

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATION JULY 2001
PRINCIPLES OF PROCESS ENGINEERING SCH 2218
TIME: 2HOURS 30MINUTES**

INSTRUCTIONS TO CANDIDATE

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Answer **ANY FOUR** questions from this question paper

1. A continuous single-effect evaporator concentrates 9072kg/h of a 1.0wt% salt solution entering at 311.0K to a final concentration of 3.0wt%. The overall coefficient $U = 1704 \text{ W/m}^2\text{K}$. Calculate the amounts of vapour and liquid product and the heat transfer area required given that:

$$C_p = 4.14 \text{ kJ/kg.K}$$

$$\text{Latent heat of steam} = 2230 \text{ kJ/kg}$$

$$T_s = 383.2 \text{ K}$$

$$H_v = 2257 \text{ kJ/kg}$$

Assume that since it is dilute, the solution has the same boiling point as water.
(25 marks)

2. A fermentation beer H containing 260mg/L of an antibiotic is to be extracted using butyl acetate L. The equilibrium constant for the system is 57. It is planned to let H equal 450L/hr and L equal 37L/hr and it is hoped that 99% of the antibiotic will be recovered in the feed. How many stages will be required to accomplish this separation?
(25 marks)
3. Give a brief classification of fluids using Newton's Law of Viscosity equation.
(25 marks)

4. An incompressible fluid is flowing inside a circular tube of inside diameter D . The significant variables are pressure drop Δp , velocity v , diameter d , tube length l , viscosity μ , and density ρ . Let Δp be the subject and find the dimensionless groups using Buckingham's method. Take ρ , v and d as your core variables. (25 marks)

5. a) Draw a schematic diagram of a distillation column showing material balance sections for McCabe-Thiele method. (10 marks)

b) Derive the equations for the stripping and rectifying sections. (15 marks)