



The Open University of Sri Lanka
Faculty of Engineering Technology

Department of Civil Engineering



052

Study Programme : Bachelor of Science Honours in Engineering
Name of the Examination : Final Examination
Course Code and Title : CVX3340 – Introduction to Hydraulics and Hydrology
Academic Year : 2023/24
Date : 09th February, 2025
Time : 1330 - 1630
Duration : 3 hours

General Instructions

1. This is a Closed Book Test (CBT).
 2. There are 5 questions on 4 pages (including this page)
 3. Read all instructions carefully before answering the questions.
 4. Answer all FIVE (05) questions.
 5. All questions are allotted equal marks.
 6. The marks for each section (a), b), etc) of a question is given as a percentage of the total mark for the question at the end of each section.
 7. Use the following values : Density of water 1000 kg/m^3 , Acceleration due to gravity 9.81 m/s^2
 8. Please contact the Supervisor in case of any doubts
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1) a) A dam of height 100 m has a vertical upstream face in the shape shown in Figure 1a. The bottom section of the dam face is a right-angled triangle while the top section is a rectangle.

Calculate the total horizontal force acting on the upstream face of the dam if the water level is 90 m above the bottom of the dam. (50%)

b) The schematic diagram of a reservoir and hydropower plant are shown in Figure 1b. The variation of the usable volume stored in the reservoir with height of the water level above the intake to the hydropower plant is shown in Table 1. The power plant is 50 m below the level of the intake, as shown in the figure.

Make your best estimate of the energy that can be generated by the hydropower plant when the water level of the reservoir is 35 m above the intake. Explain your answer. Assume that the efficiency of the hydropower plant is 90%. (50%)

Height of water level (h) (m)	0	10	20	30	40
Usable volume of water (10^6 m^3)	0	25	75	175	375

Table 1

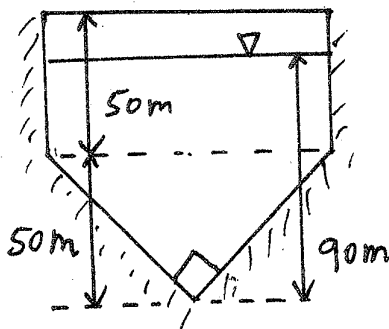


Figure 1a

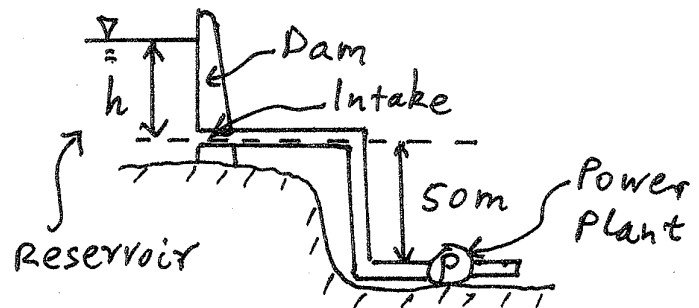


Figure 1b

2) a) Explain what is meant by the term “calibration” in relation to measuring instruments. (15%)

b) Explain using neat figures, what an Orifice Meter is and what it measures. (15%)

c) State the Bernoulli Equation as an equation. Identify all the variables. (10%)

(..... continued)

2) (... Continued)

d) List the four conditions under which the Bernoulli Equation is valid. (10%)

e) Derive an expression relating the quantity measured by the Orifice Meter to the values observed when the instrument is used. (50%)

3) Water flows in a horizontal pipe of circular cross-section that has an expansion from a diameter of 2 cm at A to a diameter of 5 cm at B, as shown in Figure 3. The direction of flow is from A to B, and the average velocity at A is 2 m/s.

Simple manometers open to the atmosphere are connected at A and B, and the water level in the manometer connected to B is 55 cm above the centreline of the pipe, as shown in the figure.

20% of the total energy of the flow at A is lost in the expansion AB.

a) Calculate the water level of the manometer connected to A. (40%)

b) State the Principle of Conservation of Momentum for a fluid Control Volume as a sentence. (10%)

c) Calculate the magnitude and direction of the force exerted on the pipe section AB by this flow. (50%)

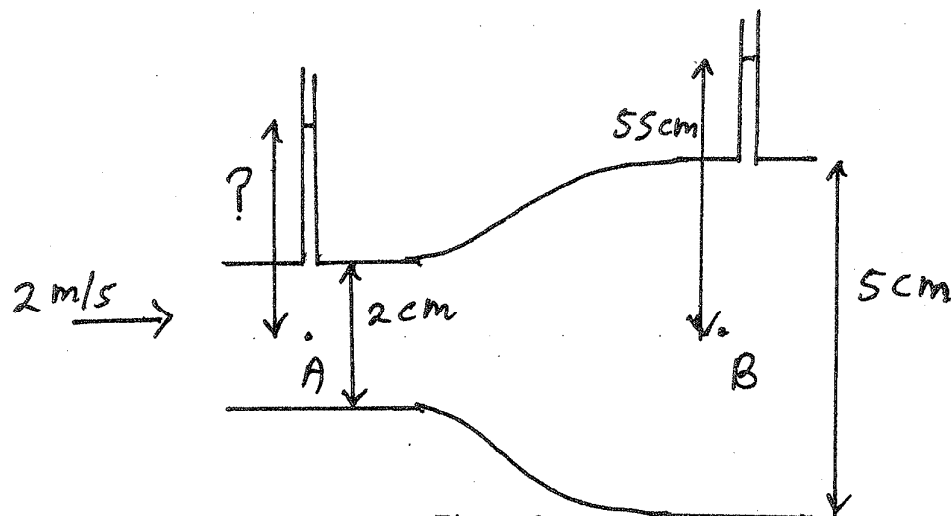


Figure 3

4) a) What is a hydrograph?

(5%)

b) The same rainfall falls on the same catchment – once during the dry season in February and once in the rainy season in May. Draw the hydrographs you expect to see in February and May on the same figure, and explain the differences. (35%)

c) A certain catchment has an area of 600 ha . A storm lasting 1 hour results in a uniform rainfall of X mm in the catchment. The discharge measured at the outlet of the catchment is given in Table 4. The run-off coefficient of the catchment for this storm is 0.7. Estimate the value of X. State all your assumptions and explain your answer. (60%)

Time from start of storm (hours)	0	1	2	3	4	5	6
Discharge (m^3/s)	0.5	3	9	6	4	2	0.5

Table 4

5) A cylindrical container has a diameter of 25 cm. The container is filled with water and a circular hole, of diameter 5 mm, is made in the wall of the container, with the centre of the hole being 10 cm above the bottom of the container, as shown in Figure 5. Water flows out of this hole as a jet.

When the water level in the container is 50 cm above the centreline of the hole, a point of the jet is observed to be 50 cm below the centreline of the hole and a horizontal distance of X cm from the hole, as shown in Figure 5.

a) Estimate the value of X. Neglect all energy losses. Explain your answer. (30%)

b) State the Principle of Conservation of Mass for a fluid Control Volume as a sentence. (10%)

c) Estimate the time taken for the water level in the container to reduce to 25 cm above the centreline of the hole. Explain your answer. (60%)

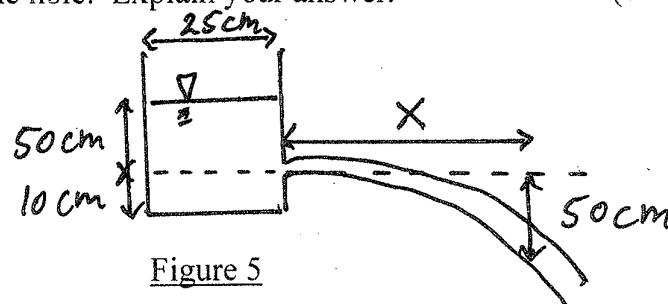


Figure 5