## Aim: How do chemists work with moles?

1) 1 mole of $\mathrm{H}_{2}$ contains $6.02 \times 10^{23}$ molecules of $\mathrm{H}_{2}$

1 mole of $\mathrm{O}_{2}$ contains $6.02 \times 10^{23}$ molecules of $\mathrm{O}_{2}$
1 mole of $\mathrm{H}_{2} \mathrm{O}$ contains $6.02 \times 10^{23}$ molecules of $\mathrm{H}_{2} \mathrm{O}$
2) You can't count 1 mole of molecules, but you could weigh them.

How much would 1mole of $\mathrm{H}_{2} \mathrm{O}$ weigh? 18 grams
Sound familiar?

$$
18 \mathrm{amu}=\text { "formula mass" of } \mathrm{H}_{2} \mathrm{O}
$$

So, $18 \mathrm{~g} / \mathrm{mole}$ is called the "gram formula mass"

$$
\begin{aligned}
& \mathrm{H}_{2} \mathrm{O} \\
& 2+16=18 \mathrm{am} \longleftrightarrow \\
& \longrightarrow
\end{aligned} 18 \mathrm{~g} / \mathrm{mole}
$$

This means that $\underline{6.02} \times \underline{10^{23}}$ molecules of water weighs $\underline{18}$ grams.

| Supermarket | Quantity | Chem Lab |
| :---: | :---: | :---: |
| 1 dozen apples | number | mole <br> $6.02 \times 10^{23}$ |
| 4 pounds apples | weight | grams |
| 1 basket apples | volume | liters |

b) What is the gram formula mass of NaCl ?

c) What is the gram formula mass of $\mathrm{CO}_{2}$ weigh?
$12+2(16)=44 \mathrm{~g} / \mathrm{mole}$
So, 1 mole of $\mathrm{H}_{2} \mathrm{O}$ weighs 18 g and 1 mole of $\mathrm{CO}_{2}$ weighs 44 grams. That is, the number of molecules is the same, but the masses are different. It's just like a dozen cherries doesn't weigh the same as a dozen apples.

2a) What is the gfm of $\mathrm{Na}_{2} \mathrm{CO}_{3}$ ?

$$
2(23)+12+3(16)=106 \mathrm{~g} / \mathrm{mole}
$$

b) How many moles are in 265 g of $\mathrm{Na}_{2} \mathrm{CO}_{3}$ ?
Refer to REF TABLE T
\#moles $=\frac{265 \mathrm{~g}}{106 \mathrm{~g} / \mathrm{mole}}=2.5 \mathrm{~mole}$
c) What is the mass of 0.75 mole $\mathrm{Na}_{2} \mathrm{CO}_{3}$ ?
\# moles $=\frac{\text { given mass }}{g \mathrm{fm}}$
0.75 mole $=\frac{\mathbf{X}}{106 \mathrm{~g} / \mathrm{mole}} \quad$ DON'T FORGET THE UNITS!!

$$
0.75 \text { mole } \cdot 106 \frac{\mathrm{~g}}{\text { mole }}=79.5 \mathrm{~g}
$$

3) How much does 2.0 mole of $\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}$ weigh?

$$
\begin{aligned}
& 6(12)+12(1)+6(16)=180 \mathrm{~g} / \mathrm{mole} \\
2.0 \mathrm{~mole} & =\frac{\mathbf{X}}{180 \mathrm{~g} / \mathrm{mole}}
\end{aligned}
$$

$$
2.0 \text { mole } \cdot 180 \mathrm{~g} / \mathrm{mole}=360 \mathrm{~g}
$$

4) How many moles are in 330 g CaCl ?

$$
X=\frac{330 \mathrm{~g}}{110 \mathrm{~g} / \mathrm{mole}} \quad X=3 \mathrm{~mole}
$$

5) Given: 1 mole $\mathrm{NH}_{3}$ and 0.5 mole $\mathrm{NO}_{2}$
a) Which quantity has the greatest \# molecules?
$\begin{array}{ll}1 \text { mole NH }_{3} & 0.5 \text { mole NO}_{2} \\ 6.02 \times 10^{23} \text { molecules } & 0.5\left(6.02 \times 10^{23}\right)=3.01 \times 10^{23} \text { molecules }\end{array}$
b) Which quantity has the greatest mass?
$\mathrm{NH}_{3}=17 \mathrm{~g} / \mathrm{mole}$
$\mathrm{NO}_{2}=46 \mathrm{~g} / \mathrm{mole}$
1 mole $\times 17 \mathrm{~g} / \mathrm{mole}=17 \mathrm{~g}$
0.5 mole $\times 46 \mathrm{~g} / \mathrm{mole}=23 \mathrm{~g}$

It's just like comparing a dozen cherries with a $1 / 2$ dozen apples. There are more cherries, but the apples weigh more.

