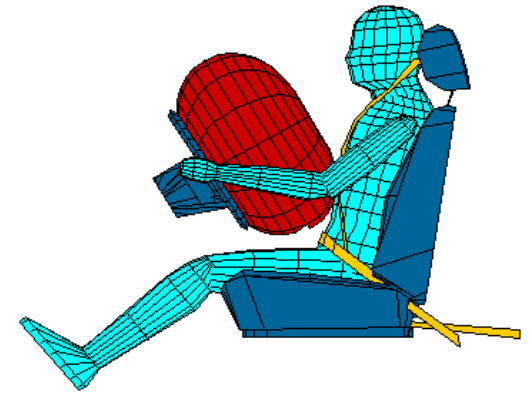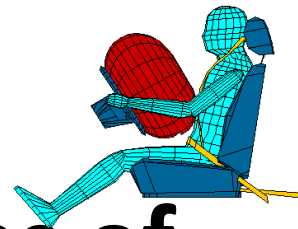# N27 - Real Life Stoichiometry Examples

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

Example #1 – AIR BAGS

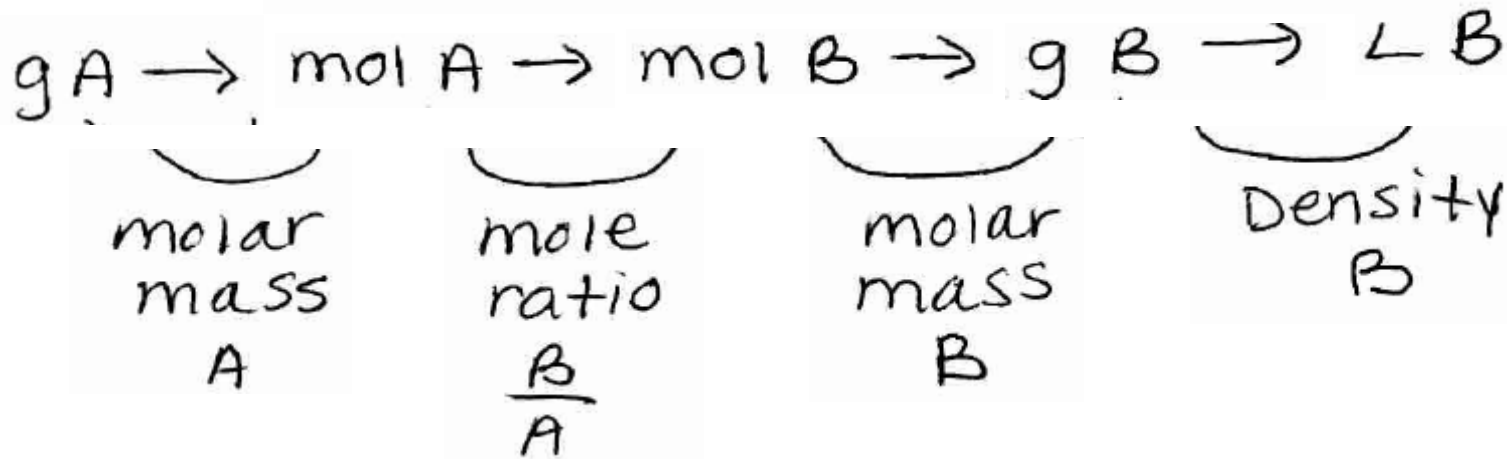Exact quantity of nitrogen gas must be produced in an instant.

__ $NaN_3(s)$ → __$Na(s)$ + __$N_2(g)$

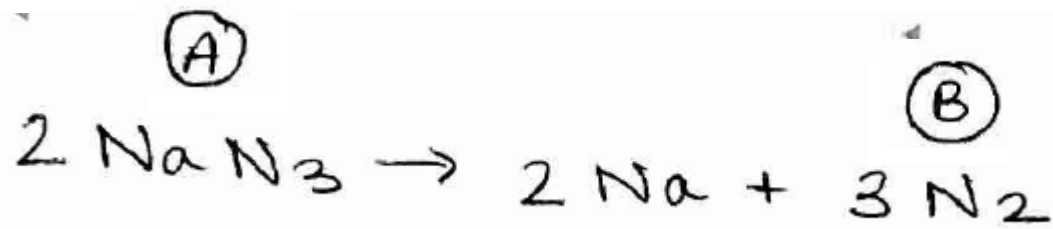$$2 \text{ NaN}_3(s) \rightarrow 2 \text{ Na}(s) + 3 \text{ N}_2(g)$$

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).

$$2\ NaN_3 \rightarrow 2\ Na + 3\ N_2$$

(A)   (B)

$$g\ A \rightarrow mol\ A \rightarrow mol\ B \rightarrow g\ B \rightarrow L\ B$$

molar mass A   mole ratio $\frac{B}{A}$ molar mass B   Density B

$$\frac{90g\ A}{} \left| \frac{1\ mol\ A}{65.01g\ A} \right| \frac{3\ mol\ B}{2\ mol\ A} \left| \frac{28.02\ g\ B}{1\ mol\ B} \right| \frac{1\ L\ B}{0.916\ g\ B}$$

= 63.52 L of N_2 gas can be formed.

so our air bag is _not_ safe because it wont inflate all the way! not good!

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.

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)

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

(A) over $C_{12}H_{26}$, (B) over O_2
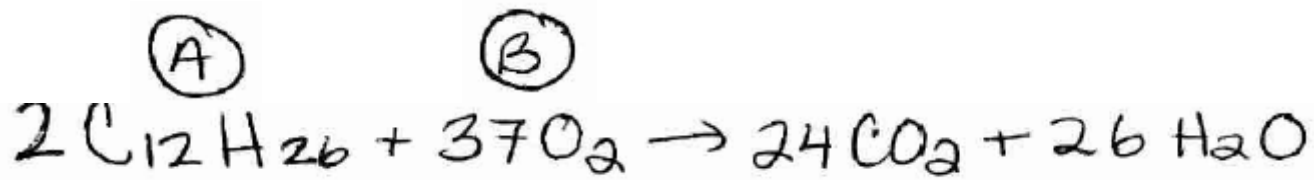
$$L_A \rightarrow g_A \rightarrow mol\ A \rightarrow mol\ B \rightarrow g_B \rightarrow L_B$$

Density A	molar mass A	mole ratio $\frac{B}{A}$	molar mass B	Density B

| $\dfrac{770886\ L_A}{1\ L_A}$ | $\dfrac{749\ g\ A}{170.33\ g\ A}$ | $\dfrac{1\ mol\ A}{2\ mol\ A}$ | $\dfrac{37\ mol\ B}{1\ mol\ B}$ | $\dfrac{32\ g\ B}{1141\ g\ B}$ | $\dfrac{1\ L\ B}{}$ |

= 1,758,801 L of O_2 needed to burn all of the Kerosene.

So we do __not__ have enough O_2 on board...
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)
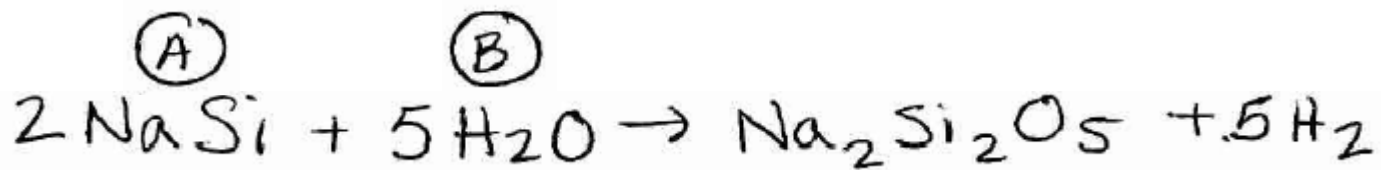
Example#3 – H$_2$ POWERED BICYCLES

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

$$2\ NaSi_{(s)} + 5H_2O_{(l)} \rightarrow Na_2Si_2O_{5(s)} + 5H_{2(g)}$$
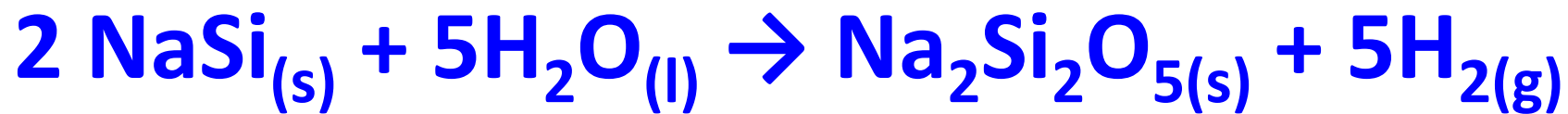
If you start with 1Kg of sodium silicide, and your tank can hold 500mL of water, will you have enough water to use up the battery?

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

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

$$Kg A \rightarrow g A \rightarrow mol A \rightarrow mol B \rightarrow g B \rightarrow mLB$$

metric conversior   molar mass A   mole ratio $\frac{B}{A}$ molar mass B   Density B

$$\frac{1 Kg A}{} \left| \frac{1000 g A}{1 Kg A} \right| \frac{1 mol A}{51.08 g A} \left| \frac{5 mol B}{2 mol A} \right| \frac{18.02 g B}{1 mol B} \left| \frac{1 mL B}{1 g B} \right.$$

= 881.95 mL of H_2O needed
     to use up all the NaSi
     in the battery.

So we do not have enough
water in the water tank.