

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

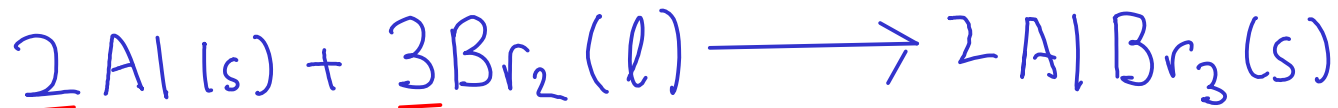


coefficients are in terms of atoms and molecules!

2 atoms Al = 3 molecules Br₂ = 2 formula units AlBr₃

2 mol Al = 3 mol Br₂ = 2 mol AlBr₃ *

- To do chemical calculations, we need to:
 - 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



* 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 the 25.0 g of bromine to moles. Use formula weight. $\text{Br}_2: \frac{2 \times 79.90}{159.8}$
 $159.8 \text{ g Br}_2 = \text{mol Br}_2$

$$25.0 \text{ g Br}_2 \times \frac{\text{mol Br}_2}{159.8 \text{ g Br}_2} = 0.1564455569 \text{ mol Br}_2$$

② Convert the moles bromine to moles aluminum. Use chemical equation.
 $2 \text{ mol Al} = 3 \text{ mol Br}_2$

$$0.1564455569 \text{ mol Br}_2 \times \frac{2 \text{ mol Al}}{3 \text{ mol Br}_2} = 0.104297038 \text{ mol Al}$$

③ Convert the moles aluminum to mass. Use formula weight. $\text{Al}: 26.98$
 $26.98 \text{ g Al} = \text{mol Al}$

$$0.104297038 \text{ mol Al} \times \frac{26.98 \text{ g Al}}{\text{mol Al}} = \boxed{2.81 \text{ g Al}}$$

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

$$25.0 \text{ g Br}_2 \times \frac{1 \text{ mol Br}_2}{159.8 \text{ g Br}_2} \times \frac{2 \text{ mol Al}}{3 \text{ mol Br}_2} \times \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = 2.81 \text{ g Al}$$

①
②
③

$$\begin{array}{r}
 25.0 \text{ g Br}_2 \\
 + 2.81 \text{ g Al} \\
 \hline
 27.8 \text{ g AlBr}_3
 \end{array}$$

Conservation of mass!

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?

Calculating the mass of aluminum bromide directly:

$$25.0 \text{ g Br}_2 \times \frac{1 \text{ mol Br}_2}{159.8 \text{ g Br}_2} \times \frac{2 \text{ mol AlBr}_3}{3 \text{ mol Br}_2} \times \frac{266.68 \text{ g AlBr}_3}{1 \text{ mol AlBr}_3} = 27.8 \text{ g AlBr}_3$$

$$\begin{array}{r}
 \text{AlBr}_3: \text{ Al} : 1 \times 26.98 \\
 \text{Br} : 3 \times 79.90 \\
 \hline
 266.68
 \end{array}$$