Molar Calculations Quiz - KEY

1. How many moles are in 5.12×10^{22} molecules of Sulfur Hexafluoride?

    A. 3.08×10^{46} moles
    B. 0.085 moles
    C. 0.1 moles
    D. 3.1×10^{46} moles

2. How many Lithium ions are in 3.11 moles of Lithium Carbonate, Li_2CO_3?

    A. 1.87×10^{24} ions
    B. 3.74×10^{24} ions
    C. 5.62×10^{24} ions
    D. 1.54×10^{-23} ions

3. What is the percent composition by mass of the elements in Calcium Chloride?

    A. 36.1% Ca, 63.9% Cl
    B. 36.1% Cl, 63.9% Ca
    C. 53.1% Ca, 46.9% Cl
    D. 53.1% Cl, 46.9% Ca

4. What is the empirical formula of a compound containing 39.9% C, 6.7% H, and 53.4% O?

    A. $C_3H_6O_3$
    B. C_2HO
    C. $C_{10}H_{20}O_{10}$
    D. CH_2O

5. What is the empirical formula of a compound containing 65.2% Sc, 34.8% O?

    A. Sc_3O_2
    B. Sc_2O_3
    C. ScO_2
    D. Sc_2O

Solutions:

1. 0.085 moles

   Molecules → moles

   $$5.12 \times 10^{22} \text{ molecules} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}} = 0.085 \text{ moles}$$

   Don't forget significant figures!! 0.1 is a correct answer, but with the wrong number of significant figures.

2. 3.74×10^{24} Chlorate ions

   Moles → Formula Units → ions

   $$3.11 \text{ moles} \times \frac{6.02 \times 10^{23} \text{ formula units}}{1 \text{ mole}} \times \frac{2 \text{ Lithium ions}}{1 \text{ formula unit}}$$

   $$= 3.74 \times 10^{24} \text{ ions}$$

   A common mistake in this problem was forgetting the last conversion to ions. Also, keep in mind that while there are 3 ions in total, the problem asks only for the Lithium Ions.

3. 36.1% Ca, 63.9% Cl

   Calcium Chloride = $CaCl_2$

   Many of you only thought of it as CaCl. Make sure you balance charges with the criss-cross rule!

   Molar mass = 1(40.078) + 2(35.453) = 110.984 g/mol

   $$\% \text{ Ca} = \frac{40.078}{110.984} \times 100\% = 36.1\%$$

   $$\% \text{ Cl} = \frac{2(35.453)}{110.984} \times 100\% = 63.9\%$$

4. CH_2O

The first thing to notice is that an empirical formula is a simplified formula. In your answer choices, A and C are not simplified, so they cannot be correct.

Step 1: Convert percent to grams	C = 39.9g	H = 6.7g	O = 53.4g
Step 2: Convert grams to moles	$C = \dfrac{39.9}{12.011}$ $= 3.32$ moles	$H = \dfrac{6.7}{1.008}$ $= 6.62$ moles	$O = \dfrac{53.4}{15.999}$ $= 3.34$ moles
Step 3: Divide by the smallest number of moles to get the mole ratios	$C = \dfrac{3.32}{3.32}$ $= 1$	$H = \dfrac{6.62}{3.32}$ $= 2$	$O = \dfrac{3.34}{3.32}$ $= 1$

This gives us a formula of CH_2O

5. Sc_2O_3

Step 1: Convert percent to grams	Sc = 65.2g	O = 34.8g
Step 2: Convert grams to moles	$Sc = \dfrac{65.2}{44.956}$ $= 1.45$ moles	$O = \dfrac{34.8}{15.999}$ $= 2.17$ moles
Step 3: Divide by the smallest number of moles to get the mole ratios	$Sc = \dfrac{1.45}{1.45}$ $= 1$	$O = \dfrac{2.17}{1.45}$ $= 1.5$
Step 4: Multiply subscripts (if necessary) to make whole numbers	1 x 2 = 2	1.5 x 2 = 3

This gives us a formula of Sc_2O_3