Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 Level 2nd Semester Examination – December/January 2017
SCT 314-2 Chemical Engineering Science

Uva Wellassa University

Instructions to candidates
Duration: Two (02) hours
Number of questions: Four (04)
Answer all questions
Mark allocation: 400 marks.

01. (i) Define the following terms.
(a) Absolute error
(b) Relative error
(c) Precision [15 marks]

(ii) Solve following problems and keep the answer to the correct number of significant figures.
(a) 4.81 + 1.038 + 75.2361 =
(b) (48 x 5.52 / 205.0) = [40 marks]

(iii) Explain the difference between the molarity and the normality. [20 marks]

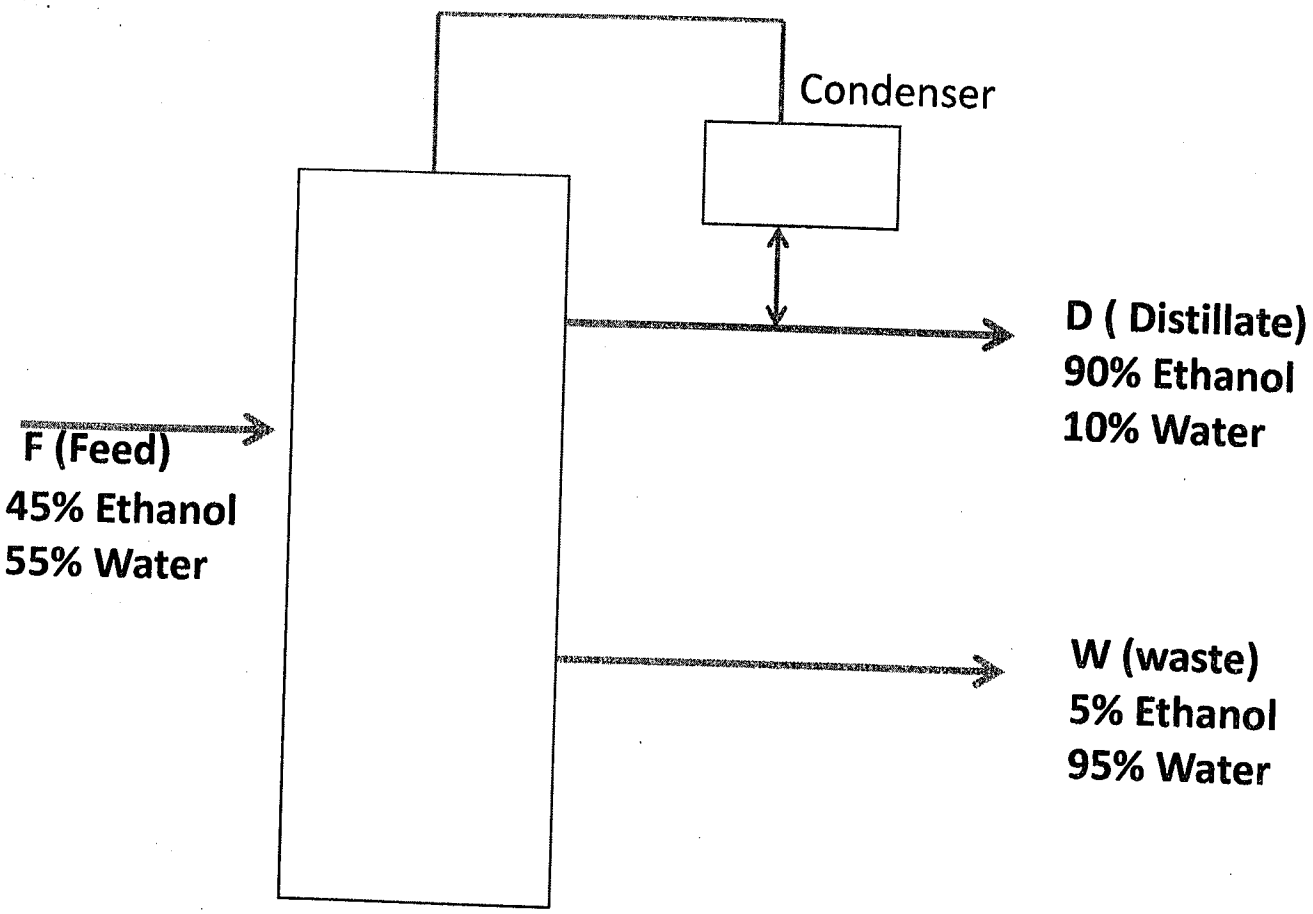
(iv) The density of the atmosphere decreases with increasing altitude. When the total pressure is 552 mmHg, how many inches of water is it? How many kilo pascals (kPa)?
(760 mm Hg = 33.91 feet H_2O,1 foot = 12 inches, 101.3 kPa = 760 mmHg)
[25 marks]

02. (i) Define the following terms.
(a) An open system
(b) A closed system [20 marks]

(ii) In a reactor, within a specific time period reactants are inserted and products are taken out. During this time period, some products are generated inside the system, and some are consumed in the system. Considering this situation, write down an expression in words for material balance, which describes the net accumulation in the system. [10 marks]

(iii) A structure of a distillation column is shown below with the known information for each stream. Calculate the kilograms of distillate (D) per kilogram of feed (F) and per kilogram of waste (W). [40 marks]

25



02. (iv) In the processing of fish, after oil is extracted, the fish cake is dried in rotary drum dryers, finely ground, and packed. In a given batch of fish cake that contains 70% of water, (the remainder is dry cake) 100 kg of water is removed. After the above procedure, dry fish cake is 20% of water. Calculate the weight of the fish cake originally put in to the dryer. [30 marks]

03. (i) Define the following terms.
(a) Extensive property
(b) Intensive property
(c) 'State' of a system
(d) Work
[20 marks]

(ii) Write an equation for enthalpy in terms of pressure, volume, and internal energy. Then using the above equation, derive an expression for heat capacity at constant pressure. [20 marks]

(iii) An equation for the relative enthalpy of a gaseous compound is given as, [20 marks]

$H - H_{298} = 25.31\ T + 0.23 \times 10^{-3}\ T^2 + 2.37 \times 10^5\ T^{-1} - 2420$

Where T (Temperature) is in Kelvin, H (enthalpy) is in cal/g mol and H_{298} is a reference state of enthalpy. Write down an equation for heat capacity at constant pressure.

(iv) A waste sample is burned to produce a gas. The gas thus produced consists of the gaseous components, A, B, and C having following compositions.

A: 10%
B: 8%
C: 82%
Total: 100%

What is the enthalpy difference for this gas per pound mole between the bottom and the top of the stack in which the gas contains, if the temperature at the bottom of the stack is 500 °F and the temperature at the top of the stack is 200 °F. Treat the gases as ideal. Neglect energy effects resulting from the mixing of the gaseous components.

Heat capacity equations are given below.
Temperature in °F. Heat capacity at constant pressure (Cp),
in Btu/(lb mol)(°F)

A: $Cp = 6 + 2T$
B: $Cp = 7 + 3T$
C: $Cp = 8 + 5T$ [40 marks]

04. (i) Briefly describe what is indicated by the following terms.
(a) Vacancy diffusion
(b) Interstitial diffusion [20 marks]

(ii) (a) Write down the Fick's first law. Give an equation which describes the Fick's first law and define the terms in the equation. [20 marks]

(c) Write down an equation which describes the Fick's second law. Define the terms. [20 marks]

(iii) Name two factors which affect the rate of diffusion of a species in to a solid. Write down an equation which shows the temperature dependence of the diffusion coefficient and define the terms in the equation. [15 marks]

(iv) Name four classification methods, which you would use to separate solid particles in industry. Explain a method you would use to separate magnetic and non-magnetic particles. [25 marks]