Physics 2211K Quiz # 12, 11/30/ 2010

TABLE 17.2 Specific heats and molar specific heats of solids and liquids

Substance	c (J/kg K)	C (J/mol K)
Solids		
Aluminum	900	24.3
Copper	385	24.4
Iron	449	25.1
Gold	129	25.4
Lead	128	26.5
Ice	2090	37.6
Liquids		
Ethyl alcohol	2400	110.4
Mercury	140	28.1
Water	4190	75.4

TABLE 17.3 Melting/boiling temperatures and heats of transformation

Substance	T_m (°C)	L_f (J/kg)	T_b (°C)	L_v (J/kg)
Nitrogen (N_2)	−210	0.26×10^5	−196	1.99×10^5
Ethyl alcohol	−114	1.09×10^5	78	8.79×10^5
Mercury	−39	0.11×10^5	357	2.96×10^5
Water	0	3.33×10^5	100	22.6×10^5
Lead	328	0.25×10^5	1750	8.58×10^5

<u>Version 1</u>*: How much water at 80° C is needed to melt 100 g ice at -20° C and bring the total liquid to a final temperature of 35° C?*

<u>Principle :</u>

$$0 = \Delta Q = \Delta Q_{\text{warming ice to 0}} + \Delta Q_{\text{melting ice}} + \Delta Q_{\text{warming water from 0}} + \Delta Q_{\text{cooling water from 80}}$$

$$0 = (0.1\text{kg})(2090)\left[0 - (-20)\right] + (0.1\text{kg})\left(3.33 \times 10^5\right) + (0.1\text{kg})(4190)(35 - 0) + m(4190)(35 - 80)$$

$$\boxed{m = 0.277 \text{ kg} = 277 \text{ g}}$$

<u>Version 2:</u> ***200 g copper at 90° C is dropped into a mixture of 5 g ice and 45 g water at 0° C. What is their final temperature at thermal equilibrium?***

<u>Principle :</u>

$$0 = \Delta Q = \Delta Q_{\text{melting 5g ice}} + \Delta Q_{\text{warming 50 g water from 0}} + \Delta Q_{\text{cooling copper from 90}}$$

$$0 = (5\text{ g})\left(3.33 \times 10^5\right) + (50\text{ g})(4190)\left(T_f - 0°\text{C}\right) + (200\text{ g})(385)\left(T_f - 90°\text{C}\right)$$

$$\boxed{T_f = 18.4°\text{C}}$$

<u>Version 3:</u> ***How much total ice at -15° C is needed to cool 80g ethyl alcohol from 40° C to 0° C with 5 g ice remaining in the liquid?***

<u>Principle :</u>

$$0 = \Delta Q = \Delta Q_{\text{warming ice to 0}} + \Delta Q_{\text{melting ice}} + \Delta Q_{\text{cooling ethanol from 40}}$$

$$0 = (m)(2090)\left[0 - (-15)\right] + (m - 5\text{ g})\left(3.33 \times 10^5\right) + (80\text{ g})(2400)(0 - 40)$$

$$\boxed{m = 25.6 \text{ g}}$$