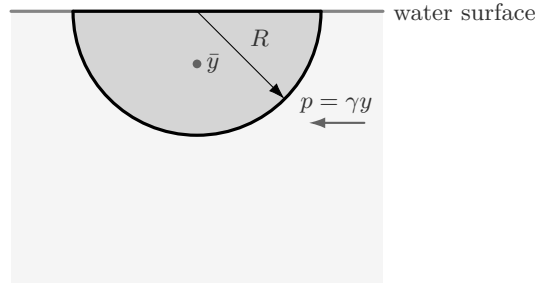
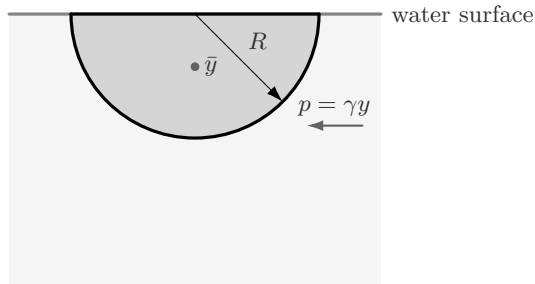


Question 8

A semicircular gate of radius R has its diameter along the water surface and lies below it. Find the force using centroid depth $4R/(3\pi)$.



Question 8 – Solution



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

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

Step 2: Find the area of the semicircle.

$$A = \frac{1}{2}\pi R^2.$$

Step 3: Use the given centroid depth. Because the diameter lies on the water surface and the semicircle lies below it,

$$\bar{y} = \frac{4R}{3\pi}.$$

Step 4: Substitute and simplify.

$$\begin{aligned} F &= \gamma \left(\frac{1}{2}\pi R^2 \right) \left(\frac{4R}{3\pi} \right) \\ &= \gamma \left(\frac{4R^3}{6} \right) = \frac{2}{3}\gamma R^3. \end{aligned}$$

$$\boxed{F = \frac{2}{3}\gamma R^3}$$

The factors of π cancel because the semicircle's area contains π while its centroid depth contains $1/\pi$.