15.2 Notes - Heat

- Remember Calorimetry = study of heat/energy from Chem rxns.

- Energy released from a chem rxn is absorbed by its surroundings
  * In a perfect scenario, we could collect it all

- We learned to solve for heat released/Absorbed with the formula $\boxed{q = m \times c \times \Delta T}$

- In calorimetry remember: heat released by one substance = heat absorbed by the other (usually H_2O)

We can solve the following:

* 100 g of H_2O ↑ in temp from 22°C to 27.9°C when a single sample of metal ($c = 0.647$ J/g°C) that was heated to 110°C was placed into it ($c_{H_2O} = 4.184$ J/g°C)

  - Solve for mass of metal used

What do we have given?

H_2O	metal
mass	
ΔT	ΔT
spec. heat	spec. heat

* we have more info for H_2O, so solve for q_{H_2O} first, then we can solve for metal

$\Delta T = 27.9° - 22° = 5.9°C$

$q_{H_2O} = m \times c \times \Delta T$

$(100g)(4.184 J/g°C)(5.9°C)$

$q_{H_2O} =$ 2,468.56 J

Heat absorbed (H_2O) = heat released (metal)

$q_{H_2O} = q_{metal}$

* solve for mass of metal

$q_{metal} = m \times c \times \Delta T$ $\Delta T_{met.} = 110 - 27.9 = 82.1°C$

$\frac{2,468.56 J}{(.647 \times 82.1)} = \frac{m \times (0.647 J/g°C)(82.1°C)}{.647 \times 82.1}$

$m =$ 46.5 g

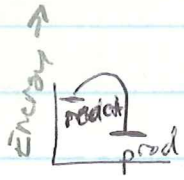
* we can solve for any variable if we have enough info.

When combustion is used to release heat, we write chem. rxns in formulas & include the heat released

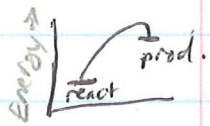
ex) $4 Fe_{(s)} + 3O_{2(g)} \rightarrow 2 Fe_2O_{3(s)} + 1625 kJ$

In <u>thermochemistry</u> - we need to think of each reaction taking place in a <u>system</u> (vessel) & the <u>surroundings</u> & both together are a <u>universe</u>

$$\boxed{\text{system + surroundings = universe}}$$



<u>Exothermic rxns</u> - heat <u>released by system</u> to surroundings



<u>Endothermic rxns</u> - heat <u>absorbed by system</u> from surroundings

* When energy studies are done @ constant pressure (controlled) we refer to the heat released/absorbed as q_p

<u>Enthalpy</u> is heat content of system @ constant pressure

$$\boxed{q_p = H}$$

- measurement of heat released/absorbed by rxn = <u>Enthalpy of Rxn</u>
- aka ΔH_{rxn}

assume constant pressure, so $q = \Delta H$

$$\boxed{\Delta H_{rxn} = H_{final} - H_{initial}} \quad \text{or} \quad \boxed{\Delta H_{rxn} = H_{prod} - H_{react}}$$

<u>For exothermic rxns</u> ($\Delta H < 0$)

$H_{prod} < H_{react}$ (heat released), so ΔH_{rxn} is $-$

<u>For endothermic rxns</u> ($\Delta H > 0$)

$H_{prod} > H_{react}$ (heat absorbed), so ΔH_{rxn} is $+$