Physics 201 Day 29

Exam 3 review:
specific heat, latent heat

Quiz 4: Problem 3 is just wrong. Sorry.

Extra Exam 3 review is <u>tomorrow</u>
5:15 - 6:45 or so come with questions! In a lab maybe 2121?

<u>Ex 1:</u>

300g of liquid water at 16.8°C
and 21 g of metal at 100°C.
When combined, $T_f = 18.3°C$
If $C_{water} = 4.18 \frac{J}{g°C}$, find C_{metal}.

$$c_1 m_1 \Delta T_1 + c_2 m_2 \Delta T_2 = 0$$

100°C

$$C_w M_w (T_f - T_{0_w}) + \overset{\star}{C_m} M_m (T_f - T_{0_m}) = 0$$

$$c_w m_w (T_f - T_{ow}) = \overset{*}{c}_m m_m (T_{om} - T_f)$$

$$c_w \frac{m_w}{m_m} \frac{(T_f - T_{ow})}{(T_{om} - T_f)} = \overset{*}{c}_m$$

$$4.18 \frac{J}{g°c} \left(\frac{300g}{21g} \right) \left(\frac{18.3°c - 16.8°c}{100°c - 18.3°c} \right) = c_m$$

$$1.1 \frac{J}{g°c} = c_m$$

<u>init</u>:

20gram ice at $-10°c$

100g water at $65°c$

Find final state and T_f.

$$c_w = 4.18 \frac{J}{g°c} \qquad c_{ice} = 2.03 \frac{J}{g°c} \text{ at } -10°c$$

$$L_f = 334 \frac{J}{g}$$

? Can hot water melt <u>all</u> ice?

$$c_w m_w |(0 - 65°c)| \ \substack{> \\ < \\ \approx} \ c_i m_i (10°c) + L_f m_i$$

If $>$, we do melt <u>all</u> ice. $T_f > 0$

$$4.18\,\frac{J}{g°C}\,(100g)(65°C) \overset{>}{\underset{<}{=}} 2.03\,\frac{J}{g°C}\,20g\,10°C + 20g\,334\,\frac{J}{g}$$

$$27170\,J \overset{>}{\underset{<}{=}} 406\,J + 6680\,J$$

$>$

yes, all ice melts. $T_f > 0$.

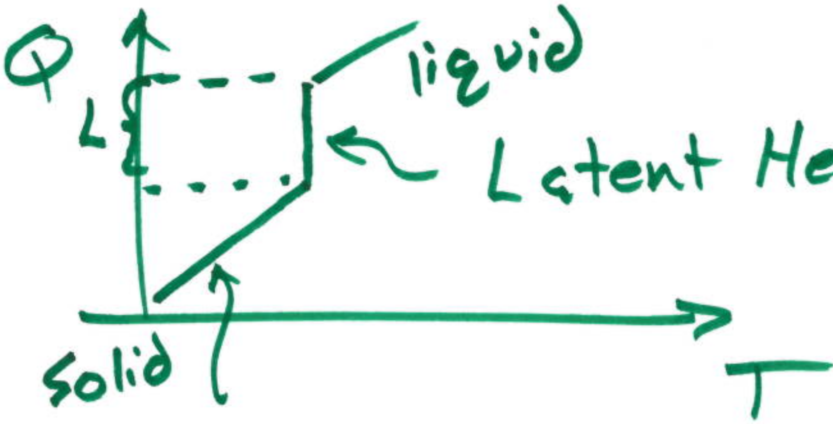
$$c_w m_w (T_f^{*} - 65°C) + c_i m_i (10°C) + L_f m_i + c_w m_i (T_f^{*} - 0°C) = 0$$

$$c_w m_w T_f + c_w m_i T_f =$$

$$\underbrace{c_w m_w 65°C}_{27170\,J} - \underbrace{c_i m_i (10°C)}_{406\,J} - \underbrace{L_f m_i}_{6680\,J}$$

$$= T_f \underbrace{c_w}_{4.18\,\frac{J}{g°C}} \underbrace{(m_w + m_i)}_{(100+20)g} = 20,084\,J$$

$$T_f = 40.0°C$$



Latent Heat of $\underbrace{\text{Fusion}}_{\text{melting}}$ $= L_f$

slope = heat capacity $C = \frac{J}{°C}$

L_v = vaporization (liquid → gas)
boiling

Friday:		Alternative:
Single Slit	→	Double Slit
#2 P of each state w/ E	→	P given: E, S
# AC LRC Circuit	→	missing one of the 3 elements.

#2 P of e^- in Hydrogen being in 2s orbital. At T = 300 K.

E of ground state (lowest) = −13.6 eV

E of 2s state $= -\frac{13.6\,\text{eV}}{4}$

$$1\,\mathrm{eV} = 23.06\ \frac{\mathrm{Kcal}}{\mathrm{mol}} \quad \text{(given)}$$

$$k_B = 0.0020\ \frac{\mathrm{Kcal}}{\mathrm{mol \cdot K}}$$

$$P \propto e^{-\beta E} \qquad \beta = \frac{1}{k_B T}$$

$$P_1 = \frac{e^{-\beta E_1}}{Z} \qquad Z = \sum_{i=1}^{2} e^{-\beta E_i}$$

$$P_1 = \frac{e^{-\beta E_1}}{e^{-\beta E_1} + e^{-\beta E_2}} \times \frac{e^{\beta E_1}}{\underbrace{e^{\beta E_1}}_{1}} = \frac{1}{1 + e^{-\beta \Delta E}}$$

$$\boxed{\Delta E = E_2 - E_1}$$

$$P_1 = \frac{1}{1 + \underbrace{e^{-392}}_{\to 0}}$$

$$E_1 = -313.6\ \frac{\mathrm{Kcal}}{\mathrm{mol}}$$

$$E_2 = -78.4\ \frac{\mathrm{Kcal}}{\mathrm{mol}}$$

$$\Delta E = E_2 - E_1 = 235.2\ \frac{\mathrm{Kcal}}{\mathrm{mol}}$$

$$\beta = \frac{1}{0.6\frac{\mathrm{Kcal}}{\mathrm{mol}}} = 1.67\ \frac{\mathrm{mol}}{\mathrm{Kcal}}$$

$$P_2 = \frac{e^{-392}}{1+e^{-392}} \approx e^{-392} \quad \text{(tiny)}$$

$$P_2 = \frac{1}{1+e^{392}} \approx e^{-392}$$

$$P_1 + P_2 = 1$$