

Name Mr. Shank

Period AP 1,2,3

Introduction to the Mole

1. What is the value of Avogadro's number?

$$N_A = \underline{6.022 \times 10^{23}}$$

2. How many eggs are in one mole of eggs?

$$\text{Eggs} = \underline{6.022 \times 10^{23}}$$

3. Give the molar masses of each of the following compounds. Show all **work** AND all **units**.

a) NO_2

$$\begin{aligned} \text{molar mass } (\text{NO}_2) &= 1 \times \text{molar mass } (\text{N}) + 2 \times \text{molar mass } (\text{O}) \\ &= 1(14.007 \text{ g/mol}) + 2(16.00 \text{ g/mol}) \\ &= \underline{46.007 \text{ g/mol}} \end{aligned}$$

b) CuSO_4

$$\begin{aligned} \text{molar mass } (\text{CuSO}_4) &= 1 \times \text{molar mass } (\text{Cu}) + 1 \times \text{molar mass } (\text{S}) + 4 \times \text{molar mass } (\text{O}) \\ &= 1(63.55 \text{ g/mol}) + 1(32.06 \text{ g/mol}) + 4(16.00 \text{ g/mol}) \\ &= \underline{159.61 \text{ g/mol}} \end{aligned}$$

c) $\text{Mg}(\text{NO}_3)_2$

$$\begin{aligned} \text{molar mass } (\text{Mg}(\text{NO}_3)_2) &= 1 \times \text{molar mass } (\text{Mg}) + 2 \times [1 \times \text{molar mass } (\text{N}) + 3 \times \text{molar mass } (\text{O})] \\ &= 1(24.30 \text{ g/mol}) + 2[1(14.007 \text{ g/mol}) + 3(16.00 \text{ g/mol})] \\ &= \underline{148.314 \text{ g/mol}} \end{aligned}$$

4. Give the number of moles in

a) 100 g of NO_2

$$100 \text{ g } \text{NO}_2 \times \frac{1 \text{ mol } \text{NO}_2}{46.007 \text{ g } \text{NO}_2} = \underline{2.17 \text{ mol } \text{NO}_2}$$

b) 26 g of CuSO_4

$$26 \text{ g } \text{CuSO}_4 \times \frac{1 \text{ mol } \text{CuSO}_4}{159.61 \text{ g } \text{CuSO}_4} = \underline{0.16 \text{ mol } \text{CuSO}_4}$$

c) 8.64 mg of $\text{Mg}(\text{NO}_3)_2$

$$\frac{8.64 \text{ mg } \text{Mg}(\text{NO}_3)_2}{1000 \text{ mg}} \times \frac{1 \text{ mol } \text{Mg}(\text{NO}_3)_2}{148.314 \text{ g } \text{Mg}(\text{NO}_3)_2} = 0.0000583 = \underline{5.83 \times 10^{-5} \text{ mol } \text{Mg}(\text{NO}_3)_2}$$

5. Give the number of molecules in ~~100 g of NO₂~~

a) 100 g of NO₂

Method 1: Convert from moles (found in last problem) to molecules

$$\frac{2.17 \text{ mol NO}_2}{1 \text{ mol NO}_2} \times \frac{6.022 \times 10^{23} \text{ molecules NO}_2}{1 \text{ mol NO}_2} = 1.31 \times 10^{24} \text{ molecules NO}_2$$

Method 2: Convert directly from mass to molecules

$$\frac{100 \text{ g NO}_2}{46.007 \text{ g NO}_2} \times \frac{1 \text{ mol NO}_2}{1 \text{ mol NO}_2} \times \frac{6.022 \times 10^{23} \text{ molecules NO}_2}{1 \text{ mol NO}_2} = 1.31 \times 10^{24} \text{ molecules NO}_2$$

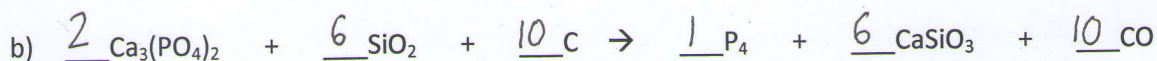
b) 31 mol of CuSO₄

$$\frac{31 \text{ mol CuSO}_4}{1 \text{ mol CuSO}_4} \times \frac{6.022 \times 10^{23} \text{ molecules CuSO}_4}{1 \text{ mol CuSO}_4} = 1.87 \times 10^{25} \text{ molecules CuSO}_4$$

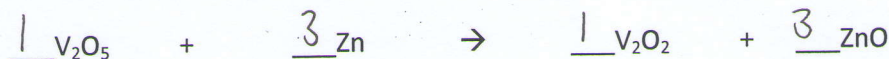
c) 92 millimole of Mg(NO₃)₂

$$\frac{92 \text{ millimole Mg(NO}_3)_2}{1000 \text{ millimole Mg(NO}_3)_2} \times \frac{1 \text{ mol Mg(NO}_3)_2}{1 \text{ mol Mg(NO}_3)_2} \times \frac{6.022 \times 10^{23} \text{ molecules Mg(NO}_3)_2}{1 \text{ mol Mg(NO}_3)_2} = 5.54 \times 10^{22} \text{ molecules Mg(NO}_3)_2$$

6. Balance the following chemical equations:



7. Vanadium (V) oxide, V₂O₅, can be reduced by zinc to form vanadium (II) oxide, V₂O₂, and zinc oxide, ZnO.



a) Balance the above reaction by putting the correct coefficients in the blanks.

b) Assuming an unlimited amount of zinc metal, what mass of V₂O₅ is needed to produce 100 g of V₂O₂?

$$100 \text{ g V}_2\text{O}_2 \times \frac{1 \text{ mol V}_2\text{O}_2}{133.88 \text{ g V}_2\text{O}_2} \times \frac{1 \text{ mol V}_2\text{O}_5}{1 \text{ mol V}_2\text{O}_2} \times \frac{181.88 \text{ g V}_2\text{O}_5}{1 \text{ mol V}_2\text{O}_5} = 135.85 \text{ g V}_2\text{O}_5$$