8.3 Videos Guide

8.3a

- Units for pressure and force
  - US system:
    - Pounds (lb) for force
    - Feet (ft) for distance
    - Weight density of water: $\rho g = 62.5$ lb/ft^3
  - SI (metric) system:
    - Newtons (N) for force (note that Newtons are kg· g where g is 9.8m/s^2)
    - Meters (m) for distance
    - Mass density of water: $\rho = 1000$ kg/m^3
    - Weight density of water: $\rho g = 9800$ N/m^3

- Expressions for pressure and force
    - Pressure: $\rho g d$
    - Force: $\rho g d A$

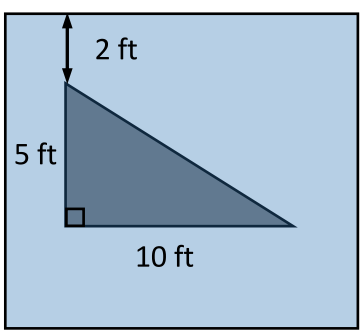
Exercises:

8.3b

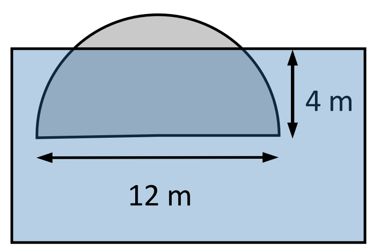
- A tank is 8 m long, 4 m wide, 2 m high, and contains kerosene with density 820 kg/m^3 to a depth of 1.5 m. Find (a) the hydrostatic pressure on the bottom of the tank, (b) the hydrostatic force on the bottom, and (c) the hydrostatic force on one end of the tank.

- A vertical plate is submerged (or partially submerged) in water and has the indicated shape. Find the hydrostatic force on one side of the plate.

8.3c



8.3d



8.3e

- Moments for discrete points
  - About the y-axis: $M_y = \sum_{i=1}^{n} m_i x_i$
  - About the x-axis: $M_x = \sum_{i=1}^{n} m_i y_i$

- Center of mass of a system: $(\bar{x}, \bar{y}) = \left(\frac{M_y}{m}, \frac{M_x}{m}\right)$, where m is the total mass of the system

Exercise:

- The masses m_i are located at the points P_i. Find the moments M_x and M_y and the center of mass of the system.
  $m_1 = 5, m_2 = 4, m_3 = 3, m_4 = 6;$
  $P_1(-4, 2), 3_1(0, 5), P_3(3, 2), P_4(1, -2)$

8.3f

- Mass, moments and center of mass of a planar lamina
  - $m = \rho \int_a^b f(x)\, dx$
  - $M_y = \rho \int_a^b x f(x)\, dx$
  - $M_x = \rho \int_a^b \frac{1}{2} [f(x)]^2\, dx$
  - $(\bar{x}, \bar{y}) = \left(\frac{M_y}{m}, \frac{M_x}{m}\right)$

Exercise:

- Sketch the region bounded by the curves, and visually estimate the location of the centroid. Then find the exact coordinates of the centroid.
  $y = \sqrt{x}, \qquad y = 0, \qquad x = 4$

- Center of mass expressions for a region between two curves f and g $(f \geq g)$
  - $\bar{x} = \frac{1}{A} \int_a^b x[f(x) - g(x)]\, dx$
  - $\bar{y} = \frac{1}{A} \int_a^b \frac{1}{2} \{[f(x)]^2 - [g(x)]^2\}\, dx$