Solutions

1. How much water at 50°C is needed to just melt 2.2 kg of ice at 0°C?

$Heat\ loss = heat\ gain$
$Heat\ loss\ of\ water = heat\ to\ melt\ ice$
$m_{water} c_{water} \Delta T = m_{ice} L_f$
$m_{water} * 4200 * (50 - 0) = 2.2 * 3.34 * 10^5$
$m_{water} = 3.50\ kg$

2. How much water at 32°C is needed to just melt 1.5 kg of ice at -10°C?

$Heat\ loss = heat\ gain$
$Heat\ loss\ of\ water = heat\ gain\ of\ ice + heat\ to\ melt\ ice$
$m_{water} c_{water} \Delta T = m_{ice} c_{ice} \Delta T + m_{ice} L_f$
$m_{water} * 4200 * (32 - 0) = 1.5 * 2300 * (0 - (-10)) + 1.5 * 3.34 * 10^5$
$m_{water} = 3.98\ kg$

3. How much steam at 100° is needed to just melt 5 kg of ice at -15°C?

$Heat\ loss = heat\ gain$
$Heat\ to\ condense\ steam + Heat\ loss\ of\ water = heat\ gain\ of\ ice + heat\ to\ melt\ ice$
$m_{steam} L_v + m_{steam} c_{water} \Delta T = m_{ice} c_{ice} \Delta T + m_{ice} L_f$
$m_{steam} * 22.5 * 10^5 + m_{steam} * 4200 * (100 - 0) = 5 * 2300 * (0 - (-15)) + 5 * 3.34 * 10^5$
$2.67 * 10^6 * m_{steam} = 1.84 * 10^6$
$m_{steam} = 0.69\ kg$

4. A copper cup holds some cold water at 4°C. The copper cup weighs 140g while the water weighs 80g. If 100g of hot water, at 90°C is added, what will be the final temperature of the water?

$Heat\ loss = heat\ gain$
$heat\ gain\ of\ cup + heat\ gain\ of\ cold\ water = heat\ loss\ of\ hot\ water$
$m_{cup} c_{cup} \Delta T + m_{cw} c_w \Delta T = m_{hw} c_w \Delta T$
$0.14 * 390 * (T_F - 4) + 0.08 * 4200 * (T_F - 4) = 0.1 * 4200 * (90 - T_F)$
$390.6 T_F - 1562.4 = 37800 - 420 T_F$
$810.6 T_F = 39362.4$
$T_F = 48.6°C$

5. a)Explain what is occuring at each section of the curve from "a" to "e"

a - ice particles are increasing in kinetic energy, raising temperature

b- ice particles are breaking apart and increasing in potential energy as ice melts

c- water particles are increasing in kinetic energy, raising temperature

d- water particles are breaking apart and increasing in potential energy as water vaporises

e- steam particles are increasing in kinetic energy, raising temperature

b) Using section "b" , calculate the amount of ice used to produce the graph

$\Delta Q = mL_f$

$480 - 140 = m * 3.34 * 10^5$

$m = 0.001\ kg\ (approx\ 1\ g, with\ error\ from\ reading\ graph)$

c) Using section "c", calculate the amount of ice used to produce the graph

$\Delta Q = mc\Delta T$

$920 - 480 = m * 4200 * (100 - 0)$

$m = 0.001\ kg\ (approx\ 1\ g, with\ error\ from\ reading\ graph)$