

4.118 Two kilograms of water is contained in a piston/cylinder (Fig. P4.118) with a massless piston loaded with a linear spring and the outside atmosphere. Initially the spring force is zero and $P_1 = P_0 = 100$ kPa with a volume of 0.2 m³. If the piston just hits the upper stops, the volume is 0.8 m³ and $T = 600^\circ\text{C}$. Heat is now added until the pressure reaches 1.2 MPa. Find the final temperature, show the P - V diagram, and find the work done during the process.

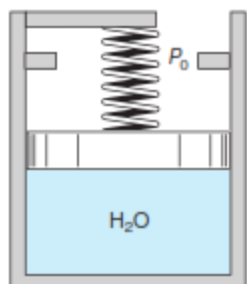


FIGURE P4.118

5.75 A rigid tank A of volume 0.6 m³ contains 3 kg of water at 120°C , and rigid tank B is 0.4 m³ with water at 600 kPa, 200°C . They are connected to a piston/cylinder initially empty with closed valves as shown in Fig. P5.75. The pressure in the cylinder should be 800 kPa to float the piston. Now the valves are slowly opened and heat is transferred so

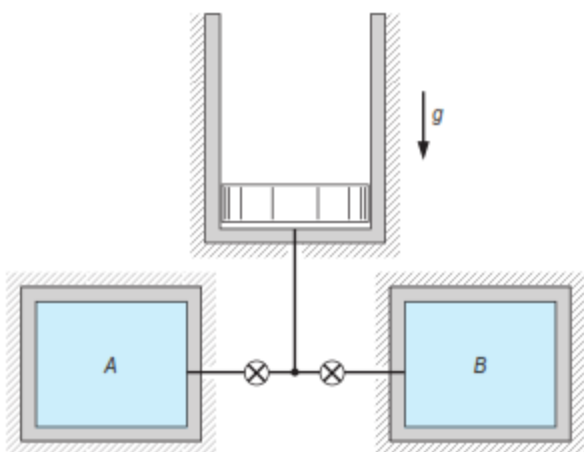


FIGURE P5.75

4.126 The gas space above the water in a closed storage tank contains nitrogen at 25°C and 100 kPa. Total tank volume is 4 m³, and there is 500 kg of water at 25°C . An additional 500 kg of water is now forced into the tank. Assuming constant temperature throughout, find the final pressure of the nitrogen and the work done on the nitrogen in this process.

5.64 A 10 -m-high open cylinder, with $A_{\text{cyl}} = 0.1$ m², contains 20°C water above and 2 kg of 20°C water below a 198.5 -kg thin insulated floating piston, as shown in Fig. P5.64. Assume standard g , P_0 . Now heat is added to the water below the piston so that it expands, pushing the piston up, causing the water on top to spill over the edge. This process continues until the piston reaches the top of the cylinder. Find the final state of the water below the piston (T , P , v) and the heat added during the process.

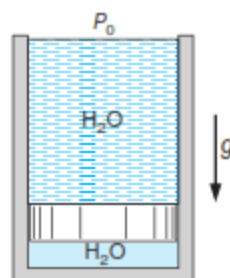


FIGURE P5.64

5.109 A 10 -m-high cylinder, with a cross-sectional area of 0.1 m², has a massless piston at the bottom with water at 20°C on top of it, as shown in Fig. P5.109. Air at 300 K, with a volume of 0.3 m³, under the piston is heated so that the piston moves up, spilling the water out over the side. Find the total heat transfer to the air when all the water has been pushed out.

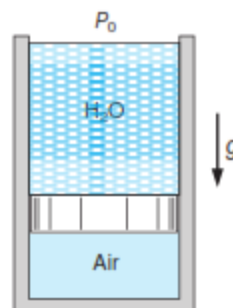


FIGURE P5.109

5.167 Consider the piston/cylinder arrangement shown in Fig. P5.167. A frictionless piston is free to move between two sets of stops. When the piston rests on the lower stops, the enclosed volume is 400 L. When the piston reaches the upper stops, the volume is 600 L. The cylinder initially contains water at 100 kPa, with 20% quality. It is heated until the water eventually exists as saturated vapor. The mass of the piston requires 300 kPa pressure to move it against the outside ambient pressure. Determine the final pressure in the cylinder, the heat transfer, and the work for the overall process.

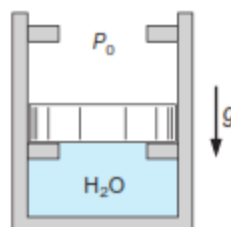


FIGURE P5.167