# Physics 215
Homework Set 1

1. A 150 g copper bowl contains 220 g of water, both at 20.0°C. A very hot 300 g copper cylinder is dropped into the water, causing the water to boil, with 5.00 g being converted to steam. The final temperature of the system is 100°C. Neglect energy transfers with the environment. (a) How much energy (in calories) is transferred to the water as heat? (b) How much to the bowl? (c) What is the original temperature of the cylinder?

2. Ethyl alcohol has a boiling point of 78°C, a freezing point of -114°C, a heat of vaporization of 879 kJ/kg, a heat of fusion of 109 kJ/kg, and a specific heat of 2.43 kJ/kgK. How much energy must be removed from 0.510 kg of ethyl alcohol that is initially a gas at 78°C so that it becomes a solid at -114°C?

3. An insulated Thermos contains 130 cm³ of hot coffee, at a temperature of 80.0°C. You put in a 12.0 g ice cube at its melting point to cool the coffee. By how many degrees has your coffee cooled once the temperature has stopped changing? Treat the coffee as though it were pure water and neglect energy transfers with the environment.

4. A sample of gas expands from 1.0 m³ to 4.0 m³ while its pressure decreases from 40 Pa to 10 Pa. How much work is done by the gas if its pressure changes with volume via each of the three paths shown in the p-V diagram?
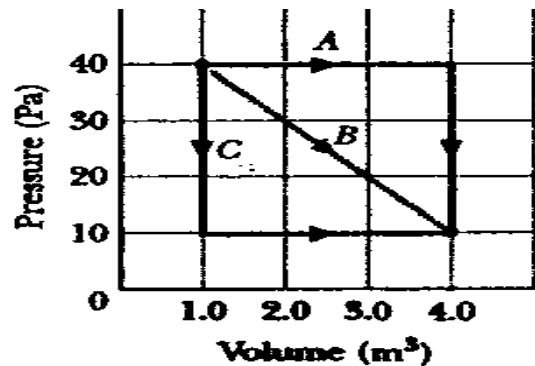
5. When a system is taken from state i to state f along path iaf in the diagram, Q= 50 cal and W=20cal. Along path ibf, Q= 36 cal.
(a) What is W along path ibf?
(b) If W = -13 cal for the return path fi, what is Q for this path?
(c) Take Ui = 10 cal. What is Uf?
(d) If Ub = 22 cal, what are the values of Q for path ib and path bf?
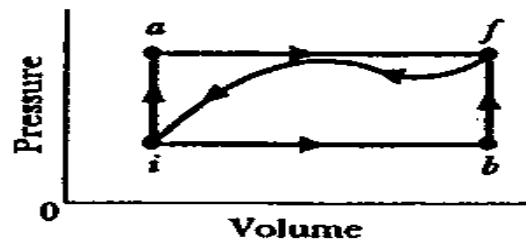
6. A sphere of radius 0.500 m, temperature 27.0°C, and emissivity 0.850 is located in an environment of temperature 77.0°C. At what rate does the sphere (a) emit and (b) absorb thermal radiation? (c) What is the sphere's net rate of energy exchange?

7. (a) What is the rate of energy loss in watts per square meter through a glass window 3.0 mm thick if the outside temperature is -20°F and the inside temperature is +72°F? (b) A storm window having the same thickness of glass is installed parallel to the first window, with an air gap of 7.5 cm between the two windows. What now is the rate of energy loss if conduction is the only important energy-loss mechanism?