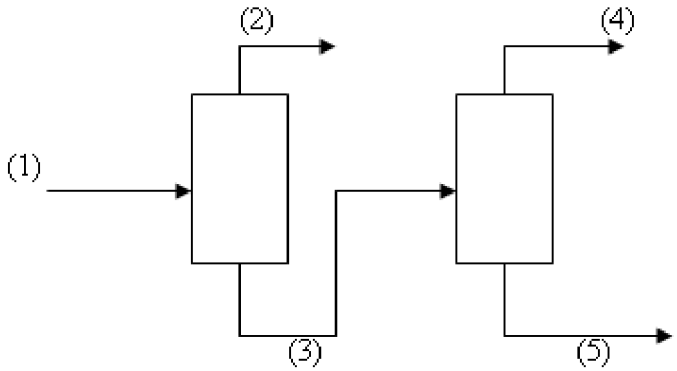
HW 2 (due Sunday 09/11/1431)

(A) It is required to produce a 12 mass % sugar solution from a 33 mass % sugar solution by adding pure water. **Calculate** the mass ratio of pure water to the 30% sugar solution.

(B) A drum contains 3.9 liters of liquid benzene (C_6H_6), through which air is bubbled at a rate of 1.8 mol/min. The gas stream leaving the drum contains 10 mol% of benzene vapor. If air is insoluble in benzene estimate the time required to evaporate all of the benzene. The specific gravity of benzene is 0.88

HW 3 (due Sunday 16/11/1431)

500 kg/s of a mixture (stream 1) containing **A** (50%)**, B** (30%) and **C** (20% by weight) is separated in a distillation column to two streams. The top stream (stream 2) contains **A** (90%) and **B** and the bottom stream (stream 3) contains **A, B** and **C.** The bottom stream is further separated in another distillation column to give: (a) a top stream (stream 4) rich in **B** (90%) and **A** (10%) and (b) a bottom stream (stream 5) rich in **C** (95%) and **B**.
(see the diagram below).



Calculate the mass flow rate and composition of stream 3.

HW 4 (due Sunday 23/11/1431)

A salt solution flowing at 1000 kg/s and contains 30% salt is mixed with a recycled stream. The mixed stream is fed to an evaporator in which part of the water is evaporated. The concentrated salt solution leaving the evaporator contain 65% salt is fed to a crystallizer equipped with a filter. The solution leaving the filter which contains 52% salt is recycled and mixed with the fresh feed. The solid portion (crystals) contains 90% salt crystals and 10% of a wetting solution having the same composition of the recycled stream. All % are mass % (i.e., weight %).

Calculate:

(i) amount of water evaporated

(ii) ratio of recycled stream to fresh feed.

HW 5 (due Sunday 01/12/1431)

The following reaction takes place in isothermal reactor:

$$C_4H_{10} \rightarrow C_2H_4 + H_2$$

The feed to reactor contains: Butane (C_4H_{10})=90% and Inert (I)=10%mol. 80% conversion of butane is achieved in the reactor. If the feed rate is 500 mol/s, **calculate** the molar composition of the product.

HW 6 (due Sunday 22/12/1431)

The following simultaneous reactions take place in a continuous reactor:

$$C_2H_6 + O_2 \rightarrow C_2H_4 + H_2O$$

$$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$$

The feed to reactor contains 25 mol% ethane (C_2H_6) and the balance is oxygen. The conversion of ethane is 60%. The selectivity of ethylene (C_2H_4) to CO_2 is 2. For a feed flow rate of 1000 mol/min:

(i) The molar flow rate of the reactor's products

(ii) The molar composition (dry basis) of the products.

HW 7 (due Sunday 29/12/1431)

Butane (C_4H_{10}) is dehydrogenated to form butylene (C_4H_8) in a catalytic reactor according to:

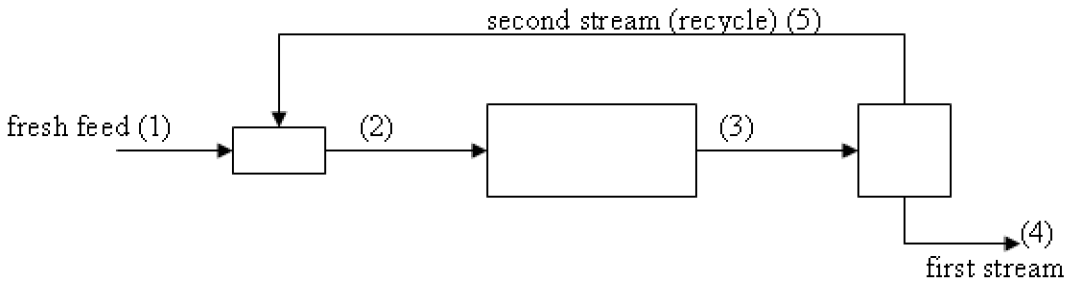
$$C_4H_{10} \rightarrow C_4H_8 + H_2$$

The process is designed for a 90% overall conversion of butane. The reactor products are separated into two streams: the first, which contains H_2, C_4H_8 and 1% of the butane that leaves the reactor, is taken off as product; the second stream, which contains the balance of unreacted butane and 2% of the butylene in the first stream, is recycled to the reactor. The fresh feed is pure butane flowing at 200 mol/s. **Calculate**:

(a) the molar composition of the product

(b) the ratio (moles recycled)/(moles fresh feed)

(c) the single pass conversion.



HW 8 (due Sunday 06/01/1432)

Determine the number of independent reactions from the following set.

$CH_4 + CO_2 \rightarrow 2CO + 2H_2$ (1)

$CH_4 + H_2O \rightarrow CO + 3H_2$ (2)

$CO_2 + H_2 \rightarrow CO + H_2O$ (3)

$CH_4 \rightarrow C + 2H_2$ (4)

$2CO \rightarrow C + CO_2$ (5)