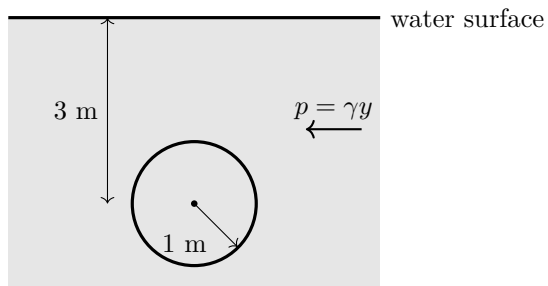
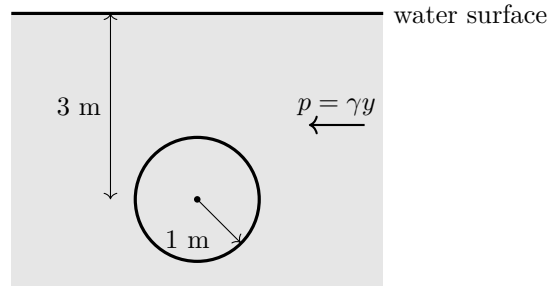


Question 3

A vertical circular porthole of radius 1 m has center 3 m below the water surface. Use water weight density 9800 N/m^3 . Find the force without integrating strips.



Question 3 – Solution



Step 1: Use the centroid form of the hydrostatic-force formula. For a submerged vertical plane region,

$$F = \gamma A \bar{y},$$

where A is its area and $\bar{y}$ is the depth of its centroid.

Step 2: Find the area of the porthole. The radius is 1 m, so

$$A = \pi r^2 = \pi(1)^2 = \pi \text{ m}^2.$$

Step 3: Identify the centroid depth. The centroid of a circle is its center, which is 3 m below the surface. Therefore,

$$\bar{y} = 3 \text{ m}.$$

Step 4: Substitute.

$$\begin{aligned} F &= (9800)(\pi)(3) \\ &= 29,400\pi \text{ N}. \end{aligned}$$

$$\boxed{F = 29,400\pi \text{ N}}$$

No strip integration is needed because the area and centroid depth are known.