

- Identify the representative particle for the following substances
 - molecular compound molecule
 - ionic compound formula unit
 - elemental substance atom
 - water molecule
 - table salt formula unit
 - a piece of coal (carbon) atom
- Define the following:
 - gram formula mass – the number of grams in one mole of an ionic substance
 - gram molecular mass – the number of grams in one mole of a molecular substance
 - gram atomic mass – the number of grams in one mole of an elemental substance
 - molar mass – the number of grams in one mole of any substance
 - molar volume – the volume one mole of a gas occupies. At standard temperature and pressure (STP), this value is 22.4 L/mol
 - STP – standard temperature and pressure. $T = 0^{\circ}\text{C}$, $P = 1 \text{ atm}$
- Find the molar mass of the following of the following compounds
 - PbSO_4 303.26 g/mol
 - $\text{Al}_2(\text{C}_2\text{O}_3)_3$ 270.02 g/mol
 - $\text{C}_{18}\text{H}_{28}\text{O}_3\text{N}_5$ 362.51 g/mol

4. How many atoms are there in 2.55 moles of calcium?

$$(2.55 \text{ mol Ca}) \left(\frac{6.02 \times 10^{23} \text{ ATOMS Ca}}{1 \text{ mol Ca}} \right) = 1.54 \times 10^{24} \text{ atoms Ca}$$

5. How many molecules of oxygen gas are there in 3.90 L at STP?

$$(3.90 \text{ L}) \left(\frac{1 \text{ mol}}{22.4 \text{ L}} \right) \left(\frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \right) = 1.05 \times 10^{23} \text{ molecules O}_2$$

6. How many grams of sodium phosphate are there in 0.417 moles of sodium phosphate?

$$\text{Na}_3\text{PO}_4 \Rightarrow (23.0 \text{ g} \times 3) + (31.0 \text{ g} \times 1) + (16.0 \text{ g} \times 4) = 164.0 \frac{\text{g}}{\text{mol}}$$

$$(0.417 \text{ mol Na}_3\text{PO}_4) \left(\frac{164.0 \text{ g}}{1 \text{ mol}} \right) = 68.4 \text{ g Na}_3\text{PO}_4$$

7. How many atoms are there in 125 g of ethanol ($\text{C}_2\text{H}_6\text{O}$)?

$$(125 \text{ g C}_2\text{H}_6\text{O}) \left(\frac{1 \text{ mol C}_2\text{H}_6\text{O}}{46.1 \text{ g}} \right) \left(\frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \right) \left(\frac{9 \text{ ATOMS}}{1 \text{ molecule}} \right) = 1.47 \times 10^{25} \text{ ATOMS}$$

$\text{C}_2\text{H}_6\text{O} \Rightarrow (12.0 \text{ g} \times 2) + (1.01 \times 6) + 16.0 = 46.1 \text{ g/mol}$

8. An unknown gas has a density of 0.760 g/L at STP. Which of the following gases could this be (NO, SO₂, O₂, Cl₂, NH₃)? FIND DENSITY OF EACH GAS & COMPARE TO 0.760 $\frac{g}{L}$

$$\text{NO} = \frac{30.0 \text{ g}}{\text{mol}} \times \left(\frac{1 \text{ mol}}{22.4 \text{ L}} \right) = 1.34 \frac{\text{g}}{\text{L}}$$

$$\text{O}_2 = \frac{32.0 \text{ g}}{\text{mol}} \times \left(\frac{1 \text{ mol}}{22.4 \text{ L}} \right) = 1.43 \frac{\text{g}}{\text{L}}$$

$$\text{SO}_2 = \frac{64.0 \text{ g}}{\text{mol}} \times \left(\frac{1 \text{ mol}}{22.4 \text{ L}} \right) = 2.85 \frac{\text{g}}{\text{L}}$$

$$\text{Cl}_2 = \frac{70.9 \text{ g}}{\text{mol}} \times \left(\frac{1 \text{ mol}}{22.4 \text{ L}} \right) = 3.17 \frac{\text{g}}{\text{L}}$$

$$\text{NH}_3 = \frac{17.0 \text{ g}}{\text{mol}} \times \left(\frac{1 \text{ mol}}{22.4 \text{ L}} \right) = 0.759 \frac{\text{g}}{\text{L}}$$

9. Find the percent composition of HCl

$$\text{H}: 1.01 \text{ g} \times 1 = 1.01 \text{ g}$$

$$\% \text{H} = \frac{1.01 \text{ g}}{36.46 \text{ g}} \times 100\% = 2.77\% \text{ H}$$

$$\text{Cl}: 35.45 \text{ g} \times 1 = 35.45 \text{ g}$$

$$36.46 \text{ g/mol}$$

$$\% \text{Cl} = \frac{35.45}{36.46} \times 100\% = 97.23\% \text{ Cl}$$

10. A compound with a gram molecular mass of 231.27 g/mol has the following percent composition:

Carbon = 77.90 % C

Hydrogen = 3.93 % H

Nitrogen = 18.17 % N

Find the empirical and molecular formulas of the compound

ASSUME 100.0g OF COMPOUND

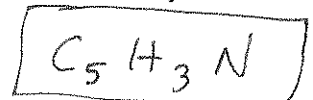
$$\left(\frac{77.90 \text{ g C}}{12.01 \text{ g C}} \right) \left(\frac{1 \text{ mol C}}{12.01 \text{ g C}} \right) = 6.486 \text{ mol C}$$

$$\left(\frac{3.93 \text{ g H}}{1.01 \text{ g H}} \right) \left(\frac{1 \text{ mol H}}{1.01 \text{ g H}} \right) = 3.89 \text{ mol H}$$

$$\left(\frac{18.17 \text{ g N}}{14.01 \text{ g N}} \right) \left(\frac{1 \text{ mol N}}{14.01 \text{ g N}} \right) = 1.297 \text{ mol N}$$

$$\begin{array}{ccc} \text{C}_{6.486} & \text{H}_{3.89} & \text{N}_{1.297} \\ \hline 1.297 & 1.297 & 1.297 \end{array}$$

↓



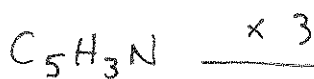
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EMPIRICAL FORMULA

$$\frac{\text{MOLECULAR MASS}}{\text{EFM}} = \frac{231.27 \frac{\text{g}}{\text{mol}}}{77.0 \frac{\text{g}}{\text{mol}}} = 3$$

$$\text{EFM} = (12.0 \times 5) + (1.01 \times 3) + (14.0 \times 1)$$

$$\text{EFM} = 77.0 \frac{\text{g}}{\text{mol}}$$



(EMPIRICAL FORMULA)

