11/2/2018

Exam 2 :: average : 70.5%   high : 103.5%

$$q = m \cdot C_s \cdot \Delta T$$

table 6-4 ... common specific heat capacities, C_s

$$\left.\begin{array}{l} Au : 0.128\ J/g\cdot°C \\ H_2O : 4.184\ J/g\cdot°C \end{array}\right\} \times 33$$

Ex: What will the final temp of a gold coin (5.25g) be, if it absorbs 125 J of heat? It's orig. temp is 22.0°C.

$$\overset{✓}{q} = \overset{✓}{m} \cdot \overset{✓}{C_s} \cdot \overset{?}{\Delta T}$$

$$\Rightarrow \Delta T = q/m \cdot C_s = \frac{(+)\ 125\ \cancel{J}}{5.25\cancel{g} \times 0.128\ \cancel{J}/\cancel{g}\cdot°C}$$

$$= (+)\ 186\ °C$$

$$\Delta T = T_f - T_i \Rightarrow T_f = T_i + \Delta T$$

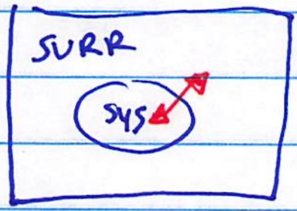
$$= 22.0°C \oplus 186°C$$

$$= 208°C \quad \text{(ouch!)}$$

Q for you: if coin was Al ($C_s = 0.903\ J/g\cdot°C$), would final T be higher or lower? 48.4°C

Thermal $\mathcal{E}$ transfer

2 objects w/ diff't t's
- when they touch, they transfer q until same final t.



$$\boxed{q_{sys} = -q_{surr}}$$

ex: if sys gains 10J of heat:

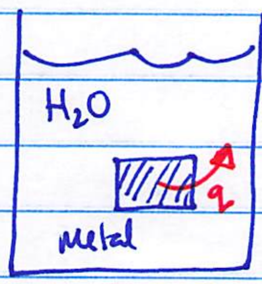
$q_{sys} = +10\,J$

equal + opposite

... then surr must lose 10J of heat:

$q_{surr} = -10\,J$

ex: drop hot piece of metal into cold water



$$q_{metal} = -q_{H_2O}$$

metal is losing heat $\Leftrightarrow$ H_2O is gaining heat!

let's take 32.5g Al @ 45.8°c + drop into 105.3g H_2O @ 15.4°c. Q: what's t_f ?

$$q_{Al} = -q_{H_2O}$$

$(q_{Al} + q_{H_2O} = 0)$

$q = m \cdot C_s \cdot \Delta T$

not the same

$$m_{Al} \times C_{s,Al} \times \Delta T_{Al} = - m_{H_2O} \times C_{s,H_2O} \times \Delta T_{H_2O}$$

$$\Rightarrow 32.5\cancel{g} \times 0.903 \, \tfrac{J}{\cancel{g} \cdot °c} \times \Delta T_{Al} = - 105.3\cancel{g} \times 4.184 \, \tfrac{J}{\cancel{g} \cdot °c} \times \Delta T_{H_2O}$$

$$29.348 \, J/°c \times \Delta T_{Al} = -440.15 \, J/°c \times \Delta T_{H_2O}$$

$$\Delta T_{Al} = \frac{-440.15 \, \cancel{J/°c} \times \Delta T_{H_2O}}{29.348 \, \cancel{J/°c}} = -14.998 \times \Delta T_{H_2O}$$

$$T_f - T_{i,Al} = -14.998 \times (T_f - T_{i,H_2O})$$

$$T_f - 45.8°c = -14.998 (T_f - 15.4°c)$$

$$T_f - 45.8°c = -14.998 \, T_f + 230.96°c$$

$$15.998 \, T_f = 276.77°c$$

$$T_f = \frac{276.77°c}{15.998} = 17.3°c$$

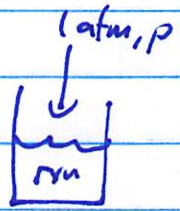
32.5g Al
45.8°c

105.3g H_2O
@15.4°c

q for chemical rxns

We can show that $\Delta E = q$ @ const V

$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad \sim q_V$



but most rxns are run @ const p (air p)

$$\Delta E \neq q_p$$

However, we can define a state function:

$$\underset{\text{Enthalpy}}{H} = E + pV$$

can show: $\Delta H = q_p$ cool! hot?!

If $\underset{(-ve)}{\Delta H < 0}$, $q_{p,rxn} < 0$, rxn loses heat

Exothermic feel hot to touch!

if $\underset{(+ve)}{\Delta H > 0}$, $q_{p,rxn} > 0$, rxn gains heat

feels cold to touch.

Endothermic