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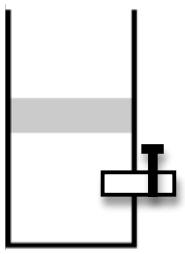
I. A container with a valve at the bottom is filled with an ideal gas. The valve is now opened and some of the gas slowly escapes. The valve is then closed, after which the piston is observed to be at a lower position. Assume that the system is in thermal equilibrium with the surroundings at all times.

A. Is the final pressure of the gas in the cylinder greater than, less then, or equal to the initial pressure? Explain



B. Explain how your answer is consistent with the forces acting on the piston in the initial and final states.

C. In this process, which of the quantities P, V, n, and T are held constant and which are allowed to change?

D. Consider the following *incorrect* student statement.

"In the ideal gas law, P = nRT/V, so the pressure is inversely proportional to the volume. If you decrease the volume, the pressure has to go up."

What is the flaw in the student's reasoning?

E. Explain why it is not possible to use the ideal gas law only to determine if the pressure changed in this process.

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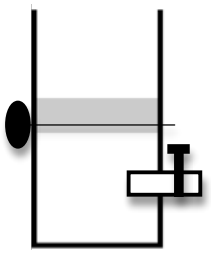
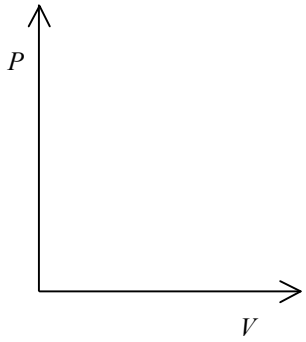
2. A long pin is used to hold the piston in place as shown in the diagram. The cylinder is then placed into boiling water (the valve is kept closed/shut the whole time).



A. Does the temperature of the gas increase, decrease, or remain the same?

B. Sketch this process in the PV diagram at right.



C. Explain why for this particular situation, it is not possible to determine the pressure of the gas as you did on page 1 of the tutorial (i.e., by considering a free-body diagram of the piston).