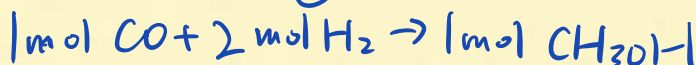
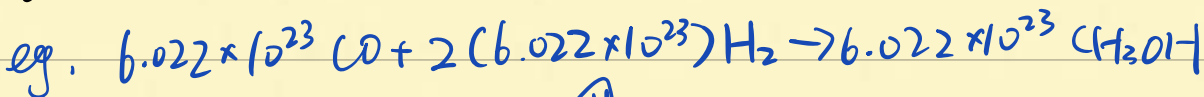


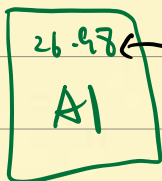
Chemical Quantities

Mole

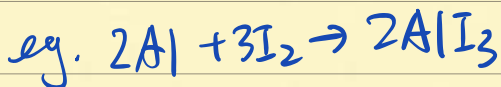
$$6.022 \times 10^{23} = 1 \text{ mole}$$



Mass



Represent 26.98g / 1mol Al
Average Atomic Mass

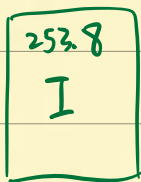


Now we got 35g Al, how much I_2 we need?

2mol Al NEED 3mol I_2 .

From table, we get 1mol Al = 26.98g

$$\Rightarrow 35 / 26.98 = 1.3 \text{ mol Al} \Leftrightarrow \frac{3}{2} \cdot 1.3 = 1.95 \text{ mol I}_2$$



$$\text{Gram of I}_2 = 253.8 \cdot 1.95 = 495 \text{ g I}_2$$

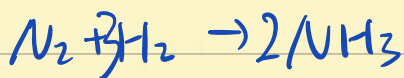
Stoichiometry: Use chemical equation to calculate the relative masses of reactant

Limiting Reacting

The reactant left after reaction

• Also called limiting reagent

eg. 25kg of nitrogen gas and 5kg of hydrogen gas are mix together to form ammonia. Calculate the mass of ammonia produced



$$N_2: 25 \text{ kg} \quad - \quad 25 \times 10^4 / 28 \text{ mol} = 8.9 \times 10^2 \text{ mol}$$

$$H_2: 5 \text{ kg} \quad - \quad 5 \times 10^3 / 2 \text{ mol} = 2.5 \times 10^3 \text{ mol}$$

eg. N_2 ran out need $2.67 \times 10^3 \text{ mol } H_2$.

↓

N_2 is limiting.

For $2.5 \times 10^3 \text{ mol } H_2$, we get $\frac{2}{3} 2.5 \times 10^3$

$$= 1.67 \times 10^3 \text{ mol}$$

$$NH_3 = 14 + 3 = 17 \text{ g/mol}$$

$$= 1.67 \times 10^3 \cdot 17 = 28.39 \text{ kg}$$

Percent yield

Theoretical Yield: Maximum Amount of possible yield

Actual Yield.

$$\text{percent yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100\%$$

Energy

• The ability to do work or produce heat

• $\left\{ \begin{array}{l} \text{potential} \\ \text{Kinetic} \end{array} \right.$

• Conservation of energy

Temperature and heat

heat: flow of energy due to a temperature difference

$$T_{\text{Final}} = \frac{T_{\text{hot init}} + T_{\text{cold init}}}{2}$$

when the mass of hot and cold are equal

Exothermic and Endothermic

Exothermic: out of energy

Endothermic: energy flow inside.

Thermodynamics

The study of energy

$$\Delta E = q + w$$

where q = heat w = work.

Calorie: Amount of energy required to raise temperature of one gram of water by one Celsius degree.

$$1 \text{ calorie} = 4.184 \text{ joules}$$

eg. energy (heat) in joules need to take 7.4g water from 29°C to 46°C.

1 cal = heat 1g water by 1°C

⇒ 29°C - 46°C of 7.4g water need:

$$(46-29) \cdot 7.4$$

And to joule:

$$(46-29) \cdot 7.4 \cdot 4.184 = 526.3472 \text{ J}$$

heat capacity

The amount of energy need to change temperature of one gram of a substance by one Celsius degree.

eg. Water = 4.184 J

eg 2. Known that iron's heat capacity = 0.45 J/g°C
Ask energy required to heat 1.3g from 25°C to 46°C.

$$0.45 \cdot 1.3 \cdot (46-25) = 12.285 \text{ J}$$

In Celsius: $12.285 / 4.184 = 2.936 \text{ cal}$

$$Q = S \cdot m \cdot \Delta T$$

Q : energy (J)

S : heat capacity

m : mass of the sample in grams

ΔT : change in temperature

eg. 1.6g need 5.8J to change T from 23°C - 41°C .
Is it gold?

$$5.8\text{J} / (1.6\text{g} \cdot (41-23)) = S = 0.2\text{J/g}^\circ\text{C}$$

-! S for gold = $0.13\text{J/g}^\circ\text{C}$.

\Rightarrow Not gold.

Thermochemistry (Enthalpy)

Enthalpy (ΔH) = heat

under constant pressure and condition

eg. when 1 mole of CH_4 burned. 890 kJ of energy released as heat. Get ΔH which 5.8g sample of methane is burned.

$$\frac{\Delta Q_1}{\Delta Q_2} = \frac{m_1}{m_2} \Rightarrow \frac{890}{\Delta Q_2}$$

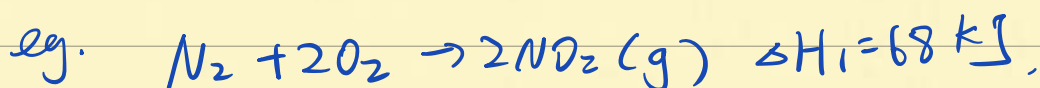
molar mass of $\text{CH}_4 = 12 + 4 = 16\text{g/mol}$

$\Rightarrow M_1 = 16g$ when CH_4 have 1 mole.

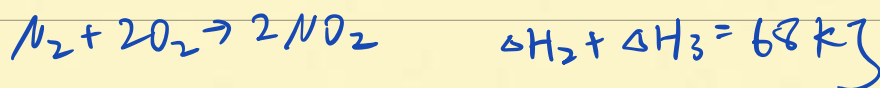
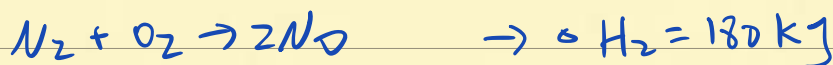
$$\Rightarrow \frac{16}{5.8} = \frac{890}{O_2} \Rightarrow O_2 = 322.625g = \Delta H$$

Hess's Law

enthalpy can be stated as a function

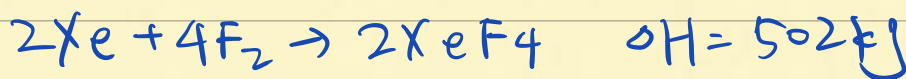
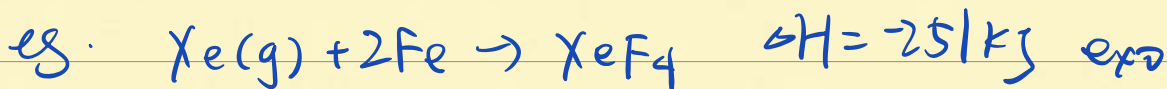


or

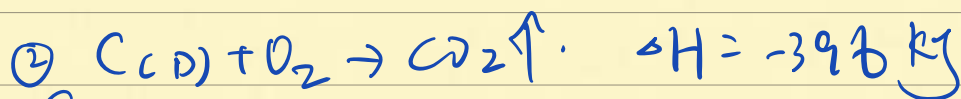
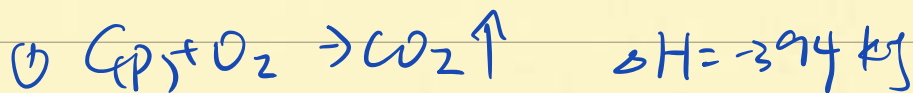
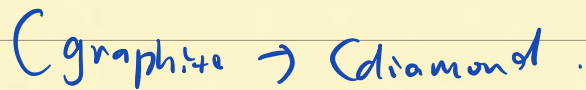


Character of Enthalpy change

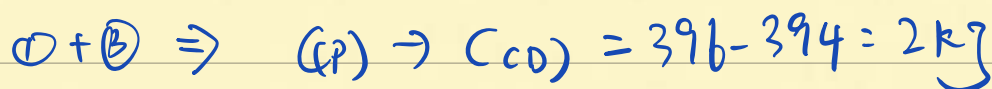
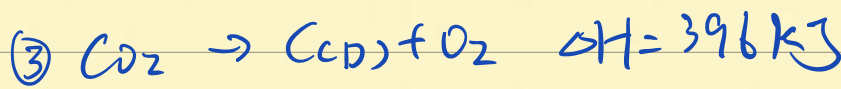
1. Reaction Reversed, Sign of ΔH reversed
2. Magnitude of ΔH proportional to the quantity of reactants and products in reaction



eg. Two form of carbon are graphite and diamond. Combustion of graphite (-394 kJ/mol) and diamond (-396 kJ/mol), calculate ΔH for the conversion of graphite to diamond



According to property:



Driven Force.

< Energy Spread
Matter Spread

Entropy

Measure of disorder or randomness

Disorder \uparrow Entropy \downarrow

Second Law of thermodynamics: The entropy of the universe is Always increased.