1. Why must we use absolute temperature in the ideal gas law \((PV = NkT)\)? Explain how using the Celsius scale would give nonsensical results.

2. A metal bar stand on a wooden deck feels colder than the wood around. Is the metal bar necessarily colder? Explain.

3. A cup of hot coffee has been poured, but the coffee drinker has a little more work to do at the computer before she picks up the cup. She intends to add some milk (at room temperature) to the coffee. To keep the coffee hot as long as possible, should she add the milk at once, or wait until just before she takes her first sip? Why?

4. A cylinder that has a 40.0-cm radius and is 50.0 cm deep is filled with air at 20.0°C and 1.00 atm (Fig. a). A 20.0-kg piston is now lowered into the cylinder, compressing the air trapped inside (Fig. b). Finally, a 75.0-kg man stands on the piston, further compressing the air, which remains at 20°C (Fig. c). (a) How far down \((\Delta h)\) does the piston move when the man steps onto it? (b) To what temperature should the gas be heated to raise the piston and man back to \(h_i\)?

5. How much work is done on the steam when 1.00 mol of water at 100°C boils and becomes 1.00 mol of steam at 100°C at 1.00 atm pressure? Assuming the steam to behave as an ideal gas, determine the change in internal energy of the material as it vaporizes.
6. A 75.0-kg cross-country skier moves across the snow. The coefficient of friction between the skis and the snow is 0.200. Assume that all the snow beneath his skis is at 0°C and that all the internal energy generated by friction is added to the snow, which sticks to his skis until it melts. How far would he have to ski to melt 1.00 kg of snow?

7. A water heater is operated by solar power. If the solar collector has an area of 6.00 m², and the intensity delivered by sunlight is 550 W/m², how long does it take to increase the temperature of 1.00 m³ of water from 20.0°C to 60.0°C?

8. A sample of an ideal gas goes through the process shown in figure. From A to B, the process is adiabatic; from B to C, it is isobaric with 100 kJ of energy entering the system by heat. From C to D, the process is isothermal; from D to A, it is isobaric with 150 kJ of energy leaving the system by heat. Determine the difference in internal energy $E_{\text{int,B}} - E_{\text{int,A}}$. 

![Diagram](image)