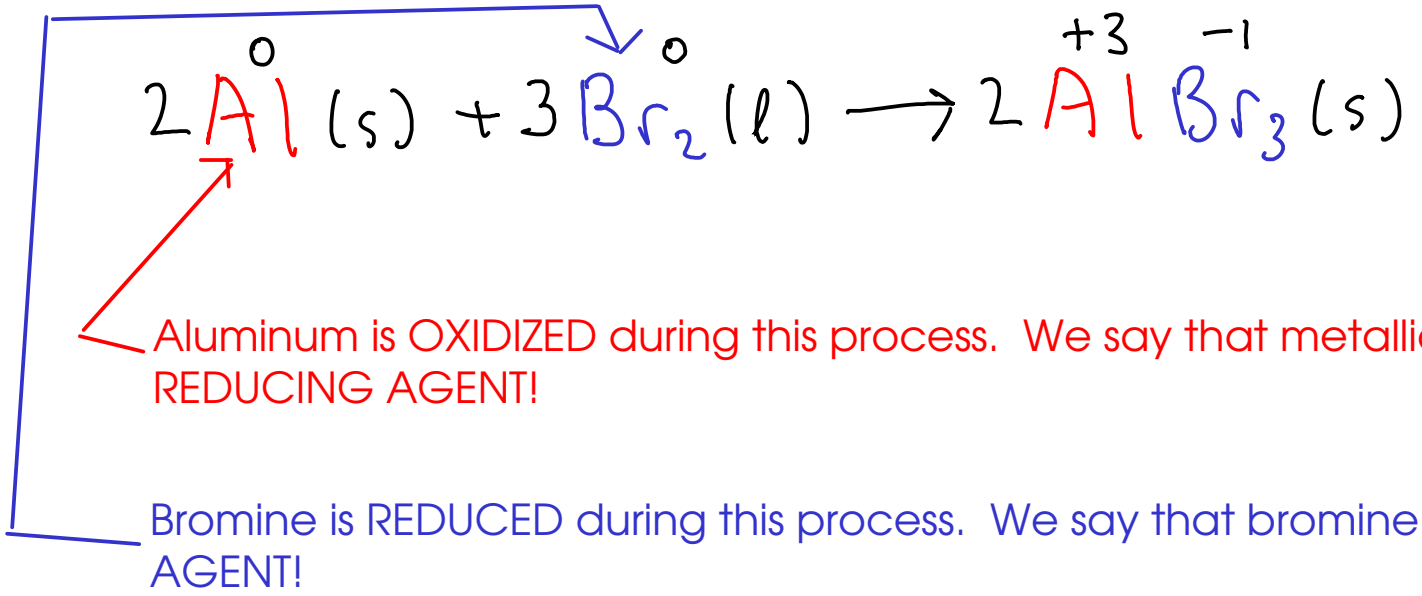
REDOX LANGUAGE

"oxidizer"

- "Oxidation" is loss of electrons, but an OXIDIZING AGENT is something that causes ANOTHER substance to lose electrons. An oxidizing agent is itself reduced during a redox reaction.

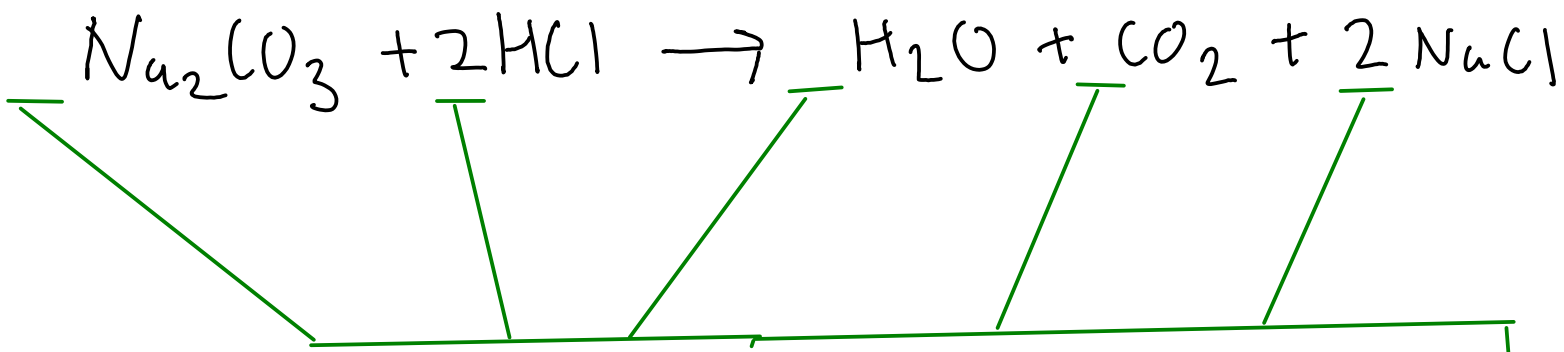
- "Reduction" is gain of electrons, but a REDUCING AGENT is something that causes ANOTHER substace to gain electrons. Reducing agents are themselves oxidized during a redox reaction.



* Strong oxidizers (oxidizing agents) can cause spontaneous fires if placed into contact with combustibles (safety issue!).

* Reactive metals tend to be REDUCING AGENTS, while oxygen-rich ions like NITRATES tend to be OXIDIZING AGENTS. HALOGENS (Group VIIA) also tend to be OXIDIZING AGENTS

CHEMICAL CALCULATIONS - RELATING MASS AND ATOMS



Chemical equations are written and balanced in terms of ATOMS and MOLECULES

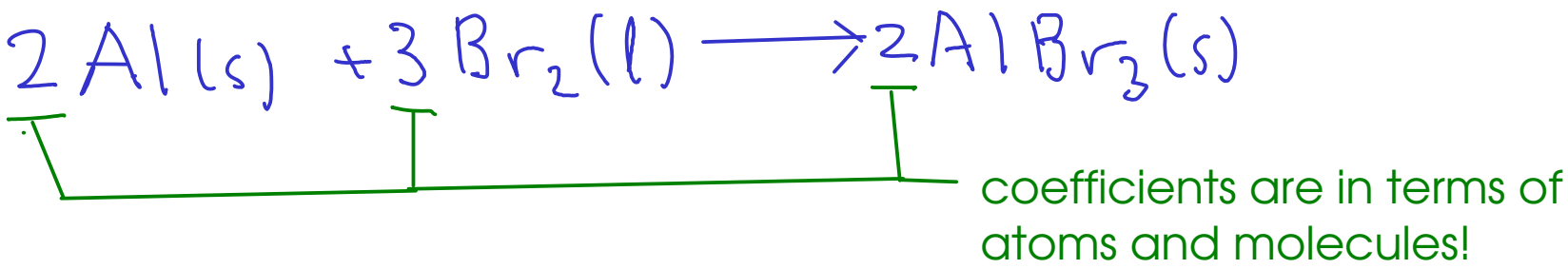
- While chemical equations are written in terms of ATOMS and MOLECULES, that's NOT how we often measure substances in lab!

- measurements are usually MASS (and sometimes VOLUME), NOT number of atoms or molecules!

CHEMICAL CALCULATIONS CONTINUED: REACTIONS

- Chemical reactions proceed on an ATOMIC basis, NOT a mass basis!

- To calculate with chemical reactions (i.e. use chemical equations), we need everything in terms of ATOMS ... which means MOLES of atoms



2 atoms Al = 3 molecules Br_2 = 2 formula units $AlBr_3$

2 mol Al = 3 mol Br_2 = 2 mol $AlBr_3$

- To do chemical calculations, we need to:
  - Relate the amount of substance we know (mass or volume) to a number of moles
  - Relate the moles of one substance to the moles of another using the equation
  - Convert the moles of the new substance to mass or volume as desired

$$2\,Al(s) + 3\,Br_2(l) \longrightarrow 2\,AlBr_3(s)$$

* Given that we have 25.0 g of liquid bromine, how many grams of aluminum would we need to react away all of the bromine?

(1) Convert grams of bromine to moles: Need formula weight $Br_2 = \frac{2 \times 79.90}{159.80}$

$159.80\ g\ Br_2 = \text{mol}\ Br_2$

$$25.0\ g\ Br_2 \times \frac{\text{mol}\ Br_2}{159.80\ g\ Br_2} = 0.15645\ \text{mol}\ Br_2$$

(2) Use the chemical equation to relate moles of bromine to moles of aluminum

$2\ \text{mol}\ Al = 3\ \text{mol}\ Br_2$

$$0.15645\ \text{mol}\ Br_2 \times \frac{2\ \text{mol}\ Al}{3\ \text{mol}\ Br_2} = 0.10430\ \text{mol}\ Al$$

(3) Convert moles aluminum to mass: Need formula weight $Al = 26.98$

$26.98\ g\ Al = \text{mol}\ Al$

$$0.10430\ \text{mol}\ Al \times \frac{26.98\ g\ Al}{\text{mol}\ Al} = \boxed{2.81\ g\ Al}$$

You can combine all three steps on one line if you like!

① $159.80\ g\ Br_2 = mol\ Br_2$ ② $2\ mol\ Al = 3\ mol\ Br_2$ ③ $26.98\ g\ Al = mol\ Al$

$$25.0\ g\ Br_2 \times \frac{mol\ Br_2}{159.80\ g\ Br_2} \times \frac{2\ mol\ Al}{3\ mol\ Br_2} \times \frac{26.98\ g\ Al}{mol\ Al} = \boxed{2.81\ g\ Al}$$

① ② ③

Things we can do:

If we have ...	... and we need ...	Use ...
MASS	MOLES	FORMULA WEIGHT
SOLUTION VOLUME	MOLES	MOLAR CONCETRATION (MOLARITY)
MOLES OF A	MOLES OF B	BALANCED CHEMICAL EQUATION

Example:

How many milliliters of 6.00M hydrochloric acid is needed to completely react with 25.0 g of sodium carbonate?

$$2HCl(aq) + Na_2CO_3(s) \longrightarrow H_2O(l) + CO_2(g) + 2NaCl(aq)$$

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1 - Convert 25.0 grams sodium carbonate to moles. Use FORMULA WEIGHT.
2 - Convert mol sodium carbonate to mol HCl. Use CHEMICAL EQUATION.
3 - Convert mol HCl to volume. Use MOLARITY. (6.00 M HCl)

① Na_2CO_3: Na - 2 x 22.99
C - 1 x 12.01
O - 3 x 16.00

105.99 g Na_2CO_3 = mol Na_2CO_3

$$25.0\ g\ Na_2CO_3 \times \frac{mol\ Na_2CO_3}{105.99\ g\ Na_2CO_3} = 0.2358713086\ mol\ Na_2CO_3$$

② 2 mol HCl = mol Na_2CO_3

$$0.2358713086\ mol\ Na_2CO_3 \times \frac{2\ mol\ HCl}{mol\ Na_2CO_3} = 0.4717426172\ mol\ HCl$$

Example:

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$6.00\ mol\ HCl = L$

③

$$0.471742617\ mol\ HCl \times \frac{L}{6.00\ mol\ HCl} = 0.0786\ L\ of\ 6.00\ M\ HCl$$

We have the volume. The problem specifically asks for mL, so do a quick conversion.

$mL = 10^{-3} L$

$$0.0786\ L \times \frac{mL}{10^{-3} L} = \boxed{78.6\ mL\ of\ 6.00\ M\ HCl}$$

42.081 g/mol 53.064 g/mol

$$4\,C_3H_6 + 6\,NO \longrightarrow 4\,C_3H_3N + 6\,H_2O + N_2$$

propylene acrylonitrile

Calculate how many grams of acrylonitrile could be obtained from 651 g of propylene, assuming there is excess NO present.

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1 - Convert 651 grams propylene to moles. Use FORMULA WEIGHT.
2 - Convert mol propylene to mol acrylonitrile. Use CHEMICAL EQUATION.
3 - Convert mol acrylonitrile to mass. Use FORMULA WEIGHT.

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① $42.081\,g\,C_3H_6 = mol\,C_3H_6$ ② $4\,mol\,C_3H_6 = 4\,mol\,C_3H_3N$

③ $53.064\,g\,C_3H_3N = mol\,C_3H_3N$

$$651\,g\,C_3H_6 \times \frac{mol\,C_3H_6}{42.081\,g\,C_3H_6} \times \frac{4\,mol\,C_3H_3N}{4\,mol\,C_3H_6} \times \frac{53.064\,g\,C_3H_3N}{mol\,C_3H_3N} = \boxed{821\,g\,C_3H_3N}$$

① ② ③