CEE 3311-MECHANICS OF FLUIDS

Tutorial sheets 1-3

Abstract

Fluid mechanics is the study of the effects of forces acting on fluids (liquids and gases). There are a number of engineering disciplines where the concepts of fluid mechanics are pertinent and these include; agricultural engineering, mechanical engineering, water resources engineering, geotechnical engineering, mining engineering, and chemical engineering to mention but a few. This documents contains tutorial sheets 1 to 3 in the series of many tutorial sheets that will be administered in the CEE3311 course.

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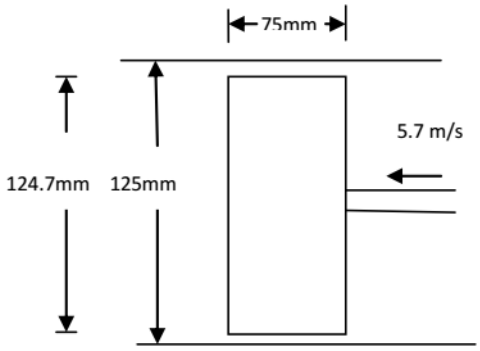
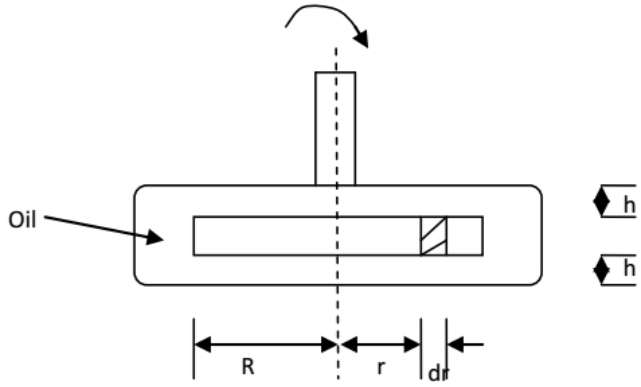
TUTORIAL SHEET 1 – FLUID PROPERTIES

1. A certain reservoir in Chawama compound of Lusaka has a mass of 1100kg and a volume of 0.9 m^3. Calculate its weight, mass-density, specific weight and specific gravity.
2. If the bulk modulus of elasticity of water is 2.2 Gpa (GN/m^2), what pressure is required to reduce a volume by 0.8%?
3. At a depth of 7.5km in the ocean, the pressure is 75Mpa. Assume a specific weight at the surface of10 KN/m^2 and an average bulk modulus of elasticity of 2.5 Gpa for that pressure range. Find
   (a) The change in specific volume between the surface and 7.5km
   (b) The specific volume at 7.5km and
   (c) The specific weight at 7.5km.
4. A piston is moving through a cylinder at a speed of 5.7 m/s as shown in the figure below. The film of oil separating the piston from the cylinder has a viscosity of 0.95 NS/m^2. What is the force required to maintain this motion?

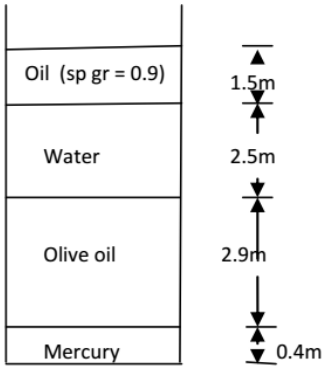


5. A disk of radius **R** rotates at an angular velocity **ω** inside an oil bath of viscosity **μ** as shown in figure below. Assuming a linear velocity profile and neglecting shear on the outer disk edges, Derive an expression for the viscous torque (overturning moment) on the disk.

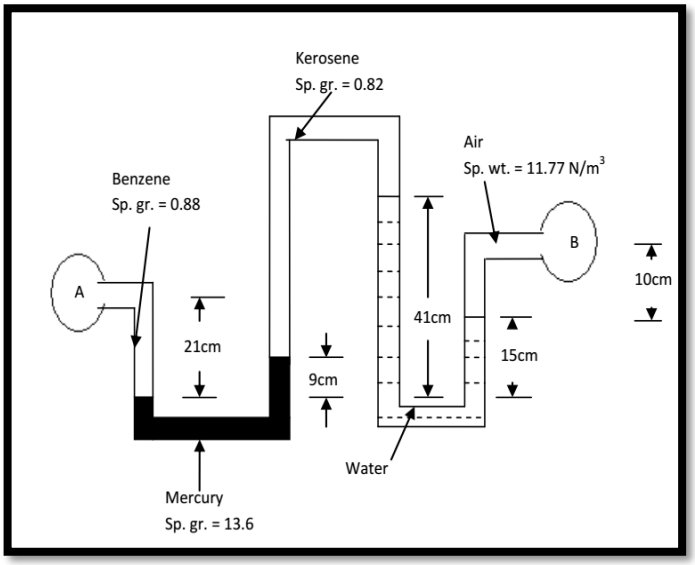


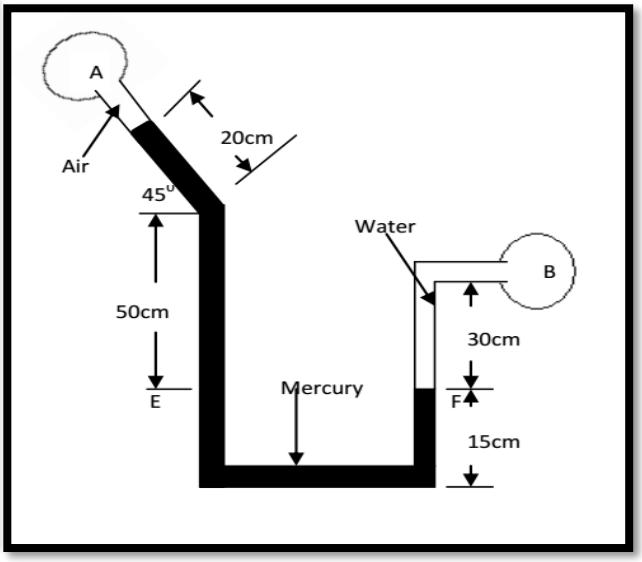
TUTORIAL SHEET 2 – FLUID PRESSURE

1. A cylinder contains a fluid at a gauge pressure of 360 KN/m^2 Express this pressure in term of a head of (a) water, and (b) mercury of sp gr = 13.6
   What would be the absolute pressure in the cylinder if atmospheric pressure is 760mm Hg.
2. In the fig., the absolute pressure at the bottom of the tank is 233.5 Kpa. Compute the sp gr of olive oil. Take atmospheric pressure = 101.3 Kpa.



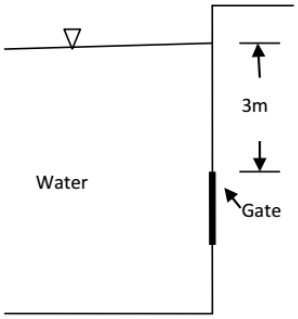
3. Determine the pressure difference between two points A and B in the figures below.



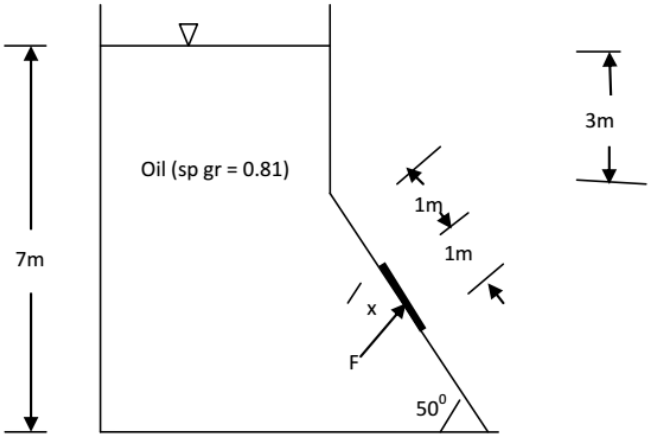


TUTORIAL SHEET 3 –HYDROSTATIC FORCE AND BOUYANCY

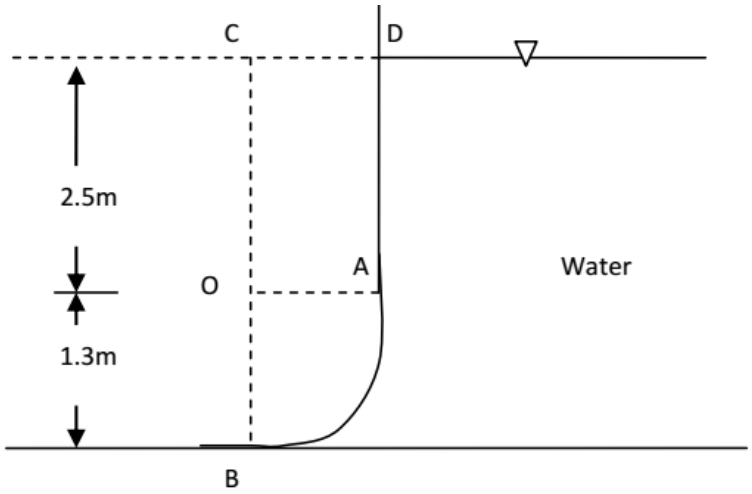
1. A vertical rectangular gate, 1.4m high and 2 m wide, contains water on one side. Determine the total resultant force acting on the gate and the location of c.p.



2. Gate AB in the fig. is 1m long and 0.7m wide. Calculate force F on the gate and position X of c.p.



3. The water is on the right side of the curved surface AB, which is one quarter of a circle of radius
   1.3m. The tank's length is 2.1m. Find the horizontal and vertical component of the hydrostatic acting on the curved surface.



4. A steel pipeline carrying gas has an internal diameter of 120cm and an external diameter of 125cm. It is laid across the bed of a river, completely immersed in water and is anchored at intervals of 3m along its length. Calculate the buoyancy force per meter run and upward force on each anchorage. Take density of steel = 7900 kg/m^3 .
5. A piece of wood of sp gr 0.65 is 80mm square and 1.5m long. How many Newtons of lead weighing 120KN/m^3 must be fastened at one end of the stick so that it will float upright with 0.3m out of water?
6. Circular gate ABC in the fig. is 4m in diameter and is hinged at B. Compute the force P just sufficient to keep the gate from opening when h is 8m.