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MODULE TITLE : FLUID MECHANICS

TOPIC TITLE : STATIC FLUID SYSTEMS

TUTOR MARKED ASSIGNMENT 1

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FM - 1 - TMA (v1)

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IMPORTANT

Before you start please read the following instructions carefully.

1. This assignment forms part of the formal assessment for this module. If you fail to reach the required standard for the assignment then you will be allowed to resubmit but a resubmission will only be eligible for a Pass grade, not a Merit or Distinction.

   You should therefore not submit the assignment until you are reasonably sure that you have completed it successfully. Seek your tutor's advice if unsure.

2. Ensure that you indicate the number of the question you are answering.

3. **Make a copy** of your answers before submitting the assignment.

4. **Complete all details on the front page of this TMA** and return it with the completed assignment including supporting calculations where appropriate. The preferred submission is via your TUOL(E) Blackboard account:

   https://eat.tees.ac.uk

5. Your tutor's comments on the assignment will be posted on Blackboard.

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1. Compare liquids and gases with regard to their:

   - shape
   - volume occupied
   - density
   - viscosity
   - compressibility.

2. (a) (i) Define dynamic viscosity and give the mathematical formula for Newton's law of viscosity.

   (ii) How does kinematic viscosity differ from dynamic viscosity?

   (b) Explain why viscosity is an important property in Fluid Mechanics.

   (c) Name **three** classes of non-Newtonian fluids and explain how their viscosity is affected by factors other than temperature.

   (d) What is the main difference between an 'ideal' fluid and a 'real' fluid?

3. (a) Often the mathematics of a problem in Fluid Mechanics is made easier if we assume the mass or area to be concentrated at a single point. What are these points known as for:

   (i) mass

   (ii) area?

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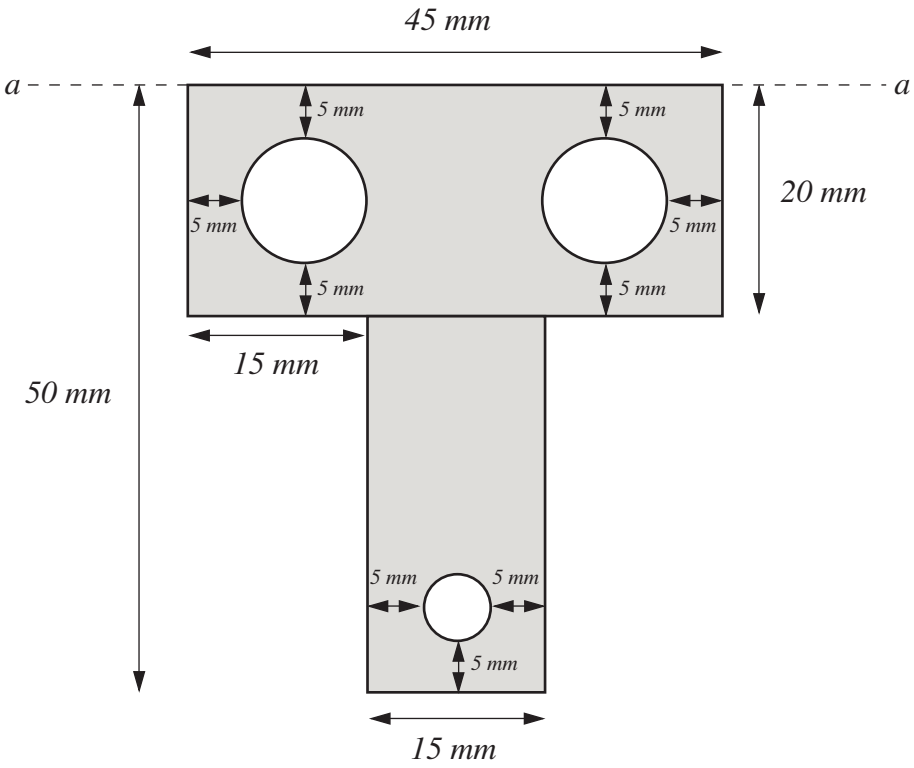
(b) (i) Determine the centroid of the following shape (note that the circles are holes):



(ii) Determine the second moment of area of this shape and hence its radius of gyration about the axis a–a.

4. (a) What is the formula for calculating the pressure due to the height of liquid?

(b) Name **two** devices which make use of this formula when used for pressure measurement.

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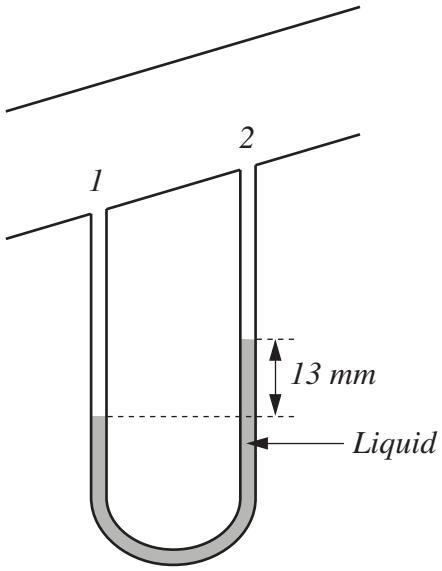
(c) (i) In the situation, below calculate the pressure difference between points 1 and 2 for the flow of a gas within the pipe. The liquid present is mercury whose density is 13 560 kg m^{-3}.



(ii) The liquid is now replaced by a new liquid whose density is 2100 kg m^{-3}. If the pressure difference remains constant, what will be the new difference in level between each limb?

(iii) What is the advantage of changing the liquid?

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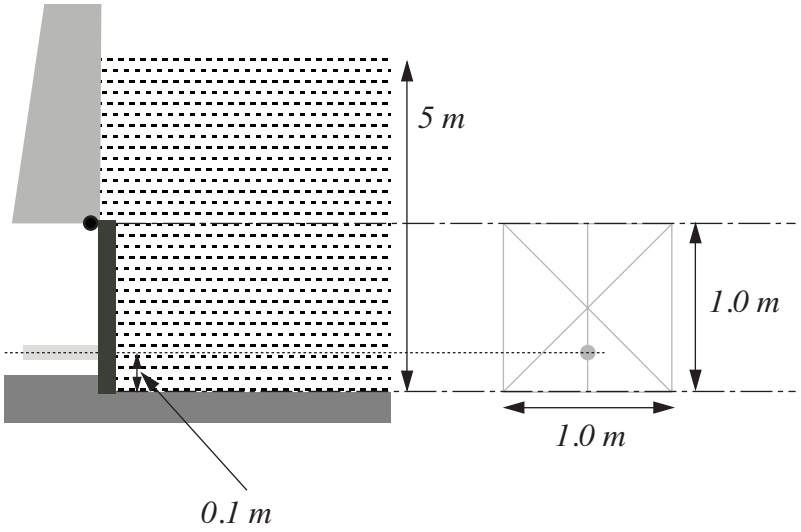
5. A concrete vessel containing water has a square seal gate, hinged at the top, blocking off the outflow of a large reservoir as shown below.



(i) Calculate the total moment about the hinge of the seal gate.

(ii) To allow the water out, a circular hydraulic ram of area 0.04 m^2 is to be used to open the hatch. The centre of the ram is situated 0.1 m from the bottom centre of the seal gate. Calculate the minimum pressure required on the ram to open the gate. (Assume the weight of the gate is negligible.)

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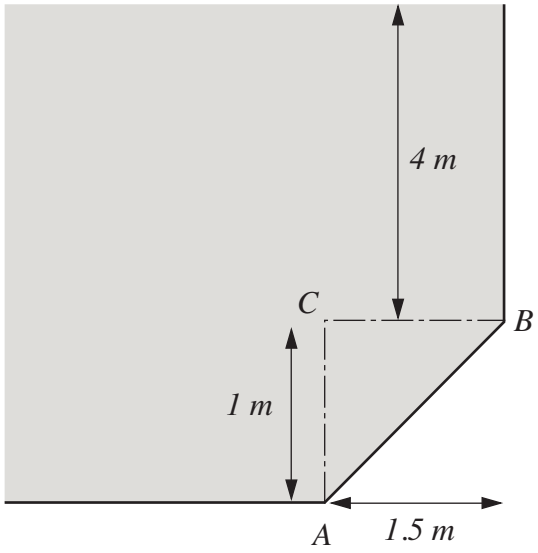
6. A storage tank has the cross-sectional shape shown below and is of 1 m breadth. Calculate the resultant force acting on the inclined surface AB and its point of action.

The density of the liquid is 900 kg m^{-3} and take $g = 9.81$ m s^{-2}.



7. (a) Describe the operation of a device which uses hydraulic pressure.

(b) Define:

(i) force ratio
(ii) movement ratio.

(c) It is required to lift a skip whose load total is 14 kN. Two simple lifting jacks are available both having an effort piston diameter of 10 mm and a load piston diameter of 70 mm and the load is to be distributed equally between the two. Calculate:

(i) the force ratio and movement ratio of each jack
(ii) the pressure within the hydraulic fluid.

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