



UNIVERSITY OF GHANA

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BSC. SECOND SEMESTER EXAMINATIONS: 2016/2017

DEPARTMENT OF FOOD PROCESS ENGINEERING

FPEN 202: FOOD PROCESS ENGINEERING CALCULATIONS (2 Credits)

INSTRUCTIONS: ANSWER QUESTION ONE AND THREE OTHER QUESTIONS

TIME ALLOWED: TWO (2) HOURS

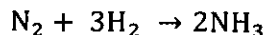
1. A fruit juice processing plant has an evaporator that produces concentrated orange juice at the rate of 20kg/min. The concentrated orange juice contains 45% of solids and the hourly rate of removal of water is 1200 kg/hr. After evaporation, the concentrated orange juice is further mixed with concentrated pineapple juice which is added at the rate of 800kg/hr. If the final concentrated juice after mixing contains 48% of solids; Calculate:
 - a. the percentage of solids in the original orange juice before evaporation.
 - b. the water content of the concentrated pineapple juice.
 - c. the amount of the final concentrated juice (final product) after mixing.

2.
 - a.
 - i. Raw food materials are processed industrially or domestically for various purposes. Explain why raw food materials are processed.
 - ii. Differentiate between recycle and by-pass streams in food processing operations.
 - b. In a dairy processing plant, skimmed milk is prepared by the removal of some of the fat from whole milk. For a particular production of skimmed milk with a 0.3% fat content, the original milk contained 4.7% fat. If the skimmed milk contains 89.8% water, 3.7% protein, 5.4% carbohydrate and 0.8% ash, determine its composition.

(Assuming: Fat only was removed to make the skimmed milk and there are no losses in processing)

3.

- a. The combustion of heptane is one of the chemical reactions that leads to the production of two distinct products. How many kg of C_7H_{16} will be needed to react completely with the stoichiometric quantity of O_2 to produce 61.6kg of CO_2 ? (Given molar mass (kg/mol): C= 12, H = 1, O = 16)
- b. Given the following chemical reaction equation, feed and product values:



	Feed	Product
N_2	95g	-
H_2	40g	-
NH_3	3g	85g

Determine

- the extent of reaction
- the grams and grams/mol of N_2 and H_2 . (Given molar mass (g/mol): N = 14, H = 1)

4)

- a.
- Differentiate between heat and enthalpy.
 - State and explain the 1st Law of Thermodynamics and the general energy balance.
- b. A meat processing plant desires to freeze 9,500 slices of bacon, each weighing 0.5 kg, from an initial room temperature of 20°C to a final store temperature of -21°C. If this is to be carried out in such a way that the maximum heat demand for the freezing is twice the average demand, estimate this maximum demand (in watts), if the total freezing time is to be 8 hours.

5) An autoclave contains 800 cans of pea soup. It is heated to an overall temperature of 100°C with the specific heats of the pea soup and the can metal being 4.1 kJ/kg °C and 0.50 kJ/kg °C respectively. The weight of each can is 55g and it contains 0.55 kg of pea soup. If the cans are to be cooled to 45°C before leaving the autoclave;

- How much heat needs to be removed to cool the cans to 45°C?
- How much cooling water is required if it enters at 18°C and leaves at 42°C?

Assume that the heat content of the autoclave walls above 45°C is 1.65×10^4 kJ and that there is no heat loss through the walls. Let the specific heat of water be 4.21 kJ/kg°C.