Chemistry Honors Name: _____

Mole Calculations Review Worksheet – answers on next page.

Complete the problems on this worksheet to review for the Chapter 10 test. Be sure to use dimensional analysis, and label all numbers with units when solving the problems.

1. Calculate the molar mass of each compound.
   a. LiOH
   b. barium bromide
   c. $Mg(C_2H_3O_2)_2$
   d. $Ca(NO_3)_2$
2. How many molecules are in 45.0 grams CH_4?
3. How many moles are in 18.8 grams NaOH?
4. A salt shaker containing 9.58×10^{23} formula units NaCl contains how many moles?
5. Which of the following has the greatest mass?

   4.2 moles C **or** 8.34×10^{24} f.u. $CaCO_3$ **or** 12.6 g $Al(NO_3)_3$
6. Find the number of representative particles in each of the following:
   a. 0.28 mol Ni
   b. 1.84 mol S
   c. 1.32 mol F_2
   d. 3.15 mol K_3PO_4
7. How many liters would 1.45 moles oxygen gas occupy at STP?
8. How many grams would 15.8 L of ammonia occupy at STP?
9. How many <u>total atoms</u> are in 5.8 mol $CaCl_2$?
10. Calculate the percent composition of each element in the following compounds:
    a. iron(III) oxide
    b. $Ca_3(PO_4)_2$
    c. methane
    d. H_2SO_4
11. Calculate the empirical and molecular formulas of adrenaline. The compound has a molecular mass of 183 g/mol, and is 59.0% C, 7.1% H, 26.2% O, and 7.7% N by mass.
12. A compound is 72.2% Mg and 27.8% N by mass. Calculate the empirical formula.
13. Nicotine is 74.1% C, 8.6% H, and 17.3% N by mass. The molecular mass of nicotine is 162 g/mol. Calculate its empirical and molecular formulas.
14. How many <u>total ions</u> are in 2.95 grams $MgSO_3$?

Answers to ch. 10 review problems

1. (a) $6.9 + 16.0 + 1.0 = \boxed{23.9\ g/mol}$

(b) $BaBr_2$: $137.3 + 2(79.9) = \boxed{297.1\ g/mol}$

(c) $24.3 + 4(12.0) + 6(1.0) + 4(16.0) = \boxed{142.3\ g/mol}$

(d) $40.1 + 2(14.0) + 6(16.0) = \boxed{164.1\ g/mol}$

2. $45.0\ g\ CH_4 \times \frac{1\ mol\ CH_4}{16.0\ g\ CH_4} \times \frac{6.02 \times 10^{23}\ molecules\ CH_4}{1\ mol\ CH_4} = \boxed{1.69 \times 10^{24}\ molecules\ CH_4}$

3. $18.8\ g\ NaOH \times \frac{1\ mol\ NaOH}{40.0\ g\ NaOH} = \boxed{0.47\ mol\ NaOH}$

4. $9.58 \times 10^{23}\ f.u.\ NaCl \times \frac{1\ mol\ NaCl}{6.02 \times 10^{23}\ f.u.\ NaCl} = \boxed{1.59\ mol\ NaCl}$

5. convert to grams, then compare all 3 gram values ...

$4.2\ mol\ C \times \frac{12.0\ g\ C}{1\ mol\ C} = 50\ g\ C$

$8.34 \times 10^{24}\ f.u.\ CaCO_3 \times \frac{1\ mol\ CaCO_3}{6.02 \times 10^{23}\ f.u.\ CaCO_3} \times \frac{100.1\ g\ CaCO_3}{1\ mol\ CaCO_3} = \boxed{1390\ g\ CaCO_3}$

$12.6\ g\ Al(NO_3)_3$

↑ greatest mass (by FAR!)

6. (a) $0.28\ mol\ Ni \times \frac{6.02 \times 10^{23}\ atoms\ Ni}{1\ mol\ Ni} = \boxed{1.7 \times 10^{23}\ atoms\ Ni}$

(b) $1.84\ mol\ S \times \frac{6.02 \times 10^{23}\ atoms\ S}{1\ mol\ S} = \boxed{1.11 \times 10^{24}\ atoms\ S}$

6. (c) $1.32 \text{ mol } F_2 \times \frac{6.02 \times 10^{23} \text{ molecules } F_2}{1 \text{ mol } F_2} = \boxed{7.95 \times 10^{23} \text{ molecules } F_2}$

(d) $3.15 \text{ mol } K_3PO_4 \times \frac{6.02 \times 10^{23} \text{ f.u. } K_3PO_4}{1 \text{ mol } K_3PO_4} = \boxed{1.90 \times 10^{24} \text{ f.u. } K_3PO_4}$

7. $1.45 \text{ mol } O_2 \times \frac{22.4 \text{ L } O_2}{1 \text{ mol } O_2} = \boxed{32.5 \text{ L } O_2}$

8. $15.8 \text{ L } NH_3 \times \frac{1 \text{ mol } NH_3}{22.4 \text{ L}} \times \frac{17.0 \text{ g } NH_3}{1 \text{ mol } NH_3} = \boxed{12.0 \text{ g } NH_3}$

9. $5.8 \text{ mol } CaCl_2 \times \frac{6.02 \times 10^{23} \text{ f.u. } CaCl_2}{1 \text{ mol } CaCl_2} \times \frac{3 \text{ total atoms}}{1 \text{ f.u. } CaCl_2} = \boxed{1.0 \times 10^{25} \text{ total atoms}}$

10. (a) Fe_2O_3 : $\%\ Fe = \frac{111.6 \text{ g}}{159.6 \text{ g}} \times 100 = \boxed{69.92\%\ Fe}$

$\%\ O = \frac{48.0 \text{ g}}{159.6 \text{ g}} \times 100 = \boxed{30.1\%\ O}$

(b) $Ca_3(PO_4)_2$: $\%\ Ca = \frac{120.3 \text{ g}}{310.3 \text{ g}} \times 100 = \boxed{38.77\%\ Ca}$

$\%\ P = \frac{62.0 \text{ g}}{310.3 \text{ g}} \times 100 = \boxed{20.0\%\ P}$

$\%\ O = \frac{128.0 \text{ g}}{310.3 \text{ g}} \times 100 = \boxed{41.25\%\ O}$

10. (c) CH_4 : $\%\ C = \frac{12.0\ g}{16.0\ g} \times 100 =$ **75.0 % C**

$\%\ H = \frac{4.0\ g}{16.0\ g} \times 100 =$ **25 % H**

(d) H_2SO_4 : $\%\ H = \frac{2.0\ g}{98.1\ g} \times 100 =$ **2.0 % H**

$\%\ S = \frac{32.1\ g}{98.1\ g} \times 100 =$ **32.7 % S**

$\%\ O = \frac{64.0\ g}{98.1\ g} \times 100 =$ **65.2 % O**

11. % data is equivalent to mass data, so...

$59.0\ g\ C \times \frac{1\ mol\ C}{12.0\ g} = 4.92\ mol\ C$

$7.1\ g\ H \times \frac{1\ mol\ H}{1.0\ g} = 7.1\ mol\ H$

$26.2\ g\ O \times \frac{1\ mol\ O}{16.0\ g} = 1.64\ mol\ O$

$7.7\ g\ N \times \frac{1\ mol\ N}{14.0\ g} = 0.55\ mol\ N$

divide by smallest mole value (0.55) to get

$C_9H_{13}O_3N$ = empirical formula

And since empirical mass is the same as the molecular mass in this case, the molecular formula is the same as the empirical.

12. $72.2\ g\ Mg \times \frac{1\ mol\ Mg}{24.3\ g} = 2.97\ mol\ Mg$

$27.8\ g\ N \times \frac{1\ mol\ N}{14.0\ g} = 1.99\ mol\ N$

> Mg_3N_2

13. $74.1\ g\ C \times \frac{1\ mol\ C}{12.0\ g} = 6.18\ mol\ C$

$8.6\ g\ H \times \frac{1\ mol\ H}{1.0\ g} = 8.6\ mol\ H$

$17.3\ g\ N \times \frac{1\ mol\ N}{14.0\ g} = 1.24\ mol\ N$

> divide by 1.24 to get C_5H_7N as the empirical.
>
> Molecular mass is $\frac{162}{81} = 2\times$ the empirical, or $C_{10}H_{14}N_2$

14. $2.95\ g\ MgSO_3 \times \frac{1\ mol\ MgSO_3}{104.4\ g} \times \frac{6.02\times10^{27}\ f.u.\ MgSO_3}{1\ mol\ MgSO_3} \times \frac{2\ ions}{1\ f.u.\ MgSO_3}$

3.40×10^{22} total ions

(Mg^{+2} and SO_3^{-2} ions).