

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
Part Two Examination January 2011

TCE2105 Fluid Flow

Duration of Examination 3 Hours

Instructions to Candidates:

Answer ALL FIVE questions.

Each question carries equal marks.

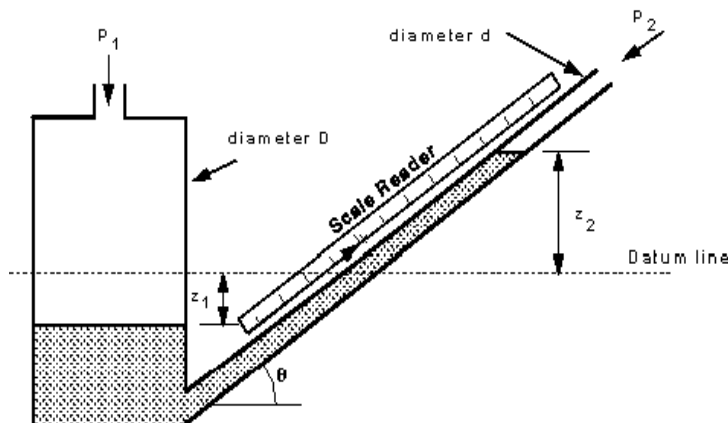
Show all steps clearly in your calculation.

Start the answers for each question on a new page.

1. a) Define the following terms in connection with the flow of a liquid (a minimum of three lines per description is required – preferably more with simple examples):
- i. Uniform flow
 - ii. Steady flow
 - iii. Unsteady flow
 - iv. Mean velocity
 - v. Discharge
 - vi. Mass flow rate
 - vii. Continuity
- (7 marks)

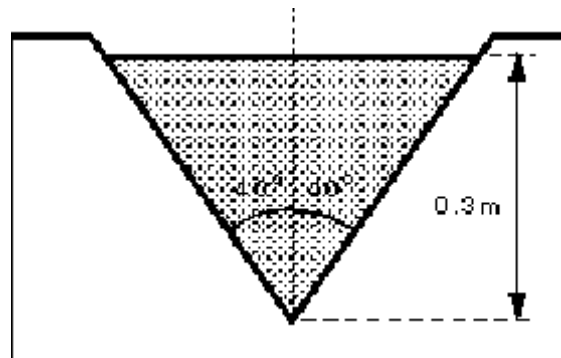
b) An inclined tube manometer consists of a vertical cylinder 35mm diameter. At the bottom of this is connected a tube 5mm in diameter inclined upward at an angle of 15 to the horizontal, the top of this tube is connected to an air duct. The vertical cylinder is open to the air and the manometric fluid has relative density 0.785. Determine the pressure in the air duct if the manometric fluid moved 50mm along the inclined tube.

What is the error if the movement of the fluid in the vertical cylinder is ignored?



(13 marks)

2. a) Using continuity and the Bernoulli equation derive an expression which can be used to measure flow in a Venturi meter. **(5 marks)**
- b) Water is discharging from a tank through a convergent-divergent mouthpiece. The exit from the tank is rounded so that losses there may be neglected and the minimum diameter is 0.05m. If the head in the tank above the centre-line of the mouthpiece is 1.83m
- i) What is the discharge? **(5 marks)**
- ii) What must be the diameter at the exit if the absolute pressure at the minimum area is to be 2.44m of water? **(5 marks)**
- iii) What would the discharge be if the divergent part of the mouth piece were removed. (Assume atmospheric pressure is 10m of water). **(5 marks)**
3. a) In an experiment water is flowing over an 80° V-notch with a constant head of 0.3m into a vertical cylindrical tank of diameter 0.5m .

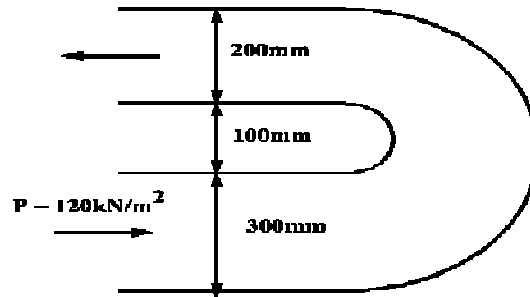


If the level in the tank rises 0.8m in 20 seconds, deriving all formulae, determine the coefficient of discharge of the notch. **(11 marks)**

- b) What is meant by the Net Positive Suction Head (NPSH) required by the pump? Explain why it exists and how it can be as low as possible. What happens if the necessary NPSH is not provided? **(9 marks)**
4. a) Two vertical cylindrical tanks of 3m and 2m diameter containing water are joined at their bases by a pipe of diameter 0.05m. This pipe is short enough to be treated as an orifice with a coefficient of discharge of 0.58. The 3m tank initially has a level 2m higher than the other, calculate how long it will take for the level difference to half. **(15 marks)**
- b) State five factors that influence the choice of pump for a particular operation

(5 marks)

5. a) Water flows along a circular pipe and is turned vertically through 180° by a reducing bend as shown in figure. The rate of flow in the pipe is 20 litres/s, the pressure measured at the entrance to the bend is 120 kN/m^2 and the volume of fluid in the bend is 0.1 m^3 . What is the magnitude and direction of the force exerted by the fluid on the bend? Ignore any friction losses. **(14 marks)**



- (b) Describe some uses for dimensional analysis. Your explanation should include the meanings and relevance of the terms *geometric similarity*, *dynamic similarity* and *kinematic similarity*. **(6 marks)**
(requires at least 5 lines per description)