HW from textbook

1. **Prob. 3.1 page 85**: A circular lamina 125cm in diameter is immersed in water so that the distance of its edge measured vertically below the free surface varies from 60cm to 150cm. Find the total force due to the water acting on one side of the lamina and the vertical distance of the centre of pressure below the surface. [12639 N, 1.1m]

2. **Prob. 3.6 page 85**: A rectangular sluice door (as shown in the figure below) is hinged at the top at A and kept closed by a weight fixed to the door. The door is 120cm wide and 90cm long and the centre of gravity of the complete door and weight is at G, the combined weight being 9810N. Find the height of the water h on the inside of the door which will just cause the door to open. [0.88m]
3. **Prob. 3.7 page 86**: A rectangular gate (as shown in the figure) of negligible thickness, hinged at its top edge and of width b, separates two tanks in which there is the same liquid of density $\rho$. It is required that the gate shall open when the level in the left-hand tank falls below a distance $H$ from the hinge. The level in the right-hand tank remains constant at a height $y$ above the hinge. Derive an expression for the weight of the gate in terms of $H$, $Y$, $y$, $b$ and $g$. Assume that the weight of the gate acts at its center of area.
4. **Prob. 3.11 page 86**: A sluice gate (as shown in the figure below) consists of a quadrant of a circle of radius 1.5m pivoted at its centre O. Its centre of gravity is at G as shown. When the water is level with the pivot O, calculate the magnitude and direction of the resultant force on the gate due to the water and the turning moment required to open the gate. The width of the gate is 3m and it has a mass of 6000kg. [61.6 kN, 57°31 ′, 35.3 kN.m]
5. **Prob. 3.13 page 87:** A The face of a dam (as shown in the figure below) is curved according to the relation \( y = \frac{x^2}{2.4} \), where \( y \) and \( x \) are in meters. The height of the free surface above the horizontal plane through A is 15.25 m. Calculate the resultant force \( F \) due to the fresh water acting on unit breadth of the dam, and determine the position of the point B at which the line of action of this force cuts the horizontal plane through A. [1290 kN/m, 14.15 m]

6. **Prob. 3.14 page 87:** A steel pipeline conveying gas has an internal diameter of 120 cm and an external diameter of 125 cm. It is laid across the bed of a river, completely immersed in water and is anchored at intervals of 3 m along its length. Calculate the buoyancy force in newtons per metre and the upward force in newtons on each anchorage. Density of steel = 7900 kg/m\(^3\), density of water = 1000 kg/m\(^3\). [12037 N/m, 13742 N]
Prob. 3.15 page 87: The ball-operated valve shown in the figure below controls the flow from a tank through a pipe to a lower tank, in which it is situated. The water level in the upper tank is 7 m above the 10 mm diameter valve opening. Calculate the volume of the ball which must be submerged to keep the valve closed. [110 cm³]
**Prob. 3.17 page 87:** A buoy floating in sea water of density 1025 kg/m³ is conical in shape with a diameter across the top of 1.2 m and a vertex angle of 60°. Its mass is 300 kg and its centre of gravity is 750 mm from the vertex. A flashing beacon is to be fitted to the top of the buoy. If this unit has a mass of 55 kg what is the maximum height of its centre of gravity above the top of the buoy if the whole assembly is not to be unstable? (The centre of volume of a cone of height h is at a distance $3h/4$ from the vertex.) [1.25 m].

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**HW from other resources:**

8. The face of a dam is vertical to a depth of 5 m below the water surface and then slopes at 30° to the vertical. If the depth of the water is 14 m, specify the resultant force per meter run acting on the dam face and the location of its line of action. [ ].
9. A structure is attached to the ocean floor as shown in the figure. A 2-m-diameter hatch is located in an inclined wall and hinged on one edge. Determine the minimum air pressure, $p_1$, within the container that will open the hatch. Neglect the weight of the hatch and friction in the hinge. [107kPa].
A 1-m-diameter cylindrical mass, $M$, is connected to a 2-m-wide rectangular gate as in the figure. The gate is to open when the water level, $h$, drops below 2.5 m. Determine the required value for $M$. Neglect friction at the gate hinge and the pulley. [2480 kg].
10. The massless, 4-ft-wide gate shown in the figure below pivots about the frictionless hinge O. It is held in place by the 2000 lb counterweight, W. Determine the water depth, \( h \). [5.24 ft].

11. The uniform 5-m-long round wooden rod in the figure below is tied to the bottom by a string. Determine (a) the tension in the string and (b) the specific gravity of the wood. Is it possible for the given information to determine the inclination angle? Explain. [ ].
12. The 4-ft-diameter log (SG = 0.80) in the figure below is 8 ft long into the paper and dams water as shown. Compute the net vertical and horizontal reactions at point C. [1].