



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY &

BACHELOR OF TECHNOLOGY IN INDUSTRIAL CHEMISTRY

ACH 4303: UNIT OPERATIONS : PAPER 2

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: Pick Date Select Month Pick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of Choose No questions. Attempt Choose instruction.

Do not write on the question paper.

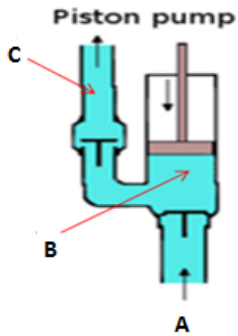
Question ONE

- (a) (i) Define the THREE types of fluid properties **(3 Marks)**
- (ii) State the importance, significance and different ranges of Reynolds Number in relation to fluid flow **(3 Marks)**
- (b) With Illustrations, explain how a Venturi Meter works in relation to fluid flow **(6 Marks)**
- (C) (i) Explain the mode of operation and application of Piston pumps

(3.½ Marks)

(ii) Label the parts A, B, and C in the drawing below

(1½ Marks)



(d) Differentiate between Diameter of the screen fraction and Diameter of solid particles in relation to screening terminologies (2 Marks)

(e) The energy required to reduce particles from a mean diameter of 2.0 cm to 0.1 cm is 20kj/kg. Using Kicks law calculate the energy required to reduce the size from 0.1 to 0.01, comment on the results in terms of energy consumption giving reasons.

(4 Marks)

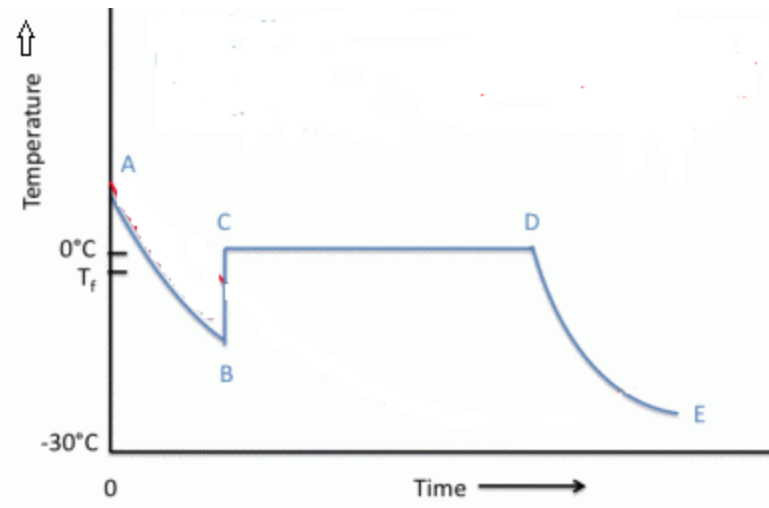
(f) Name FOUR applications of extraction in chemical industries (4 Marks)

(g) Explain how Alkyl Based Defoamers work (3 Marks)

Question TWO

Question Two

Below is a diagram showing crystallization of water



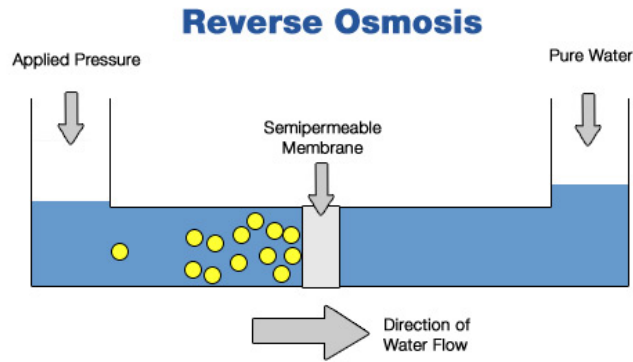
- (a) Name the stages of crystallization as shown in the diagram **(4 Marks)**
- (b) Discuss the stages of crystallization shown in the drawing above **(11 Marks)**
- (c) With an aid of a labeled diagram explain how parallel feeding evaporators operate in relation to crystallization **(5 Marks)**

Question THREE

Discuss atomization of feed slurry using **Rotary and Nozzle Atomizers** in a spray drying process **(20 Marks)**

Question FOUR

- (a) Below is a drawing showing the principle of Reverse osmosis, explain how this takes place in relation to osmosis and diffusion **(8 Marks)**



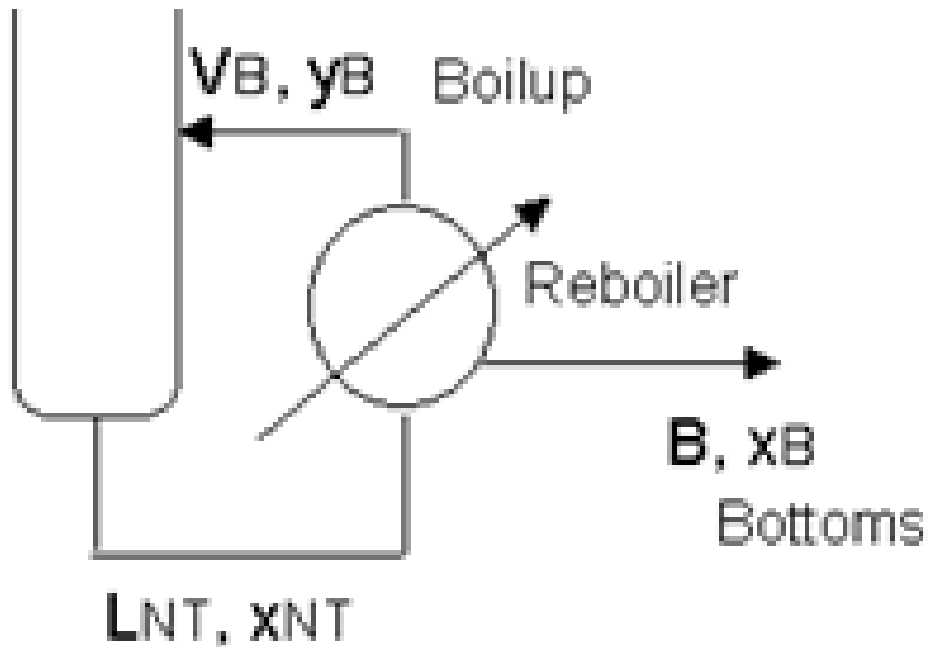
- (b) Given below is an equation for determining transmembrane flux in reverse osmosis. State the meaning of the symbols used in the equation **(4 Marks)**

$$J = \frac{dw}{dt} = \left(\frac{K_w}{x}\right) A (\Delta P - \Delta \Pi) = KA (\Delta P - \Delta \Pi)$$

- (c) Discuss the factors that affect the performance of an ultrafiltration system under the following headings
- (i) Flow across the membrane surface **(3 Marks)**
 - (ii) Operating Pressure **(3 Marks)**
 - (iii) Operating Temperature **(2 Marks)**

Question FIVE

- (a) With an aid of a labeled diagram explain how co-current flow in a heat exchange takes place **(4 Marks)**
- (b) Below is part of the rectifying section of a distillation column. Derive the operating line of the rectifying section including interpretation of this line, by taking a material balance around the condenser and accumulator **(6 Marks)**



- (c) Using the McCabe-Thiele graphical approach, draw a graph showing the Vapour Liquid Equilibrium (VLE) plot to determine the theoretical number of trays (stages) required to effect the separation of a binary mixture. The graph should show clearly the following:
- (i) The components of X-axis and Y-axis
 - (ii) The operating lines of both the rectifying and stripping sections
 - (iii) The Bottom, Feed and Distillate Compositions
 - (iv) The q-line and the feed tray (plate)
 - (v) The Vapour-liquid equilibrium line and the $x = y$ line

(10 Marks)

