NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES
BACHELOR OF SCIENCE (HONS) DEGREE
Part Two Examination May 2005

SCH 2208 UNIT OPERATIONS (APPLIED CHEMISTRY STREAM)

Duration of Examination 3 Hours

Instructions to Candidates:
1. Answer any four questions only.
2. All questions carry equal marks.

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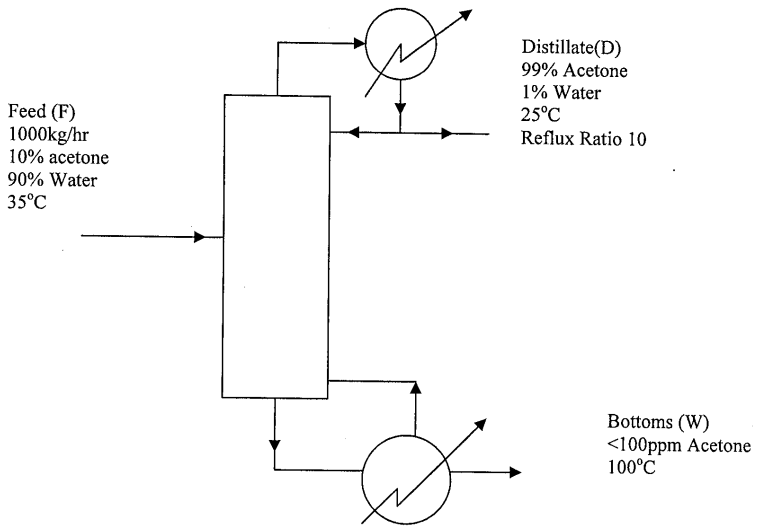
(1) Estimate the steam and cooling water required for the distillation column below. (25)



All compostions are by mass
Steam is available at 25psig (274kN/m^2 abs)
The rise in cooling water temperature is limited to 30°C
Column operates at 1bar

Heat capacity data
Acetone 2.2kJ/kgK

Water 4.2kJ/kgK

Latent Heat data
Acetone at 56.5°C = 620kJ/kg
Water at 56.5°C = 2500kJ/kg
Latent heat of steam = 2174kJ/kg

(2) Describe how the following Equipment works
(a) A continous destillation column (10)
(b) A multiple effect evaporator (15)

(3) A single-effect evaporator is used to concentrate 7kg/s of a solution from 10 to 50% solids. Steam is available at 205kN/m^2 and evaporation takes place at 13.5kN/m^2. If the overall heat transfer coefficient is 3kW/m^2K, calculate the heating surface required and the amount of steam used if the feed to the evaporator is at 294K and the condensate leaves the heating space at 352.7K. (Specific heat of 10% solution = 3.76kJ/kgK, Specific heat of 50% solution = 3.14kJ/kgK.)
Also given: At 205 kN/m^2, the stem temperature = 394K and the toatal enthalpy = 2530kJ/kg
At 13.5kN/m^2 water boils at 325K and the total entalpy of steam at 325K is 2594 kJ/kg
Specfic heat capacity of water is 4.18kJ/kgK (25)

(4) (a)Describe the general configuration of a chemical processing plant (10)
(b) Give a qualitative description of extraction process (10)
© Decribe how a packed column absorber works (5)

(5) A continous fractionating column, operating at atmospheric pressure, is to be designed to separate a mixture containing 15.67% CS2 and 84.33% CCl4 into an overhead product containing 91% CS2 and a waste of 97.3% CCL4 (all mass percent). Assume a plate efficiency of 70% and a reflux of 3.16 kmol per kmol of product.
Feed enters at 290K with a specific heat of 1.7kJ/kgK and boiling-point of 366K.
Latent of CS2 and CCl4 is 25900kJ/kmol

Mol % CS2 in vapour	0	8.23	15.55	26.6	33.2	49.5	63.4	74.7	82.9	87.8	93.2
Mol % CS2 in Liquor	0	2.96	6.15	11.06	14.35	25.85	39.0	53.18	66.30	75.75	86.04

(a) How many theoretical plates are required in the the column? (15)
(b) What is the actual number of plates if the plate efficiency is 70% (10)