Unit 4 - Quiz/Test Review and Key

MOLES, MOLAR MASS, PERCENT COMPOSITION, EMPIRICAL AND MOLECULAR FORMULAS

The quiz will cover items 1-3 only. The test will cover items 1-5.

1. Students should be able to calculate the molar mass of elements and compounds. Calculate the molar mass of the following:

   A. $Fe(NO_3)_3$

   B. $FeCl_2$

   C. $CuSO_4 \cdot 5H_2O$

2. Students should be able to convert moles to grams, grams to moles, moles to particles, and particles to moles.

   A. Calculate the number of atoms in a 0.75 mole carbon dioxide.

   B. How many grams are there in 1.5×10^{25} molecules of CO_2?

   C. How many atoms are there in 1.3×10^{22} molecules of NO_2?

3. Students should be able to determine the percent composition of a given compound based on its chemical formula. Calculate the percent composition of all elements in the following compounds:

   A. $AgNO_3$

   B. $Pb(SO_4)_2$

   C. Percent by mass of water in magnesium sulfate heptahydrate.

4. Students should be able to find the empirical formula of a compound given its percent composition.

   A. 20.2% Al, 79.8% Cl

   B. 80.3% Zn, 19.7% O

5. Students should be able to find the molecular formula of a compound when given the molar mass of a compound and enough information to find the empirical formula.

   A. Find the molecular formula of a compound made up of 92.3% carbon and 7.7% hydrogen. The molar mass of the compound is 78.00 g/mole.

   B. Find the molecular formula of a compound made up of 94.1% oxygen and 5.9% hydrogen. The molar mass of the compound is 34.00 g/mole.

KEY

1. A) $Fe(NO_3)_3$ $1\,Fe \times 55.85 = 55.85$, $3\,N \times 14.01 = 42.03$, $9\,O \times 16.00 = 144.00$ } = **241.88 g**

B) $FeCl_2$ $1\,Fe \times 55.85 = 55.85$, $2\,Cl \times 35.45 = 70.90$ } = **126.75 g**

C) $CuSO_4 \cdot 5H_2O$ $1\,Cu \times 63.55 = 63.55$, $1\,S \times 32.07 = 32.07$, $4\,O \times 16.00 = 64.00$, $10\,H \times 1.01 = 10.10$, $5\,O \times 16.00 = 80.00$ } **249.72 g**

2. A) $\frac{.75 \text{ mol } CO_2}{1} \frac{6.02 \times 10^{23} \text{ molecules } CO_2}{1 \text{ mol } CO_2} \frac{3 \text{ atoms}}{1 \text{ molecule } CO_2} =$ **1.4×10^{24} atoms**

B) $\frac{1.5 \times 10^{25} \text{ molecules } CO_2}{1} \frac{1 \text{ mol } CO_2}{6.02 \times 10^{23} \text{ molecules } CO_2} \frac{44.01 \text{ g } CO_2}{1 \text{ mol } CO_2}$ ($12.01 + 16.00 + 16.00$) $=$ **1.1×10^{3} g CO_2**

C) $\frac{1.3 \times 10^{22} \text{ molecules } NO_2}{1} \frac{3 \text{ atoms}}{1 \text{ molecule } NO_2} =$ **3.9×10^{22} atoms**

3. A) $AgNO_3$ $1\,Ag \times 107.87 = 107.87$, $1\,N \times 14.01 = 28.02$, $3\,O \times 16.00 = 48.00$, 183.89

$\%\,Ag = \frac{107.87}{183.89} \times 100 = 58.66\%$

$\%\,N = \frac{28.02}{183.89} \times 100 = 15.23\%$

$\%\,O = \frac{48.00}{183.89} \times 100 = 26.10\%$

B) $Pb(SO_4)_2$ $1\,Pb \times 207.2 = 207.2$, $2\,S \times 32.07 = 64.14$, $8\,O \times 16.00 = 128.00$, 399.34

$\%\,Pb = \frac{207.2}{399.34} \times 100 = 51.89\%\,Pb$

$\%\,S = \frac{64.14}{399.34} \times 100 = 16.06\%\,S$

$\%\,O = \frac{128.00}{399.34} \times 100 = 32.05\%\,O$

c) $MgSO_4 \cdot 7H_2O$

$1 Mg \times 24.31 = 24.31$
$1 S \times 32.07 = 32.07$
$4O \times 16.00 = 64.00$
$14H \times 1.01 = 14.14$
$7O \times 16.00 = 112.00$
246.52 (126.14 g)

$\%H_2O = \frac{126.14\ g\ H_2O}{246.52\ g\ total} \times 100 =$

51.17% H_2O

4. a) $\frac{20.2\ g\ Al}{1} \frac{1\ mol\ Al}{26.98\ g\ Al} = \frac{.749\ mol\ Al}{.749} = 1$

$\frac{79.8\ g\ Cl}{1} \frac{1\ mol\ Cl}{35.45\ g\ Cl} = \frac{2.25\ mol\ Cl}{.749} = 3$

$AlCl_3$

b) $\frac{80.3\ g\ Zn}{1} \frac{1\ mol\ Zn}{65.39\ g\ Zn} = 1.23\ mol\ Zn$

$\frac{19.7\ g\ O}{1} \frac{1\ mol\ O}{16.00\ g\ O} = 1.23\ mol\ O$

ZnO

5. a) $\frac{92.3\ g\ C}{1} \frac{1\ mol\ C}{12.01\ g\ C} = 7.69\ mol$

$\frac{7.7\ g\ H}{1} \frac{1\ mol\ H}{1.01\ g\ H} = 7.62\ mol$

empirical **CH** → weighs $12.01\ g + 1.01\ g = 13.01\ g$

$\frac{78.00\ g}{13.01\ g} = 6$

C_6H_6 molecular

b) $\frac{94.1\ g\ O}{1} \frac{1\ mol\ O}{16.00\ g\ O} = 5.88\ mol\ O$

$\frac{5.9\ g\ H}{1} \frac{1\ mol\ H}{1.01\ g\ H} = 5.8\ mol\ H$

empirical **HO** → weighs $1.01 + 16.00 = 17.01\ g$

$\frac{34.00\ g}{17.01\ g} = 2$

H_2O_2 molecular