



UNIVERSITY OF JOHANNESBURG

FIRST SEMESTER EXAMINATION

COURSE: ENGINEERING
SUBJECT: APPLIED FLUID MECHANICS (STR2A11)
EXAMINER: MR STEPHEN A. AKINLABI
MODERATOR: MR DANIEL M. MADYIRA

TIME: 3 Hours
MARKS: 100 Marks
DATE: June 2014.

Instructions:

- Answer Question 1, it's compulsory.
- Answer any other 4 questions – any two questions from questions 2, 4 & 6 and any two questions from questions 3, 5 & 7.
- Ensure you answer 5 questions in all – question 1 and any other 4 questions as instructed.
- Show your workings clearly and systematically in the answer booklet provided.

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06/08/2014

Question 1 (30 Marks)

(a)

A vehicle is to be propelled by a jet of water impinging on a vane as shown in **Figure 1**. The jet has a velocity of 30 m/s and issues from the nozzle with a diameter of 200 mm. Calculate the force on the vehicle:

- (i) If it is stationary
- (ii) It is moving at 12 m/s

[14 marks]

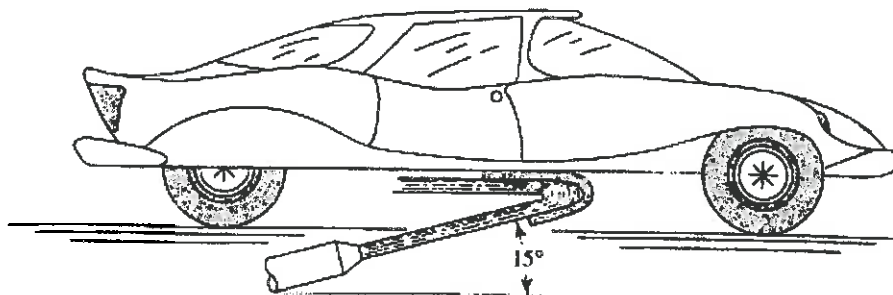


Figure 1: Propelled vehicle

(b)

A system of fluid flow between two reservoirs is shown in Figure 2. Calculate the vertical distance between the surfaces of the two reservoirs when water at 10°C flows from A to B at the rate of $0.03 \text{ m}^3/\text{s}$. The elbows are standard. The total length of the 3-in pipe is 100m and the 6-inch pipe is 300 m.

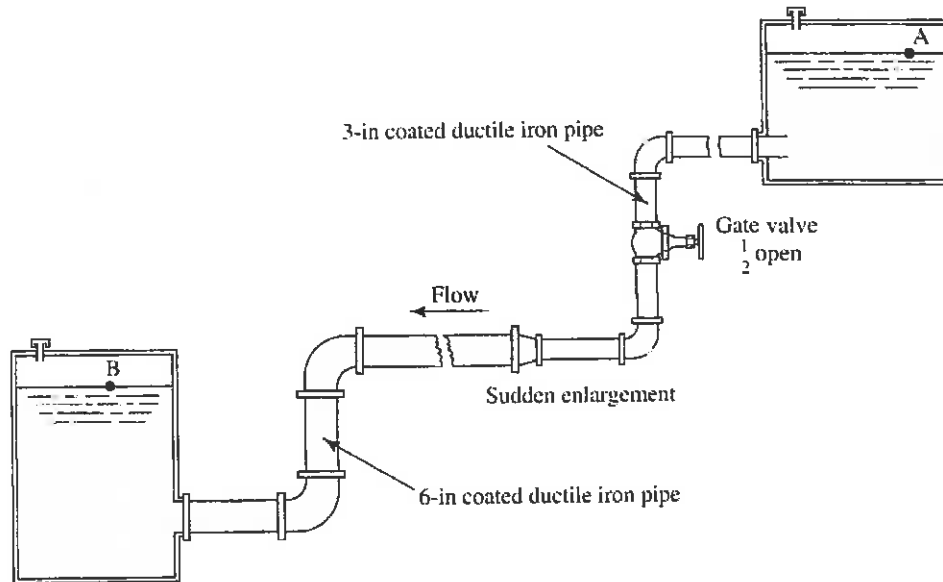


Figure 2: System of fluid flow between two reservoirs

[8 Marks]

(c)

A manometer is to be used to indicate the pressure difference between two points in a water pipe system. This arrangement is called a Venturi meter which is often used for flow measurement. If the pipe system has two different diameters of 50 mm and 25mm;

- (i) Make a schematic of the intended manometer to be used to measure the pressure difference between two points in a pipe system of smaller diameter of 25 mm and 50 mm, using mercury as the manometric fluid.
- (ii) Calculate the volume flow rate of water in the system if the manometer deflection h is 250 mm.

[8 Marks]

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Question 2 (15 Marks)

(a)

- (i) List six factors that affect the selection and use of a flow meters [3 Marks]
- (ii) Define range as it relates to flow meters [1 Marks]
- (iii) What is meant by the throat of a Venturi tube? [1 Marks]

(b)

A Venturi meter similar to the one shown in **Figure 3** has a pipe diameter of 100 mm and a throat diameter of 50 mm, while it is carrying water at 80°C , a pressure difference of 55 kPa is observed between section 1 and 2. Calculate the volume flow rate of water.

[5 marks]

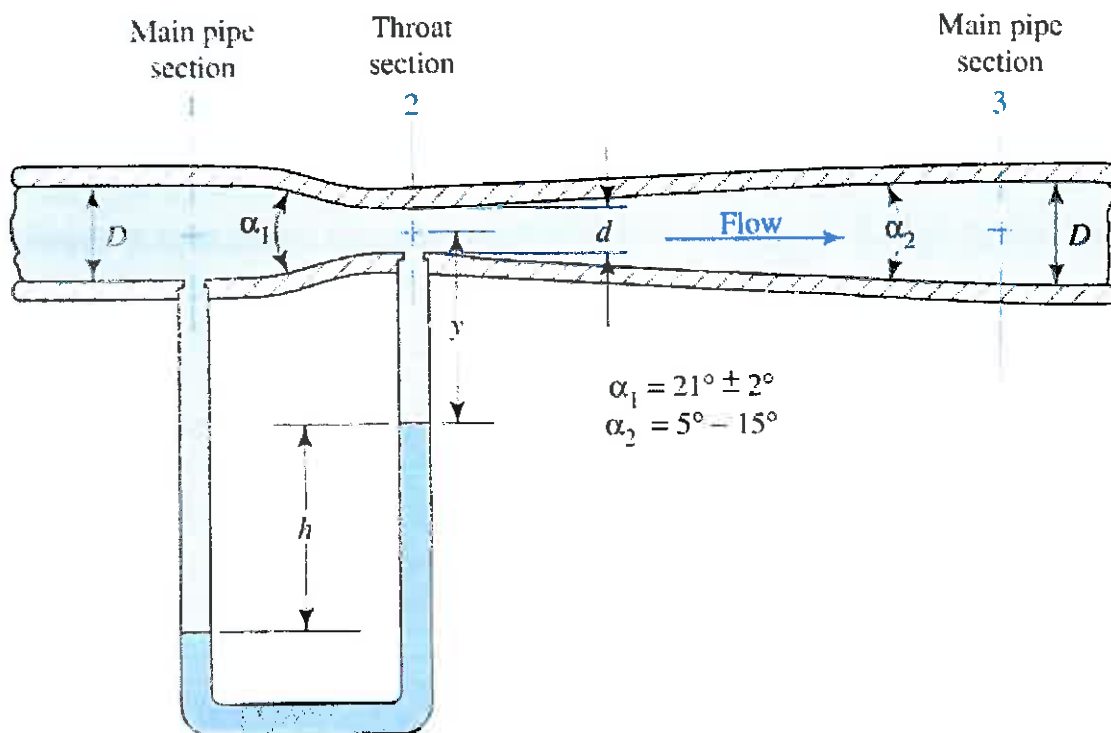


Figure 3: Typical Venturi meter

(c)

What will be the specific weight and the specific gravity of a body of unknown composition, if the weight in air is found to be 1000 N, and in water it weighs 750 N?

(Hint – the volume can be found from a force balance when the body is submerged)

[5 marks]

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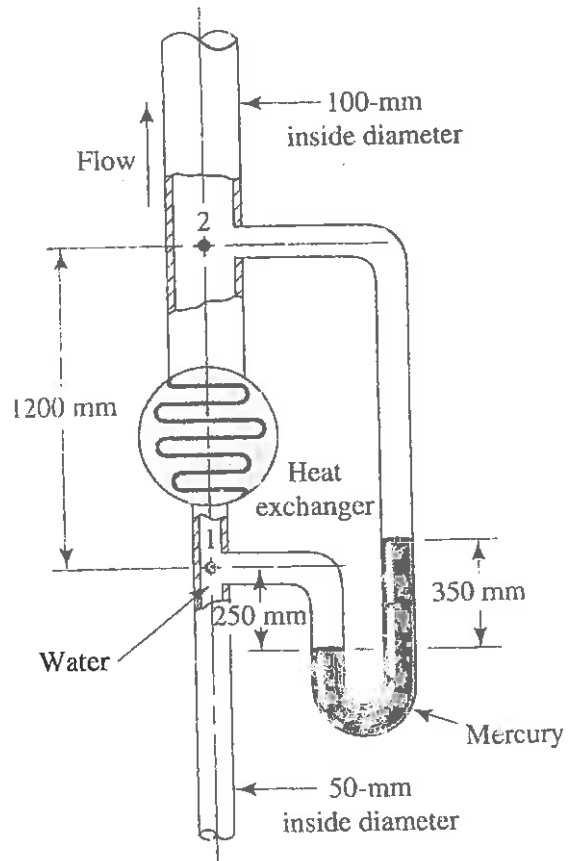


Figure 5: Test set up

[10 Marks]

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Question 7 (15 Marks)

(A)

(i) Differentiate between a Newtonian fluid and Non Newtonian fluid. [2 Marks]

(ii) State the mathematical definition for dynamic viscosity and its standard unit in the SI system. [2 Marks]

(iii) What do you understand by the term viscosity index? [2 Marks]

(iv) A buoy of solid cylinder 0.5 m in diameter and 1.7 m long, is made of a material with a specific weight of 8.3 kN/m^3 . If it floats upright, how much of its length is above the water? [4 Marks]

(B)

A typical composite cylinder is shown in **Figure 10**. What thickness (t) of brass is required to cause the cylinder to float in the position shown in carbon tetrachloride at 25°C ? [5 Marks]

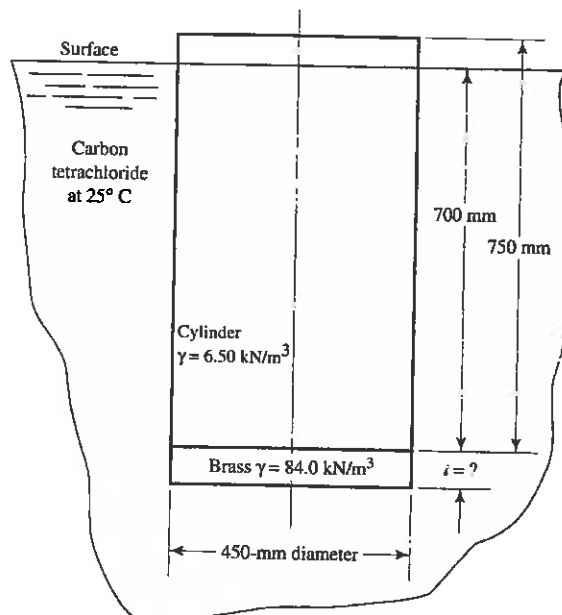


Figure 10: Composite Cylinder

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