

PROBLEM 3.31

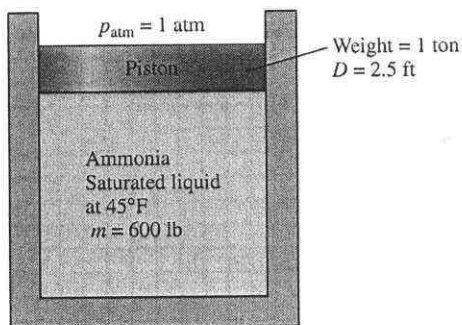
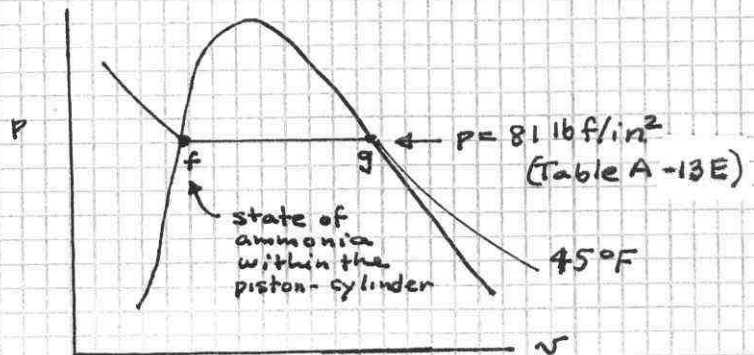
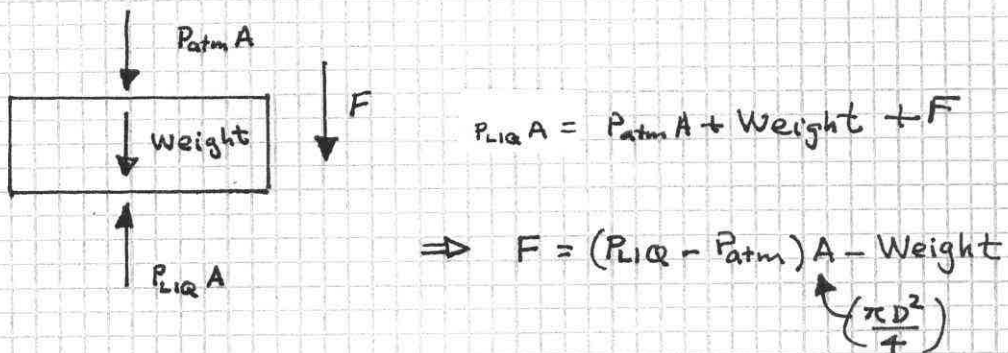


Fig. P3.31



In the absence of friction, the forces acting on the piston include the force of the pressure acting on the bottom of the piston, the piston weight, the force of the atmosphere acting on the top of piston, and the force F , if any, required to hold the piston in place. Assuming the force F acts vertically downward, the piston force balance reads



Calculating,

$$F = (81 - 14.7) \frac{\text{lbf}}{\text{in}^2} \left[\frac{\pi (2.5 \text{ ft})^2}{4} \right] \left| \frac{144 \text{ in}^2}{1 \text{ ft}^2} \right| - 1 \text{ ton} \left| \frac{2000 \text{ lbf}}{1 \text{ ton}} \right|$$

$$= 44,865 \text{ lbf} \leftarrow$$

Yes, mechanical attachments, such as stops, are required. \leftarrow

The volume occupied by the ammonia liquid is

$$V = m v_f = (600 \text{ lb}) \left(0.02548 \frac{\text{ft}^3}{\text{lb}} \right) = 15.29 \text{ ft}^3 \leftarrow$$

Table A-13E