



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY

SCH 318: THEORY AND APPLICATION OF FLUID FLOW, HEAT AND MASS TRANSFER

DATE: TUESDAY, 3RD APRIL 2012

TIME: 8.00 A.M – 10.00 A.M

INSTRUCTIONS

Attempt ALL questions.

Necessary information

$$g=9.81 \text{ m/s}^2$$

$$\pi = 3.14 \text{ or } \frac{22}{7}$$

$$h= 25 \text{ W/m}^2 \cdot ^\circ\text{C}$$

$$k \text{ of carbon steel, 1\% C} = 43 \text{ W/m}^\circ\text{C}.$$

$$\delta = 5.669 \times 10^{-8} \text{ W/m}^2 \text{K}^4$$

Question 1 (Total 18 marks)

a. Define the following terms

- i) System
- ii) Thermal diffusivity
- iii) Specific weight

b. i) Laminar flow and Turbulence flow

- ii) Shear stress and shear strain
- iii) Module of Elasticity in an Isothermal process and modulus of Elasticity in Adiabatic process.

[12 marks]

Question 2 (Total 14 marks)

2. The table below gives the relationship between the time rates of strain and shear stress of a particular fluid.

N/m ²	0	0.25	0.5	1	1.25	1.5	2.0	2.5	3.0	3.5	4.0
S ⁻¹	0	2.50	4.80	6.20	6.50	6.60	6.70	6.75	6.80	6.90	7.0

- a. Determine the Dynamic viscosity of the fluid at a time rate of strain of 5.05^{-1}
- b. What will be the kinematic viscosity of the same at a pressure of $103 \text{ k.Ns}^2/\text{m}^4$
- c. What is the relationship between the sheer stress and sheer strain in this fluid.[2 marks]
- d. Classify the above fluid and give one example of this type of fluid. [2 marks]

Question 3 (Total 12 marks)

- a. What will be the kinematic viscosity in m^2/s when we assume standard atmosphere pressure for the following fluids. Give an explanation for your answer .
 - i) Carbon tetrachloride between 16°C and 34°C . [2 marks]
 - ii) Helium between 20°C and 28°C . [2 marks]
 - iii) Crude oil between 42°C and 72°C [2 marks]
- b. Ethyl alcohol at a temperature of 63°C can be used to replace Benzene in fluid flow process due to the timely inefficiency of the process machinery. If the pressure at which the process is being run remains constant.
 - i) What would have been the normal working temperature for the process when the machinery were at max efficiency. [2 marks]
 - ii) If the process deviates from the normal working temperature by around 18°C which fluid would be best placed to use as a coolant. [2 marks]

Question 4 (Total 19 marks)

- a.
 - i) Give the graphical interpretation of Bernoulli's equation. [4 marks]
 - ii) How can the total hydraulic pressure be attained with the help of the equation. [4 marks]
 - iii) Give the version of the equation for ideal fluids. [2 marks]
- b. Applying system is conveying $0.28 \text{ m}^3/\text{s}$ of ethanol. At a particular cross section of the system , section 1 , the pipe diameter is 0.30 m the pressure is 124 kpa and the elevation is 42.7 m . At another cross section further stem , section 2 the pipe diameter is 0.20 m and the head loss of 2.74m between these sections due to pipe friction
 - i) Compute the velocity at each section. [2 marks]
 - ii) Compute the expected pressure at section 2 [2 marks]

Question 5 (Total 7 marks)

- i) Air at 20°C blows over a hot plate 50cm by 75 cm maintained at 250°C . The convection heat transfer coefficient is $25 \text{ w/m}^2.\text{c}$. Calculate the heat transfer
- ii) Assuming that the above plate is made of carbon steel (1%) 2cm thick and 300w is lost from the plate surface by radiation. Calculate the inside plate temperature.
- iii) Classify the above heat transfer process.