Chapter-19

1. You are working in your kitchen preparing lunch for your family. You have decided to make egg salad sandwiches and are boiling six eggs, each of mass 55.5 g, in 0.750 L of water at 100oC. You wish to take all the eggs out of the boiling water and immediately place them in 23.0oC water to cool them down to a comfortable temperature to hold them and peel them. You decide that you wish the mixture of the water and the eggs to reach an equilibrium temperature of 40.0oC. Explaining this to a family member, she challenges you to determine exactly how much water at 23.0oC you need to achieve your desired equilibrium temperature. Take the average specific heat of an egg over the expected temperature range to be 3.27X 103 J/kg **.** oC

Ans:

1. (a) How much work is done on the steam when 1.00 mol of water at 100oC boils and becomes 1.00 mol of steam at 100oC at 1.00 atm pressure? Assume the steam to behave as an ideal gas. (b) Determine the change in internal energy of the system of the water and steam as the water vaporizes.

Ans:

1. For bacteriological testing of water supplies and in medical clinics, samples must routinely be incubated for 24 h at 37oC. Peace Corps volunteer and MIT engineer Amy Smith invented a low-cost, low-maintenance incubator. The incubator consists of a foam-insulated box containing a waxy material that melts at 37.0oC interspersed among tubes, dishes, or bottles containing the test samples and growth medium (bacteria food). Outside the box, the waxy material is first melted by a stove or solar energy collector. Then the waxy material is put into the box to keep the test samples warm as the material solidifies. The heat of fusion of the phase-change material is 205 kJ/kg. Model the insulation as a panel with surface area 0.490 m2, thickness 4.50 cm, and conductivity 0.012 0 W/m **.** oC. Assume the exterior temperature is 23.0oC for 12.0 h and 16.0oC for 12.0 h. (a) What mass of the waxy material is required to conduct the bacteriological test? (b) Explain why your calculation can be done without knowing the mass of the test samples or of the insulation.

Ans: