



[University of Choice]

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY**

[MMUST]

MAIN EXAMINATION

2021 / 2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY

COURSE CODE: SCI 365

COURSE TITLE: FLUID FLOW, HEAT & MASS TRANSFER

DATE: 21-04-2022

TIME: 15:00-17:00

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **FOUR** questions
2. Answer **ALL** Questions
3. All symbols have their usual meaning

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over

QUESTION ONE**[18 marks]**

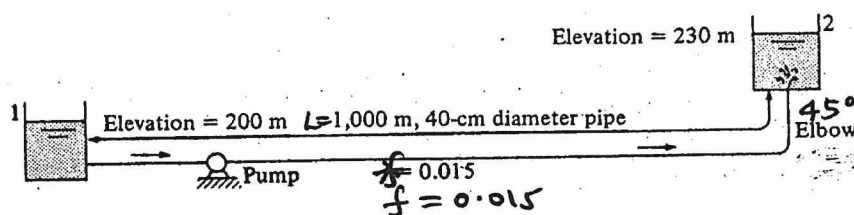
- a] State any three assumptions made in the applicability of Bernoulli's equation for fluid flow [3 marks]
- b] Write Bernoulli's equation in head form and verify that each of the terms in head form has the SI units of metres [3 marks]
- c] A horizontal nozzle discharges into the **atmosphere**. The bore areas at the inlet and outlet are 0.0006 m^2 and 0.0002 m^2 respectively. Determine the volume flow rate when the inlet pressure is 400 Pa. Ignore frictional losses [12 marks]

QUESTION TWO**[18 marks]**

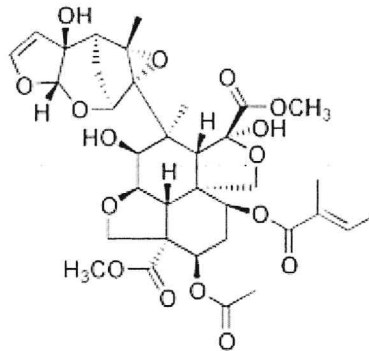
- a] For turbulent flow region, the friction factor **f** is a function of which Parameters? [3 marks]
- b] A 50mm diameter commercial steel pipe with an absolute roughness of 0.05 mm has a length of 100 m. Determine the head loss for water flowing through the pipe at 1 L/s. Take the kinematic viscosity to be $\nu = 1.39 \times 10^{-6} \text{ m}^2/\text{s}$ [12 marks]
- c] Water flows at the rate of $4 \text{ dm}^3/\text{s}$ from a pipe of diameter 40mm into a larger pipe. Given that the loss coefficient K_L due to sudden expansion is 0.8, calculate the head loss due to sudden expansion [3 marks]

QUESTION THREE**[18 marks]**

- a] For a pump, discuss the difference between brake horsepower and water horsepower, and also define pump efficiency in terms of these quantities [4 marks]
- b] The water system shown in **Fig.3b** carries a discharge of $0.27 \text{ m}^3/\text{s}$. The friction factor f is 0.015 while the minor loss coefficients K_L at the entrance, 45° elbow and exit are 0.5, 0.4 and 1 respectively.
- Determine the head added by the pump [12 marks]
 - If the efficiency of the pump is 80%, calculate the power input required by the pump to maintain the flow [2 marks]

**Fig.Q3b**

- d) A Bachelor of Science (Chemistry) graduate from MMUST secured a position at pigment and dye manufacturing industry to work as a quality control manager. Describe the procedures he would apply on treatment of different pollutants generated from the industrial processes 3 marks
- e) Azadirachtin whose structure is drawn below, is a natural product isolated from *Azadirachta indica* plant and was found to have good insect antifeedant activity. Describe the process of its commercialization for use as insecticide. 3 marks



- f) By use of examples, differentiate between thermoset and thermoplastic polymers 3 marks

QUESTION THREE (20 MARKS)

- a) List the four typical steps/processes involved in heterogeneous catalysis. 4 marks
- b) Explain the importance of catalysts in an industrial process? 4 marks
- c) Use example to illustrate the differences between calcination and roasting 4 marks
- d) Define mineral and ores. Which type of metals exist in the form of ores? 4 marks
- e) Describe with example, the necessity for applying different methods for concentration of ores. 4 marks

QUESTION FOUR (15 MARKS)

- a) Select any raw material from your county and explain the process by which it can be industrially treated to a final useable product. 5 marks
- b) Why is the reduction of a metal oxide easier if the metal formed is in liquid state at the temperature of reduction? 4 marks
- c) Although thermodynamically feasible, in practice, magnesium metal is not used for the reduction of alumina in the metallurgy of aluminium. Why? 3 marks
- d) At a site, low grade copper ores are available and zinc and iron scraps are also available. Which of the two scraps would be more suitable for reducing the leached copper ore and why? 3marks