

2.72

**2.72** A rectangular gate that is 2 m wide is located in the vertical wall of a tank containing water as shown in Fig. P2.72. It is desired to have the gate open automatically when the depth of water above the top of the gate reaches 10 m. (a) At what distance,  $d$ , should the frictionless horizontal shaft be located? (b) What is the magnitude of the force on the gate when it opens?

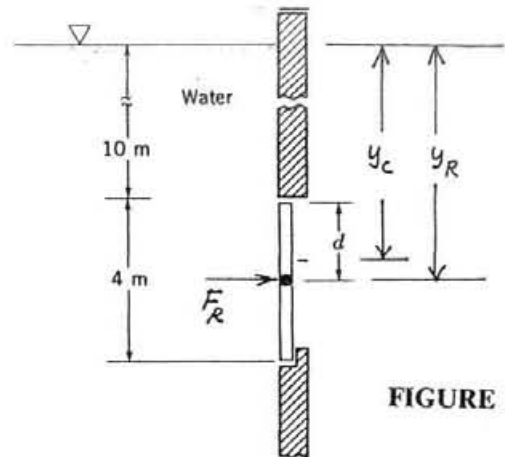


FIGURE P2.72

(a) As depth increases the center of pressure moves toward the centroid of the gate. If we locate hinge at  $y_R$  when depth =  $10\text{ m} + d$ , the gate will open automatically for any further increase in depth.

Since,

$$y_R = \frac{I_{xc}}{y_c A} + y_c = \frac{\frac{1}{12} (2\text{ m})(4\text{ m})^3}{(12\text{ m})(2\text{ m} \times 4\text{ m})} + 12\text{ m} = 12.11\text{ m}$$

then

$$d = y_R - 10\text{ m} = 12.11\text{ m} - 10\text{ m} = \underline{\underline{2.11\text{ m}}}$$

(b) For the depth shown,

$$F_R = \gamma h_c A = (9.80 \frac{\text{kN}}{\text{m}^3})(12\text{ m})(2\text{ m} \times 4\text{ m}) = \underline{\underline{941\text{ kN}}}$$