

2.31

2.31 A piston having a cross-sectional area of  $0.07 \text{ m}^2$  is located in a cylinder containing water as shown in Fig. P2.31. An open U-tube manometer is connected to the cylinder as shown. For  $h_1 = 60 \text{ mm}$  and  $h = 100 \text{ mm}$ , what is the value of the applied force,  $P$ , acting on the piston? The weight of the piston is negligible.

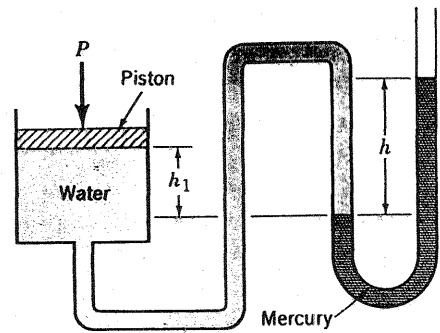


FIGURE P2.31

For equilibrium,  $P = p_p A_p$  where  $p_p$  is the pressure acting on piston and  $A_p$  is the area of the piston. Also,

$$p_p + \gamma_{H_2O} h_1 - \gamma_{Hg} h = 0$$

or

$$p_p = \gamma_{Hg} h - \gamma_{H_2O} h_1$$

$$= (133 \frac{\text{kN}}{\text{m}^3})(0.100 \text{ m}) - (9.80 \frac{\text{kN}}{\text{m}^3})(0.060 \text{ m})$$

$$= 12.7 \frac{\text{kN}}{\text{m}^2}$$

Thus,

$$P = (12.7 \times 10^3 \frac{\text{N}}{\text{m}^2})(0.07 \text{ m}^2) = \underline{\underline{889 \text{ N}}}$$