- 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

$$2\,Al\,(s) + 3\,Br_2\,(\ell) \longrightarrow 2\,AlBr_3\,(s)$$
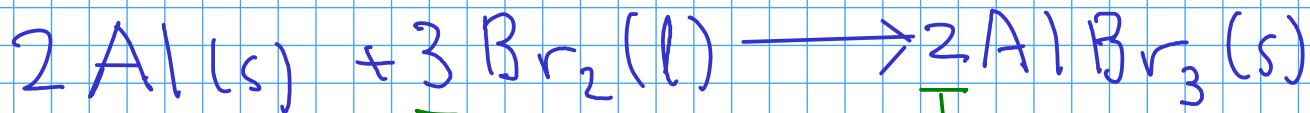
coefficients are in terms of atoms and molecules!

$$2 \text{ atoms } Al = 3 \text{ molecules } Br_2 = 2 \text{ formula units } AlBr_3$$

$$2 \text{ mol } Al = 3 \text{ mol } Br_2 = 2 \text{ mol } AlBr_3 \quad *$$

① - Relate the amount of substance we know (mass or volume) to a number of moles

② - Relate the moles of one substance to the moles of another using the equation

③ - Convert the moles of the new substance to mass or volume as desired

$$2\,Al\,(s) + 3\,Br_2\,(\ell) \longrightarrow 2\,Al\,Br_3\,(s)$$
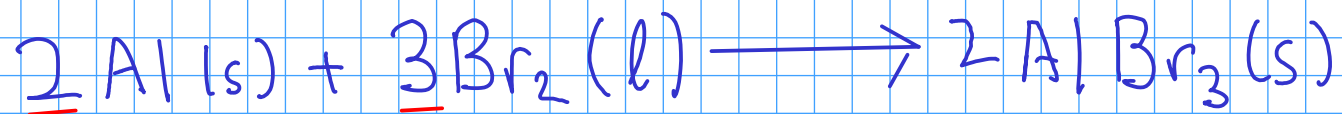
* Given that we have 25.0 g of liquid bromine, how many grams of aluminum would we need to react away all of the bromine? How many grams of aluminum bromide would be produced?

① Convert 25.0 g of bromine to moles. Use formula weight: $Br_2: \dfrac{2 \times 79.40}{159.80}$

$$159.80\,g\,Br_2 = 1\,mol\,Br_2$$

$$25.0\,g\,Br_2 \times \frac{1\,mol\,Br_2}{159.80\,g\,Br_2} = 0.15645\,mol\,Br_2$$

② Convert mol bromine to mol aluminum. Use chemical equation.

$$3\,mol\,Br_2 = 2\,mol\,Al$$

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

③ Convert mol aluminum to g aluminum. Use formula weight: $Al: 26.98$

$$26.98\,g\,Al = 1\,mol\,Al$$

$$0.10430\,mol\,Al \times \frac{26.98\,g\,Al}{1\,mol\,Al} = \boxed{2.81\,g\,Al}$$

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

$$25.0 \text{ g } Br_2 \times \frac{1 \text{ mol } Br_2}{159.80 \text{ g } Br_2} \times \frac{2 \text{ mol } Al}{3 \text{ mol } Br_2} \times \frac{26.98 \text{ g } Al}{1 \text{ mol } Al} = \boxed{2.81 \text{ g } Al}$$

①   ②   ③

$$25.0 \text{ g } Br_2 \longleftarrow \text{Conservation of mass!}$$
$$+ \quad 2.81 \text{ g } Al$$
$$\overline{}$$
$$27.8 \text{ g } AlBr_3$$

But …

…what would you have done to calculate the mass of aluminum bromide IF you had NOT been asked to calculate the mass of aluminum FIRST?

$$25.0 \text{ g } Br_2 \times \frac{1 \text{ mol } Br_2}{159.8 \text{ g } Br_2} \times \frac{2 \text{ mol } AlBr_3}{3 \text{ mol } Br_2} \times \frac{266.68 \text{ g } AlBr_3}{1 \text{ mol } AlBr_3} = 27.8 \text{ g } AlBr_3$$

$$AlBr_3: \quad Al = 1 \times 26.98$$
$$Br = 3 \times 79.90$$
$$\overline{}$$
$$266.68$$