

CHE 100
Worksheet # 8
Graham/09

Name _____ Key _____

Due _____

1. According to the law of definite proportions, if a sample of a compound contains 7.00 grams of sulfur and 3.50 grams of oxygen, then another sample of the same compound which contains 14.0 grams of sulfur must contain

- a) 3.50 g of oxygen
- b) 5.00 g of oxygen
- c) 2.50 g of oxygen
- d) 7.00 g of oxygen
- e) 21.0 g of oxygen

_____ **d** _____

- 2.) The air pollutant NO is a component of automobile exhaust. A 5.00 g sample of NO is found to contain 46.7% N and 53.3% O. What would be the percent composition of a 1.00 g sample of this compound?

(Any size sample will have the same composition)

_____ **46.7%N_53.3%O** _____

- 3.) Which of the following compounds has the largest formula mass?

- a) H₂O (18.02 amu)
- b) NH₃ (17.04 amu)
- c) CO (28.01 amu)
- d) BeH₂ (11.03 amu)
- e) NO (30.01amu)

_____ **e** _____

- 4.) The formula for the mineral mica is $\text{KLi}_2\text{Al}(\text{Si}_2\text{O}_5)_2(\text{OH})_2$. Calculate its formula mass.

K: 1 x 39.10 amu = 39.10

Li: 2 x 6.94 amu = 13.88

Al: 1 x 26.98 amu = 26.98

Si: 4 x 28.09amu = 112.36

O: 12 x 16.00amu = 192.00

H: 2 x 1.01 amu = 2.02

386.34 amu

_____ **386.34 amu** _____

5.) Calculate the percent composition for sucrose (table sugar), $C_{12}H_{22}O_{11}$

$$\begin{array}{l} \text{C: } 12 \times 12.01 \text{ amu} = 144.12 \\ \text{H: } 22 \times 1.01 \text{ amu} = 22.22 \\ \text{O: } 11 \times 16.00 \text{ amu} = \underline{176.00} \\ \qquad \qquad \qquad 342.34 \text{ amu} \end{array}$$

$$\% \text{ C} = \frac{144.12}{342.34} \times 100 = 42.098\% \text{ C}$$

$$\% \text{ H} = \frac{22.22}{342.34} \times 100 = 6.491\% \text{ H}$$

$$\% \text{ O} = \frac{176.00}{342.34} \times 100 = 51.411\% \text{ O}$$

$$\underline{42.098\% \text{ C} \quad 6.491\% \text{ H} \quad 51.411\% \text{ O}}$$

6.) Calculate the mass percentage of S in the compound $MgSO_4$.

$$\begin{array}{l} \text{Mg} = 24.31 \text{ amu} \\ \text{S} = 32.07 \text{ amu} \\ 4 \times \text{O} = \underline{64.00 \text{ amu}} \\ \qquad \qquad \qquad 120.38 \text{ amu} \end{array}$$

$$\% \text{ S} = \frac{32.07}{120.38} \times 100 = 26.6428512 \text{ (calc.)}$$

$$\underline{26.64\% \text{ S}}$$

7.) Calculate the percent Composition of each of the following compounds from the given information.

a.) 1.12 g of Fe and 0.48 g of O completely react to produce a sample of a compound

$$\begin{array}{l} 1.12 \text{ g Fe} \\ +0.48 \text{ g O} \\ \hline 1.60 \text{ g compound} \end{array}$$

$$\frac{1.12 \text{ g Fe}}{1.60 \text{ g compound}} \times 100 = \boxed{70.0\% \text{ Fe}}_{3\text{sf}}$$

$$\frac{0.48 \text{ g O}}{1.60 \text{ g compound}} \times 100 = \boxed{30.0\% \text{ O}}_{2\text{sf}}$$

Alternative: 100.0%
 $\begin{array}{r} 100.0\% \\ - 70.0\% \text{ Fe} \\ \hline \boxed{30.0\% \text{ O}} \\ 3\text{sf} \end{array}$

b.) Decomposition of an 18.03 g sample of a compound yields 4.79 g of K, 6.38 g of Cr and 6.86 g of O.

$$\frac{4.79 \text{ g K}}{18.03 \text{ g compound}} \times 100 = \boxed{26.6\% \text{ K}}$$

$$\frac{6.86 \text{ g O}}{18.03 \text{ g compound}} \times 100 = \boxed{38.0\% \text{ O}}$$

$$\frac{6.38 \text{ g Cr}}{18.03 \text{ g compound}} \times 100 = \boxed{35.4\% \text{ Cr}}$$

7.) Cont'd.

c.) A 5.76 g sample of P is reacted with oxygen to give 13.20 g of a compound

$$\frac{13.20 \text{ g compound} - 5.76 \text{ g P}}{13.20 \text{ g compound}} \times 100 = \boxed{43.6\% \text{ P}}$$

7.44 g O

$$\frac{7.44 \text{ g O}}{13.20 \text{ g compound}} \times 100 = \boxed{56.4\% \text{ O}}$$

d.) The reaction of 4.67 g of N with 10.00 g of O produces 10.00 g of a compound and 4.67 g of unreacted (leftover) O.

$$\frac{10.00 \text{ g O} - 4.67 \text{ g O (unreacted)}}{10.00 \text{ g compound}} \times 100 = \boxed{46.7\% \text{ N}}$$

7.44 g O

↑
amt. of O in
compound

$$\frac{5.33 \text{ g O}}{10.00 \text{ g compound}} \times 100 = \boxed{53.3\% \text{ O}}$$

8.) Which of the following contains the greatest number of atoms?

- a) 1 mole NO_2 (3 moles of atoms)
- b) 2 moles Ar (2 moles of atoms)
- c) 3 moles Cl_2O (9 moles of atoms)
- d) 4 moles CO (8 moles of atoms)
- e) 3 moles NH_3 (12 moles of atoms)

_____ **e** _____

9.) One mole of H_2CO_3 molecules contains:

- a) 3 atoms of O
- b) 1 atom of C
- c) 2 moles of H atoms
- d) 1 mole of O atoms
- e) 6 total atoms
- f.) all of the above

_____ **c** _____

10.) How many NH_3 molecules are present in 1.00 mole of NH_3 ?

$$1.00 \text{ mole NH}_3 \times \frac{6.022 \times 10^{23} \text{ molecules NH}_3}{1 \text{ mole NH}_3} = \boxed{6.02 \times 10^{23} \text{ molecules NH}_3}$$

11.) How many SO₃ molecules are present in 0.433 mole of SO₃ ?

$$0.433 \text{ mole SO}_3 \times \frac{6.022 \times 10^{23} \text{ molecules SO}_3}{1 \text{ mole SO}_3} = \boxed{2.61 \times 10^{23} \text{ molecules SO}_3}$$

12.) a.) How many atoms are present in 1 molecule of Cl₂O₇?

$$1 \text{ molecule Cl}_2\text{O}_7 \times \frac{9 \text{ atoms}}{1 \text{ molecule Cl}_2\text{O}_7} = 9 \text{ atoms}$$

9 atoms

b.) How many moles of atoms are present in 1 mole of Cl₂O₇?

$$1 \text{ mole Cl}_2\text{O}_7 \times \frac{9 \text{ moles atoms}}{1 \text{ mole Cl}_2\text{O}_7} = 9 \text{ moles of atoms}$$

9 moles of atoms

c.) How many atoms of chlorine are present in 1 molecule of Cl₂O₇?

$$1 \text{ molecule Cl}_2\text{O}_7 \times \frac{2 \text{ atoms Cl}}{1 \text{ molecule Cl}_2\text{O}_7} = 2 \text{ atoms Cl}$$

2 atoms Cl

d.) How many moles of chlorine are present in 6 moles of Cl₂O₇?

$$6 \text{ moles Cl}_2\text{O}_7 \times \frac{2 \text{ moles Cl}}{1 \text{ mole Cl}_2\text{O}_7} = 12 \text{ moles Cl}$$

12 moles Cl

e.) How many atoms of oxygen are present in 2.69 moles of Cl₂O₇?

$$2.69 \text{ moles Cl}_2\text{O}_7 \times \frac{7 \text{ moles O}}{1 \text{ mole Cl}_2\text{O}_7} \times \frac{6.022 \times 10^{23} \text{ atoms O}}{1 \text{ mole O}} = \boxed{1.13 \times 10^{25} \text{ atoms O}}$$

13.) Which quantity contains the greater number of total moles of atoms -

1.00 mole (NH₄)₂CO₃ or **3.00 moles Ba(OH)₂** ? (circle one; explain your reasoning)

$$\begin{array}{l} 1.00 \text{ mole (NH}_4\text{)}_2\text{CO}_3 \times \frac{14 \text{ moles of atoms}}{1 \text{ mole (NH}_4\text{)}_2\text{CO}_3} = 14 \text{ moles of atoms in (NH}_4\text{)}_2\text{CO}_3 \\ 3.00 \text{ mole Ba(OH)}_2 \times \frac{5 \text{ moles of atoms}}{1 \text{ mole Ba(OH)}_2} = 15 \text{ moles of atoms in Ba(OH)}_2 \end{array}$$

14.) What is the molar mass of $\text{Ca}(\text{ClO}_4)_2$?

$$\begin{aligned}\text{Ca: } & 40.08 = 40.08 \\ \text{Cl: } & 2 \times 35.45 = 70.90 \\ \text{O: } & 8 \times 16.00 = \underline{128.00} \\ & 238.98 \text{ g/mole}\end{aligned}$$

238.98 g/mole

15.) Which has the greater mass, in grams?

2.00 moles of CO_2 or 1.00 mole of SO_3 (circle one, and explain your reasoning)

Molar Masses

$\text{CO}_2 = 44.01 \text{ g/mole}$
 $\text{SO}_3 = 80.06 \text{ g/mole}$

$$2.00 \text{ moles } \text{CO}_2 \times \frac{44.01 \text{ g } \text{CO}_2}{1 \text{ mole } \text{CO}_2} = 88.0 \text{ g } \text{CO}_2$$

$$1.00 \text{ mole } \text{SO}_3 \times \frac{80.06 \text{ g } \text{SO}_3}{1 \text{ mole } \text{SO}_3} = 80.1 \text{ g } \text{SO}_3$$

16.) Calculate the mass, in grams, of 0.981 mole of S_4N_4

$$4 \times \text{S} = 128.28$$

$$4 \times \text{N} = \underline{56.04}$$

$$184.32 \text{ g/mole}$$

$$0.981 \text{ mole } \text{S}_4\text{N}_4 \times \frac{184.32 \text{ g } \text{S}_4\text{N}_4}{1 \text{ mole } \text{S}_4\text{N}_4} = 181 \text{ g } \text{S}_4\text{N}_4$$

181 g S_4N_4

17.) A 0.571 mole sample of a pure substance has a mass of 36.60 g. What is the molar mass of the substance?

$$\frac{36.60 \text{ g}}{0.571 \text{ mole}} = 64.098073 \text{ (calc.)}$$

64.1 g/mole

18.) Calculate the number of moles of F in 27 g of OF_2

Molar mass OF_2

$$\text{O} = 16.00$$

$$2 \times \text{F} = \underline{38.00}$$

$$54.00 \text{ g/mole}$$

$$27 \text{ g } \text{OF}_2 \times \frac{1 \text{ mole } \text{OF}_2}{54 \text{ g } \text{OF}_2} \times \frac{2 \text{ mole F}}{1 \text{ mole } \text{OF}_2} = 1.0 \text{ mole OF}_2$$

1.0 mole OF_2

19.) Calculate the number of atoms present in a 3.752 g sample of Pb.

$$3.752 \text{ g Pb} \times \frac{1 \text{ moles Pb}}{207.2 \text{ g Pb}} \times \frac{6.022 \times 10^{23} \text{ atoms Pb}}{1 \text{ mole Pb}} = \boxed{1.090 \times 10^{22} \text{ atoms Pb}}$$

20.) Calculate the number of molecules present in a 52.0 g sample of HClO₃.

Molar mass HClO₃

3 x O = 48.00

1 x Cl = 35.45

1 x H = 1.01

84.46 g/mole

$$52.0 \text{ g HClO}_3 \times \frac{1 \text{ moles HClO}_3}{84.46 \text{ g HClO}_3} \times \frac{6.022 \times 10^{23} \text{ molecules HClO}_3}{1 \text{ mole HClO}_3} = \boxed{3.71 \times 10^{23} \text{ molecules HClO}_3}$$

21.) What is the mass, in grams, of 989 molecules of H₂O ?

$$989 \text{ molecules H}_2\text{O} \times \frac{1 \text{ moles H}_2\text{O}}{6.022 \times 10^{23} \text{ molecules H}_2\text{O}} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mole H}_2\text{O}} = \boxed{2.96 \times 10^{-20} \text{ g H}_2\text{O}}$$

22.) How many grams of nitrogen are present in 26.2 grams of HNO₃?

Molar mass HNO₃

3 x O = 48.00

1 x N = 14.01

1 x H = 1.01

63.02 g/mole

$$26.2 \text{ g HNO}_3 \times \frac{1 \text{ moles HNO}_3}{63.02 \text{ g HNO}_3} \times \frac{1 \text{ mole N}}{1 \text{ mole HNO}_3} \times \frac{14.01 \text{ g N}}{1 \text{ mole N}} = \boxed{5.82 \text{ g N}}$$