Exam 1

BIEN 401

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Rework Example 1.5 assuming there are 0.21 mole of glycerol formed for each mole of ethanol and 0.13 mole of water formed for each mole of glycerol.

Using Example 1.5 we see that:

Carbon balance: 6 = b + 2c + 3d + e

Hydrogen balance: 12 + 3a = 1.74b + 6c + 8d + 2f

Oxygen balance: 6 = 0.45b + c + 3d + 2e + f

Nitrogen balance: a = 0.2b

Other constraints: d = 0.21c and f = 0.13d

We arrange these equations in the following matrix:



Solution of the above matrix gives a = 0.081, b = 0.403, c = 1.492, d = 0.313, e = 1.673, and f = 0.041.

1. Consider a solution of glucose on one side of a membrane that is impermeable to the transport of glucose. The temperature of the glucose solution is 200C. What pressure drop must be applied across the membrane to stop the flow of water into the glucose solution? Assume that the glucose concentration is 1 mg mL-1and that the molecular weight of glucose is 180 gmol-1.

We can start with Equation 3.4 and let A denote the side with glucose and B the side with pure water. We need to find the pressure in A that stops the osmotic flow of water hence Q =0.



Therefore  = 0. With πB = 0 this means that PA – PB = πA.



1. A hollow fiber membrane cartridge is being evaluated for use in an aquapheresis system. In one experiment using blood, a cartridge with a surface area of 1.5 m2 had a filtration flow across the hollow fiber membranes of 1000 mL h-1. The average pressure of the blood flowing inside the tubes of the hollow fiber membranes was 120 mmHg and the suction pressure on the filtrate side of the hollow fibers averaged -150 mmHg. Assuming that the plasma proteins were totally retained on the blood side of the hollow fiber membrane, estimate the hydraulic conductance of these membranes in milliliters per hour per square meter per mmHg.

We can start with Equation 3.4 and let A denote the side fluid within the hollow fiber and B the outside of the hollow fiber with pure water. The retained proteins have an osmotic pressure of πA = 28 mmHg. Solving Equation 3.4 for the hydraulic conductance gives:

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1. Considering the solution to the equations that represent mixing in a well-agitated vessel with known flows in and out, F1 and F2, as shown in the figure below:



The inlet and outlet flows consist of a solvent that contains two soluble components, A & B. The constant inlet concentrations are CA1 and CB1. If the volume in the tank is well mixed, the concentration of A & B in the tank equal the concentration of A & B in the exit stream and the equations relating the exit compositions to the inlet compositions are based on simple mass balances.

rate of accumulation = inflow - outflow



Overall Mass Balance





and,



Mass balance on component A



Mass balance on component B



First, define known equation parameters that characterize the system.

Inlet flow rate



Outlet flow rate



Initial Volume



Composition of A in the inlet stream



Composition of B in the inlet stream



Endpoint of solution interval















Use Odesolve to solve the system of differential equations and graph the resulting function for CA2(t) and CB2(t)

F1:=6 V0:= 100 CA1:=5

F2:=5 T1:=100 CB1:=2.5



