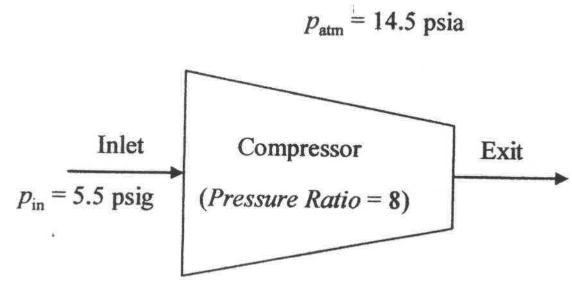
PROBLEM 1.40



From the compressor pressure ratio, the exit pressure in psia can be determined from

$$\text{pressure ratio} = p_{exit}/p_{in} \quad \rightarrow \quad p_{exit} = p_{in}(\text{pressure ratio})$$

in psia

Inlet pressure must be expressed as absolute pressure to solve for exit pressure. Conversion from the inlet pressure gage reading to absolute pressure is determined from

$$p_{in}(\text{gage}) = p_{in}(\text{absolute}) - p_{atm}(\text{absolute})$$

Rearranging the equation to solve for p_{in}(absolute) and substituting values yield

$$p_{in}(\text{absolute}) = p_{in}(\text{gage}) + p_{atm}(\text{absolute}) = 5.5 \text{ psig} + 14.5 \text{ psia} = 20 \text{ psia}$$

Substituting absolute pressure at the inlet into the equation for exit pressure yields

$$p_{exit} = (20 \text{ psia})(8) = \underline{160 \text{ psia}}$$

PROBLEM 1.41

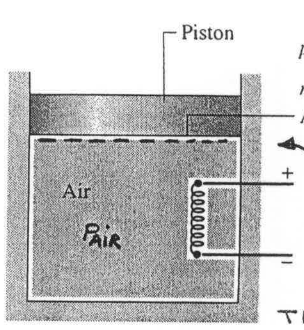


Fig. P1.41

$p_{atm} = 14.7$ lbf/in^2

$m_{piston} = 100$ lb

$A_{piston} = 1$ ft^2

$g = 32.0$ ft/s^2

We assume the air expands slowly. Thus, at the interface between the lower piston surface and the air static equilibrium exists. Moreover, as the piston moves smoothly in the cylinder friction between the piston and cylinder can be ignored.

Force balance:

F_{atm} ↓ Piston weight ↓

↑ F_{AIR}

$$\Rightarrow P_{AIR} A_{pist} = P_{atm} A_{pist} + m_{pist}\, g$$

$$\therefore P_{AIR} = P_{atm} + \frac{m_{pist}\, g}{A_{pist}}$$

Thus,

$$P_{AIR} = 14.7 \frac{\text{lbf}}{\text{in}^2} + \left(\frac{(100\text{ lb})(32.0\text{ ft/s})}{1\text{ ft}^2}\right)\left|\frac{1\text{ ft}^2}{144\text{ in}^2}\right|\left|\frac{1\text{ lbf}}{32.2\text{ lb}\cdot\text{ft/s}^2}\right| = 15.39 \frac{\text{lbf}}{\text{in}^2} \text{ (absolute)} \leftarrow$$

rounded

With Eq. 1.14 we get,

$$P_{AIR} = 0.69 \frac{\text{lbf}}{\text{in}^2} \text{ (gage)}. \leftarrow$$