

## Mole Conversion Practice Test

Name:

Date:

Block:

Key

1 L = 1000 mL

1 kg = 1000 g

1 g = 1000 mg

- C 1. The percentage of calcium (by mass) in the molecule  $\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$  is  
 a) 7.89 % b) 22.0 % c) 23.7 % d) 54.4 %

Show your work below:

$$\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3 = (3 \times 40.08) + (2 \times 55.85) + (3 \times 28.09) + (12 \times 16.00) = 508.21 \text{ g/mol}$$

$$\frac{\text{mass Ca}}{\text{total}} = \frac{(3 \times 40.08)}{508.21} \times 100\% = 23.66\%$$

- A 2. A molecular formula tells us:

- a) The actual number of atoms of each element in a compound  
 b) The lowest ratio of atoms of each element in a compound  $\rightarrow$  empirical  
 c) All possible multiples of an empirical formula  
 d) The concentration of that compound in a solution

- C 3. What are the units for molarity?

- a) g/L b) mol/mL c) mol/L d) L/mol

$$M = \frac{\text{mol}}{\text{L}}$$

- D 4. The empirical formula tells us:

- a) the actual number of atoms in a compound  
 b) the concentration of a compound  
 c) the molar mass of a compound  
d) the lowest ratio of each element in a compound

- A 5. Another term for molarity is:

- a) concentration b) molar mass c) molecular formula d) moles/gram

- A 6. What is the mass of a single molecule of water?  $\text{H}_2\text{O}$

- a)  $3.0 \times 10^{-23}$  grams b) 1.0 gram c)  $6.0 \times 10^{-22}$  gram d) 18.0 grams e)  $2.9 \times 10^{23}$  grams

$$1 \text{ molecule H}_2\text{O} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ molecules}} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol}}$$

- A 7. At the same temperature and pressure, which sample of gas contains the same number of particles as one liter of oxygen,  $\text{O}_2$ ?

- a) one liter of He  
 b) three liters of  $\text{CO}_2$   
 c) two liters of Ne  
 d) two liters of  $\text{H}_2$   
 e) four liters of  $\text{SO}_3$

At STP,  $\frac{22.4 \text{ L}}{\text{mol}}$  for all gases

**Written:**

1. How many atoms are in  $\text{Ni}(\text{H}_2\text{O})_2(\text{NH}_3)_3\text{Cl}_2$ ?

$$\begin{array}{l} \text{Ni} - 1 \quad \text{N} - 3 \\ \text{H} - 4 + 9 \quad \text{Cl} - 2 \\ \text{O} - 2 \end{array} \quad \text{Total} = \boxed{21 \text{ atoms}}$$

2. What is the mass of a 250.0 mL sample of hydrogen sulfide ( $\text{H}_2\text{S}$ ) at STP?

$$250.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{34.09 \text{ g}}{1 \text{ mol}} = 0.380468 = \boxed{0.3805 \text{ g H}_2\text{S}}$$

4sf

3. At STP, argon gas has a molar volume of 22.4 L.

4. How many molecules of potassium iodide are in 10.0g of potassium iodide?

$$10.0 \text{ g} \times \frac{1 \text{ mol}}{166.00 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 3.6277 \times 10^{22} = \boxed{3.63 \times 10^{22} \text{ molecules KI}}$$

3sf

5. A 0.600 mol sample of an unknown gas has a mass of 52.8 g. This gas is a compound of carbon and fluorine. Find the molecular formula.

$$\frac{52.8 \text{ g}}{0.600 \text{ mol}} = 88.0 \text{ g/mol}$$



$$\begin{array}{l} \text{C} = 12.01 \text{ g/mol} \\ \text{F} = 19.00 \text{ g/mol} \end{array}$$

6. An experiment is conducted to calculate the molar volume. The following data is collected:

Moles of $\text{N}_2$ gas	0.00166 mol
Volume of $\text{N}_2$ collected	47.2 mL
Room temperature	21.0°C
Pressure	100.4 kPa

Calculate the molar volume of  $\text{N}_2$  at 21.0°C and 100.4 kPa using the data.

$$\frac{47.2 \text{ mL}}{0.00166 \text{ mol}} \times \frac{1 \text{ L}}{1000 \text{ mL}} = \boxed{28.4 \text{ L/mol}}$$

3sf

7. Find the volume occupied by 21.6g of  $\text{N}_2\text{H}_4$  gas at STP.

$$21.6 \text{ g} \times \frac{1 \text{ mol}}{32.06 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \boxed{15.1 \text{ L N}_2\text{H}_4}$$

3sf

8. The molar volume of H<sub>2</sub> at 21.0°C, 100.4 kPa is 24.3 L/mol. Calculate the mass of 0.213 L of H<sub>2</sub>.

$$0.213 \cancel{\text{L}} \times \frac{1 \cancel{\text{mol}}}{24.3 \cancel{\text{L}}} \times \frac{2.02 \text{g}}{1 \cancel{\text{mol}}} = \boxed{0.0177 \text{g H}_2}$$

3sf

9. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as NutraSweet. The molecular formula for aspartame is C<sub>14</sub>H<sub>18</sub>N<sub>2</sub>O<sub>5</sub>.

a. Calculate the molar mass of aspartame.

$$(14 \times 12.01) + (18 \times 1.01) + (2 \times 14.01) + (5 \times 16.00) = \boxed{294.34 \text{g/mol}}$$

C<sub>14</sub>H<sub>18</sub>N<sub>2</sub>O<sub>5</sub>

b. How many moles of molecules are present in 10.0 g of aspartame?

$$10.0 \cancel{\text{g}} \times \frac{1 \cancel{\text{mol}}}{294.34 \cancel{\text{g}}} \times \frac{6.022 \times 10^{23} \text{molecules}}{1 \cancel{\text{mol}}} = \boxed{2.05 \text{molecules C}_{14}\text{H}_{18}\text{N}_2\text{O}_5}$$

3sf

c. Calculate the mass in grams of 1.56 mol of aspartame.

$$1.56 \cancel{\text{mol}} \times \frac{294.34 \text{g}}{1 \cancel{\text{mol}}} = 459.17 = \boxed{459 \text{g C}_{14}\text{H}_{18}\text{N}_2\text{O}_5}$$

3sf

d. How many molecules are in 5.0 mg of aspartame?

$$5.0 \cancel{\text{mg}} \times \frac{1 \cancel{\text{g}}}{1000 \cancel{\text{mg}}} \times \frac{1 \cancel{\text{mol}}}{294.34 \cancel{\text{g}}} \times \frac{6.022 \times 10^{23} \text{molecules}}{1 \cancel{\text{mol}}} = \boxed{1.0 \times 10^{19} \text{molecules C}_{14}\text{H}_{18}\text{N}_2\text{O}_5}$$

2sf

10. Nitrosyl chloride (NOCl) is a gas used in the synthesis of some pharmaceutical compounds. Find the mass of a 5.62 mL sample of nitrosyl chloride at STP.

$$5.62 \cancel{\text{mL}} \times \frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \times \frac{1 \cancel{\text{mol}}}{22.4 \cancel{\text{L}}} \times \frac{65.46 \text{g}}{1 \cancel{\text{mol}}} = \boxed{0.0165 \text{g NOCl}}$$

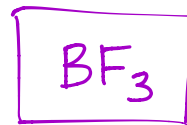
3sf

11. Find the empirical formula for the following compounds:

a) 15.9% B, 84.1% F

$$B: 15.9g \times \frac{1 \text{ mol}}{10.81g} = 1.47 \text{ mol}_B \rightarrow \text{Smallest} = 1 B$$

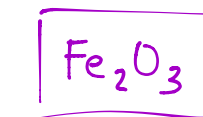
$$F: 84.1g \times \frac{1 \text{ mol}}{19.00g} = 4.43 \text{ mol}_F \rightarrow \frac{4.43 \text{ mol}_F}{1.47 \text{ mol}_B} = \sim 3 F$$



b) 70.0% Fe, 30.0% O

$$Fe: 70.0g \times \frac{1 \text{ mol}}{55.85g} = 1.25 \text{ mol}_{Fe} \rightarrow \text{Smallest} = 1 Fe$$

$$O: 30.0g \times \frac{1 \text{ mol}}{16.00g} = 1.88 \text{ mol}_O \rightarrow \frac{1.88 \text{ mol}_O}{1.25 \text{ mol}_{Fe}} = 1.5 O$$



12. What molar concentration of KCl is produced by measuring out 1.0g KCl and adding water up to 0.350L of solution?

$$\frac{\text{mol}}{L}$$

$$\frac{1.0g}{0.350L} \times \frac{1 \text{ mol}}{74.55g} = \boxed{0.038M \text{ KCl}}$$

2sf