Phys102 (Sec # 40) Quiz # 3 (Ch.18)

Name: Key ID #

1- If 500 grams of water at 75° C ~~are~~ added to 50 grams of ice at -2° C. What is the final temperature of the mixture?

to melt all ice:

$Q = m_i c_i (0-(-2)) + m_i L_f$

$= 0.05 (2.1\times10^3)(2) + 0.05 (333\times10^3)$

$= 210 + 16650 = 16860$ J

to cool the water to 0°C

$Q_{lost} = m_w c_w (75) = 0.5 (4186)(75)$

$= 156,975$ J

This means that all ice will melt then we will have water at T_f between 0 and 75°C

$Q_{lost} + Q_{gained} = 0$

$m_w c_w (T_f - 75) + m_i L_f + m_i c_w (T_f - 0) = 0$

$0.5 (4186)(T_f - 75) + 0.05 (333\times10^3) + 0.05 (4186) T_f = 0$

$2093 T_f - 156975 + 1.665\times10^3 + 209.3 T_f = 0$

$\Rightarrow 2302.3 T_f = 155310$

$T_f = 67.5^\circ C$

2- A cylindrical copper rod of length 2 m and cross section 5 cm^2 is insulated to prevent heat loss through its surface. The ends are maintained at a temperature difference of 100 by having one end in a water-ice mixture and the other in boiling water and steam. How much ice is melted per hour at the cold end? (thermal conductivity of copper = 400 W/(m.K); heat of fusion of ice, = $333*10^3$ J/kg)

$P_{end} = \frac{Q}{t} = K \frac{A (T_H - T_c)}{L}$

$K = 400 \frac{W}{mK}$

$A = 5\times10^{-4} m^2$

$L = 2$ m

$T_H - T_c = 100^\circ C$

$t = 3600$ s

$Q = \frac{t K A (T_H - T_c)}{L} = 36\,000$ J

This heat will melt ice:

$Q = L_f m \Rightarrow m = \frac{Q}{L_f} = \frac{36\,000 \text{ J}}{333\,000 \text{ J/kg}}$

$m \simeq 0.11$ kg