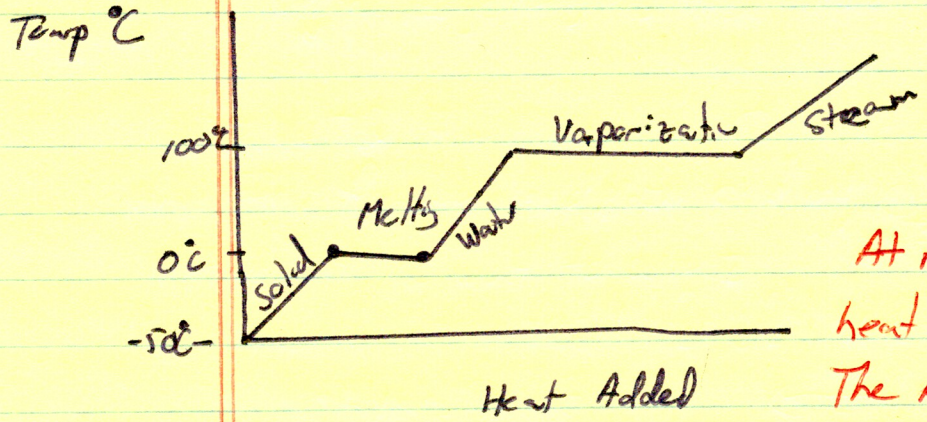
4/8/17

3. IB: Phase Change & Specific Heat — Day #2

Heating Curve of 1 Gram of ICE



Why are there temperature plateaus during melting and boiling?

At melting temp, any additional heat energy changes the bonding (PE). The KE stays the same.

Takes 1 cal. of heat Energy to raise the temp of 1 gram of water by 1°C

(c) Specific Heat Capacity: Amount of heat energy needed to raise a unit mass of a substance by 1°C

$$c = \frac{Q}{m\Delta T}$$

Amount of heat added / mass of substance × Change of Temp

Capital

(C) Heat Capacity: Heat Energy needed to raise the temp of an object (regardless of mass) 1°C

$$C = \frac{Q}{\Delta T}$$

Amount of heat need an object (regardless of mass) to raise temp 1°C.

Time 11:13

Question #1: 500J of heat is transferred to 200g. of lead. How much will the lead increase its temp by

130 J/Kg °C Table = .130 J/g °C

Need Video for specific Heat Table

$c = \frac{Q}{mc\Delta T}$ $\Delta T = \frac{Q}{mc}$ $\Delta T = \frac{500J}{200g \times .130\ J/g°C}$ · $\Delta T = 19°C$

Tue
12:35

Quest #2 Hammer: 200g Wood Handle 500g Iron Head
What is the heat capacity of the hammer

① Write out formulas ② Cross x by m ③ Set = $\frac{Q}{\Delta T}$

$C = \frac{Q}{\Delta T}$ $mc = \frac{Q}{m\Delta T}$ $mc = C$

$C_{Hammer} = C_{Head} + C_{Handle}$

$500g\left(.11\frac{cal}{g°C}\right) + 200g\left(.4\frac{cal}{g°C}\right) =$

$55 + 80 = 135\ cal/°C$

Latent Heat of Fusion (L_f)
Heat Energy needed to melt 1g of a substance
- For water $L_f = 80$ cal/g

Latent Heat of Vaporization (L_v)
Heat Energy needed to vaporize 1g of a substance
- For H_2O $L_v = 540$ cal/g

Tue
16:40

Quest - How many Joules of heat Energy would be absorbed by 500g of lead to melt it if the temp is 327°C

$L_f = \frac{Q}{m}$ $Q = mL_f$ $H_f = 5.9$ kcal/kg

$= 500g\ (5.9\ cal/g)$

$= 3600$ cal.

Tue
17:57

Questn

a) Deduce that Energy is supplied @ a rate of 530W c = 4200

$Q = mc\Delta T$ $P = \frac{\Delta Energy}{time}$ Given c of wat

$P \cdot t = mc\Delta T$

$P(30s) = .25kg\,(4200\ J/kg\,K)(15°C)$

$P = 525W$ or $P \approx 530W$

b) Determine specific heat of ice

$Q = mc\Delta T$

$Pt = mc\Delta T$

$530W(15s) = (.25kg)\,c\,(20°C)$

$c = 1590\ J/kg\,°C \approx 1600\ J/kg\,°C$

c) Define specific L_f of ice

$Q = mL_f$

$Pt = mL_f$

$L_f = \frac{Pt}{m}$ $L_f = \frac{(530W)(150s)}{.25kg} \approx 318{,}000\ J/kg$ $320{,}000\ J/kg$

Question

A 200g piece of iron @ 300°C is dropped in a 1kg H_2O @ 20°C. Predict the final equilibrium temp C of Fe = 450 J/kg K c of H_2O = 4200 J/kg K

Let T = Final Temp

iron cools off Wat Gai

$m_{iron}\,c_{iron}(300 - T) = m_{H_2O}\,c_{H_2O}(T - 20)$ Q = -

$.200kg\,(450)(300 - T) = 1kg\,(4200)(T - 20)$

$90(300 - T) = 4200(T - 20)$

$27000 - 90T = 4200T - 84{,}000$

$\frac{111{,}000}{4290} = \frac{4290T}{4290}$ $T = 26°C$