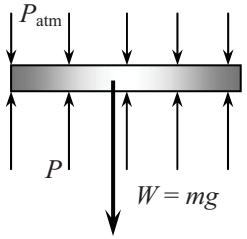
4-50 A vertical piston-cylinder device is filled with water and covered with a 20-kg piston that serves as the lid. The boiling temperature of water is to be determined.

Analysis The pressure in the cylinder is determined from a force balance on the piston,

$$PA = P_{atm}A + W$$

or,

$$\begin{aligned} P &= P_{atm} + \frac{mg}{A} \\ &= (100\ \text{kPa}) + \frac{(20\ \text{kg})(9.81\ \text{m/s}^2)}{0.01\ \text{m}^2}\left(\frac{1\ \text{kPa}}{1000\ \text{kg/m}\cdot\text{s}^2}\right) \\ &= 119.61\ \text{kPa} \end{aligned}$$



The boiling temperature is the saturation temperature corresponding to this pressure,

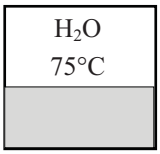
$$T = T_{sat@119.61\ kPa} = \mathbf{104.7°C} \qquad \text{(Table A-5)}$$

4-51 A rigid tank that is filled with saturated liquid-vapor mixture is heated. The temperature at which the liquid in the tank is completely vaporized is to be determined, and the T-v diagram is to be drawn.

Analysis This is a constant volume process ($v = V/m$ = constant),

and the specific volume is determined to be

$$v = \frac{V}{m} = \frac{2.5\ \text{m}^3}{15\ \text{kg}} = 0.1667\ \text{m}^3/\text{kg}$$



When the liquid is completely vaporized the tank will contain saturated vapor only. Thus,

$$v_2 = v_g = 0.1667\ \text{m}^3/\text{kg}$$

The temperature at this point is the temperature that corresponds to this v_g value,

$$T = T_{sat@v_g = 0.1667\ m^3/kg} = \mathbf{187.0°C} \quad \text{(Table A-4)}$$