

1. The following three containers have identical capacities. Each contains Avogadro's number of particles of a gaseous element. Fill in the blanks with the missing information. (3 marks)

| | | |
|------------------------|---|---------------------------------------|
| A | B | C |
| 20.18 g | 159.8 g | 32.00 g |
| One mol of Ne atoms | One mol of <u>Br₂</u> molecules | One mol of oxygen <u>molecules</u> |

2. Calculate the molar mass, in grams, of the following (1 mark): (NH₄)₂SO₄

$$\begin{array}{l}
 N = (14.01 \times 2) = 28.02 \\
 H = (1.01 \times 8) = 8.08 \\
 S = (32.06 \times 1) = 32.06 \\
 O = (16.00 \times 4) = 64.00
 \end{array}
 \left. \vphantom{\begin{array}{l} N \\ H \\ S \\ O \end{array}} \right\}
 \underline{132.16 \text{ g/mol}} = \boxed{132.2 \text{ g/mol}}$$

From here on, show all of your work! Remember sigfigs.

3. Determine the mass, in grams, of the following molecule (2 marks): 1 molecule Sc(OH)₃

$$1 \text{ molec Sc(OH)}_3 \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ molec}} \times \frac{95.99 \text{ g}}{1 \text{ mol}} = 1.593988 \times 10^{-22} \Rightarrow \boxed{1.594 \times 10^{-22} \text{ g}}$$

$$(44.96 \times 1) + (16.00 \times 3) + (1.01 \times 3) = 95.99 \text{ g/mol}$$

4. How many moles of CCl₄ are there in 2.67 x 10²⁵ molecules CCl₄? (2 marks)

$$2.67 \times 10^{25} \text{ molec CCl}_4 \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ molec}} = 44.337 \Rightarrow \boxed{44.3 \text{ mol CCl}_4}$$

5. How many moles of Cl are there in question #4? (2 marks)

$$2.67 \times 10^{25} \text{ molec CCl}_4 \times \frac{1 \text{ mol CCl}_4}{6.022 \times 10^{23} \text{ molec CCl}_4} \times \frac{4 \text{ mol Cl}}{1 \text{ mol CCl}_4} = 177.349 \Rightarrow \boxed{177 \text{ mol Cl}}$$

6. How many oxygen atoms are in 23.5 grams of lithium phosphate? (5 marks)

$$23.5 \text{ g Li}_3\text{PO}_4 \times \frac{1 \text{ mol}}{115.79 \text{ g Li}_3\text{PO}_4} \times \frac{6.022 \times 10^{23} \text{ molec}}{1 \text{ mol}} \times \frac{4 \text{ atoms O}}{1 \text{ molec}} = 4.8867 \times 10^{23}$$

$$(6.94 \times 3) + (30.97 \times 1) + (16.00 \times 4) = 115.79 \text{ g/mol}$$

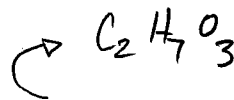
$$\boxed{4.89 \times 10^{23} \text{ atoms O}}$$

7. 0.50 mol of an element has a mass of 25.99 grams. Identify this element. (2 marks)

$$\frac{25.99 \text{ g}}{0.50 \text{ mol}} = 51.98 \frac{\text{g}}{\text{mol}} = \boxed{52 \frac{\text{g}}{\text{mol}}} \rightarrow \text{Chromium} \\ \text{Cr}$$

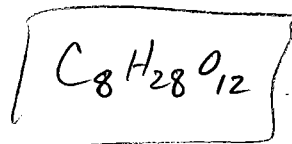
8. A sample was analyzed and found to contain 30.4% carbon, 8.8% hydrogen, and 60.7% oxygen. Calculate the empirical formula. (4 marks)

$$\begin{aligned} \text{C} &\rightarrow 30.4 \text{ g} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = \frac{2.531 \text{ mol}}{2.531 \text{ mol}} = 1 \quad \times 2 = 2 \\ \text{H} &\rightarrow 8.8 \text{ g} \times \frac{1 \text{ mol}}{1.01 \text{ g}} = \frac{8.71287 \text{ mol}}{2.531 \text{ mol}} = 3.442 \times 2 \approx 7 \\ \text{O} &\rightarrow 60.7 \text{ g} \times \frac{1 \text{ mol}}{16.00 \text{ g}} = \frac{3.7937 \text{ mol}}{2.531 \text{ mol}} = 1.4987 \times 2 = 3 \end{aligned}$$



9. In the above question the molecular formula mass was found to be 316 grams. Calculate the molecular formula. (2 marks)

$$\frac{316 \text{ g}}{79.09 \text{ g}} = 3.995 \approx 4$$



$$(12.01 \times 2) + (1.01 \times 7) + (16.00 \times 3) = 79.09 \text{ g/mol}$$

10. What mass of silver is in 2.24 kg sample of silver chromate? (4 marks)

$$2240 \text{ g Ag}_2\text{CrO}_4 \times \frac{1 \text{ mol}}{331.74 \text{ g Ag}_2\text{CrO}_4} \times \frac{6.022 \times 10^{23} \text{ molec}}{1 \text{ mol}} \times \frac{2 \text{ atoms Ag}}{1 \text{ molec}} \times \frac{1 \text{ mol Ag}}{6.022 \times 10^{23} \text{ atoms}}$$

$$\frac{107.87 \text{ g Ag}}{1 \text{ mol Ag}} = 1456.735 \text{ g} \Rightarrow \boxed{1.46 \text{ Kg Ag}}$$

$$(107.87 \times 2) + (116.00 \times 1) = 331.74 \frac{\text{g}}{\text{mol}}$$