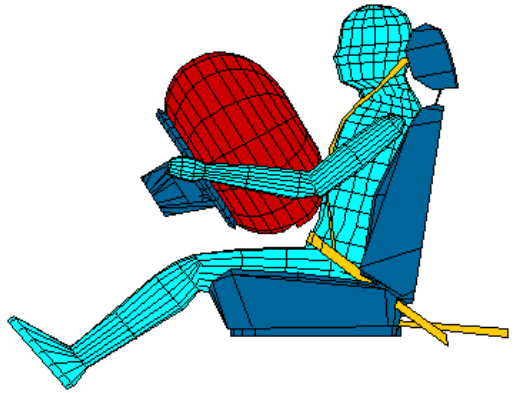
N27 - Real Life Stoichiometry Examples

Target: I can apply stoichiometry to real life examples that have context/stories behind them.

Link to YouTube Presentation: https://youtu.be/DK2MEqz9fFs

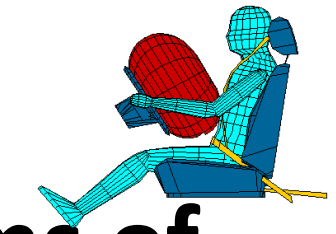
Example #1 – AIR BAGS



Exact quantity of nitrogen gas must be produced in an instant.

$$\underline{2}\ NaN_3(s) \rightarrow \underline{2}\ Na(s) + \underline{3}\ N_2(g)$$

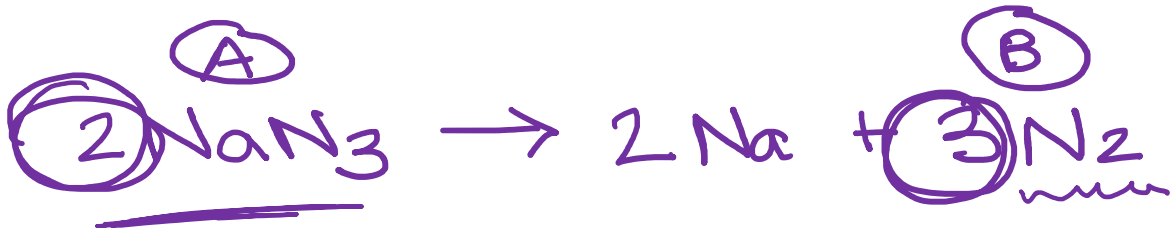
$2\ NaN_3(s) \rightarrow 2\ Na(s) + 3\ N_2(g)$



If an airbag is made with 90 grams of NaN_3 will it be safe?

Assume that 65.1 L of N_2 gas are needed to inflate an air bag to the proper size to protect you during an accident.

(<u>Hints:</u> Make NaN_3 your A value. The density of N_2 gas at this temperature is about 0.916 g/L).



Density
0.916 g/L

g A → mol A → mol B → g B → L B

molar mass A
65.01 g/mol

mole ratio
B / A

molar mass B
28.02 g/mol

Density B

= 63.52 L $N_2(g)$

90 g A	1 mol A / 65.01 g A	3 mol B / 2 mol A	28.02 g B / 1 mol B	1 L B / 0.916 g B

- **63.52 L N_2 gas**
- **NOT SAFE! The air bag will not inflate all the way which would be dangerous.**

Example #2 – ROCKET FUEL

In 1967 the Saturn V Rocket did an unmanned test flight to the moon. It used kerosene fuel to get through the atmosphere into outer space. The kerosene ($C_{12}H_{26}$) combusts with liquid oxygen (O_2) on board the rocket to form carbon dioxide and water.

74 Oxygens

24 x 2

26 x 1

$$2\,C_{12}H_{26} + 37O_2 \rightarrow 24\,CO_2 + 26\,H_2O$$

Example #2 – ROCKET FUEL

$2\ C_{12}H_{26} + 37\ O_2 \rightarrow 24\ CO_2 + 26\ H_2O$

If the Saturn V rocket was loaded with 770,886 Liters of kerosene fuel and 890,650 Liters of liquid oxygen, would it have enough liquid oxygen on board to use up all the kerosene in order to get out of the atmosphere?

(Hints: Make kerosene your A value. The density of kerosene is 749g/L, and the density of liquid oxygen is 1141 g/L)

(A) (B)

$$2C_{12}H_{26} + 37O_2 \rightarrow 24CO_2 + 26H_2O$$

water density
1g 1 mL
only density to memorize

L A → g A → mol A → mol B → g B → L B

Density A: 749g A / 1L A

m.m A: 170.33 g A / 1 mol A

m.R: B / A

$\frac{37 \text{ mol B}}{2 \text{ mol A}}$

m.m B: $\frac{32 \text{ g B}}{1 \text{ mol B}}$

Density B: $\frac{1141 \text{ g B}}{1 \text{ L B}}$

$$770886 \text{ L A} \times \frac{749 \text{ g A}}{1 \text{ L A}} \times \frac{1 \text{ mol A}}{170.33 \text{ g A}} \times \frac{37 \text{ mol B}}{2 \text{ mol A}} \times \frac{32 \text{ g B}}{1 \text{ mol B}} \times \frac{1 \text{ L B}}{1141 \text{ g B}} = 1{,}758{,}801 \text{ L O2}$$

Brought 890,650 L Need :(

- **1,758,801 L of liquid O_2 needed**
- **NOT ENOUGH liquid O_2 on board to burn all the kerosene! Uh oh…**

Example#3 - HYDROGEN POWERED BICYCLES

Electric Bicycles are becoming very popular these days. They typically have a rechargeable battery pack and electric hub motor.

A new electricity source combines a hydrogen fuel cell with a ***"sodium silicide"*** fuel cartridge (winner of a "Green Chemistry Challenge Award)

Example#3 – H_2 POWERED BICYCLES

The sodium silicide reacts with water to make the hydrogen fuel to run the bicycle.

$$2\ NaSi_{(s)} + 5H_2O_{(l)} \rightarrow Na_2Si_2O_{5(s)} + 5H_{2(g)}$$

If you start with 1Kg of sodium silicide, and your tank can hold 500mL of water, will you have enough water to use up the battery?

(Hints: Use 1kg of sodium silicide as your A value. The Density of water is 1g/mL)

memorize!

(A) (B)
$2NaSi + 5H_2O \rightarrow Na_2Si_2O_5 + 5H_2$

Density doesn't always have the same units!

$KgA \rightarrow gA \rightarrow molA \rightarrow molB \rightarrow gB \rightarrow mL\ B$

metric conversion! Kinahenry... OR 1000g/1kg

m.m A: $\frac{51.08gA}{1molA}$

m.R B/A: $\frac{5molB}{2molA}$

m.m B: $\frac{18.02gB}{1molB}$

Density B: $\frac{1mL\ B}{1gB}$

$$\frac{1KgA}{} \left|\frac{1000gA}{1KgA}\right|\frac{1molA}{51.08gA}\left|\frac{5molB}{2molA}\right|\frac{18.02gB}{1molB}\left|\frac{1mLB}{1gB}\right| = \boxed{881.95\ mL\ H_2O}$$

- **881.95 mL of H2O needed to use up all the NaSi in the battery.**
- **NOT ENOUGH water in the water tank to use up the entire battery.**

holds 500 mL H_2O Need 881.95 mL

- Balanced EQ
- pathway
- label pathway
- Dimensional Analysis – LINE METHOD
  - units (A & B OR formulas)
  - cancel units
- Final Ans. w/ units AND formula
- Box your ans.
- Answer the story Question Also!

YouTube Link to Presentation

- https://youtu.be/DK2MEqz9fFs