2.12

2.12 The basic elements of a hydraulic press are shown in Fig. P2.12. The plunger has an area of 1 in.^{2}, and a force, F_1, can be applied to the plunger through a lever mechanism having a mechanical advantage of 8 to 1. If the large piston has an area of 150 in.^{2}, what load, F_2, can be raised by a force of 30 lb applied to the lever? Neglect the hydrostatic pressure variation.

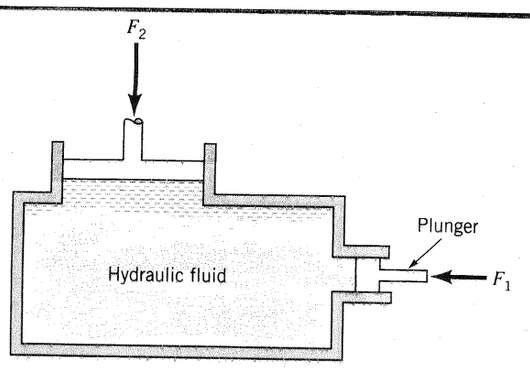


FIGURE P2.12

A force of 30 lb applied to the lever results in a plunger force, F_1, of $F_1 = (8)(30) = 240$ lb. Since $F_1 = pA_1$ and $F_2 = pA_2$ where p is the pressure and A_1 and A_2 are the areas of the plunger and piston, respectively. Since p is constant throughout the chamber,

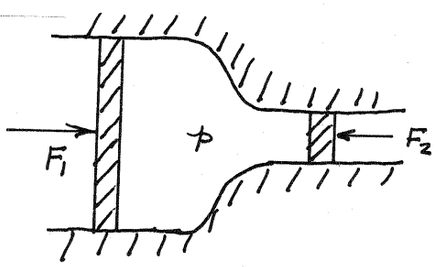
$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

so that

$$F_2 = \frac{A_2}{A_1} F_1 = \left(\frac{150 \text{ in.}^2}{1 \text{ in.}^2}\right)(240 \text{ lb}) = \underline{\underline{36{,}000 \text{ lb}}}$$

2.13

2.13 A 0.3-m-diameter pipe is connected to a 0.02-m-diameter pipe and both are rigidly held in place. Both pipes are horizontal with pistons at each end. If the space between the pistons is filled with water, what force will have to be applied to the larger piston to balance a force of 80 N applied to the smaller piston? Neglect friction.



$F_1 = pA_1$

$F_2 = pA_2$

Thus,

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

or

$$F_1 = \frac{A_1}{A_2} F_2 = \frac{(0.3\text{m})^2}{(0.02\text{m})^2}(80\text{N}) = \underline{\underline{18{,}000 \text{ N}}}$$