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)**

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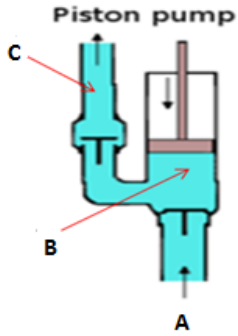
(d) Differentiate between Diameter of the screen fraction and Diameter of solid particles in relation to screening terminologies   **(2 Marks)**

(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.
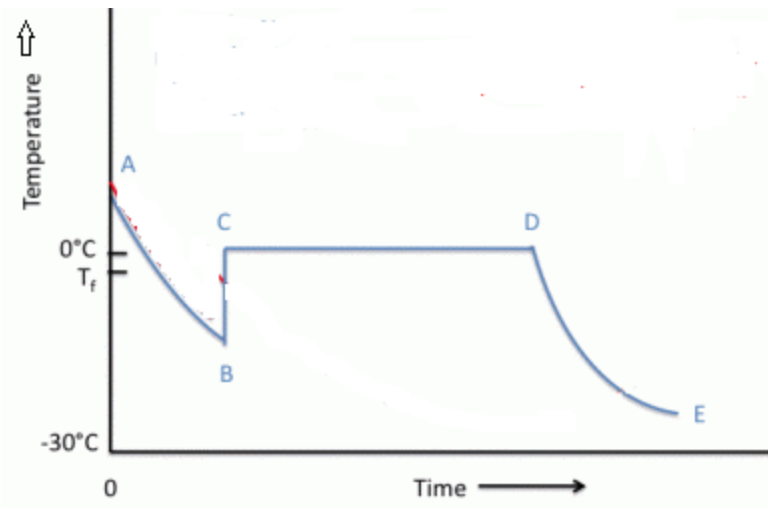   **(4 Marks)**

(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)**
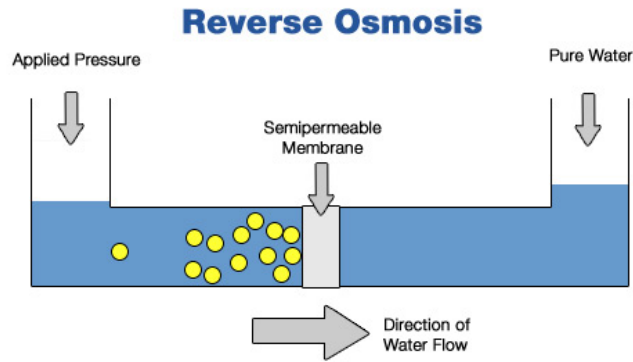
Reverse Osmosis

(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)**

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

(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)**

VB, yB Boilup

Reboiler

B, xB
Bottoms

LNT, xNT
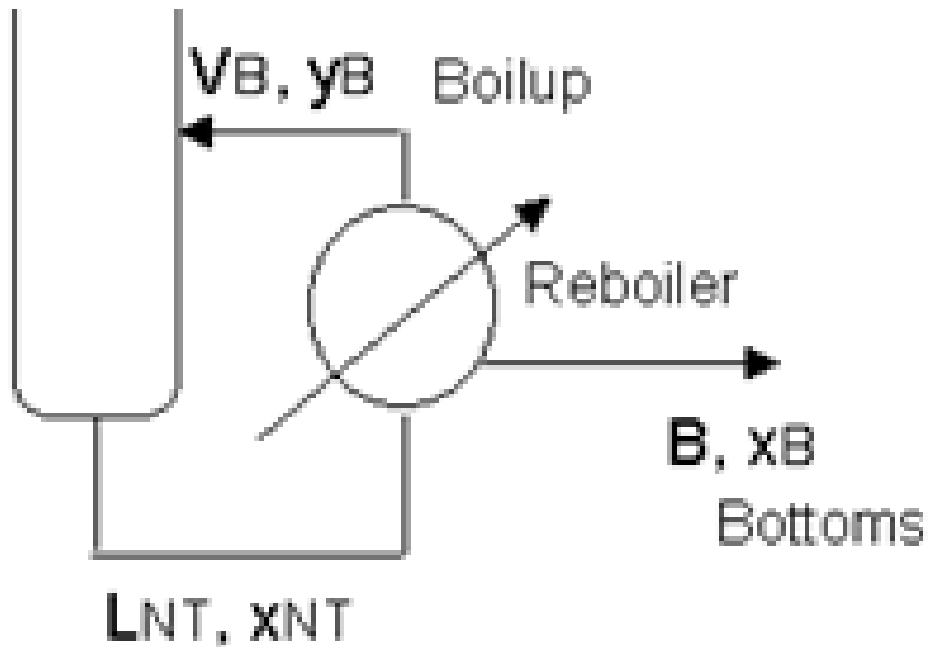
(c) Using the McCabe-Thiele graphical approach, draw a graph showing the Vapour Liquid Equilibrium (VLE) plot to determine the theoretical number of trays (stages) required to effect the separation of a binary mixture. The graph should show clearly the flowing:

  (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)