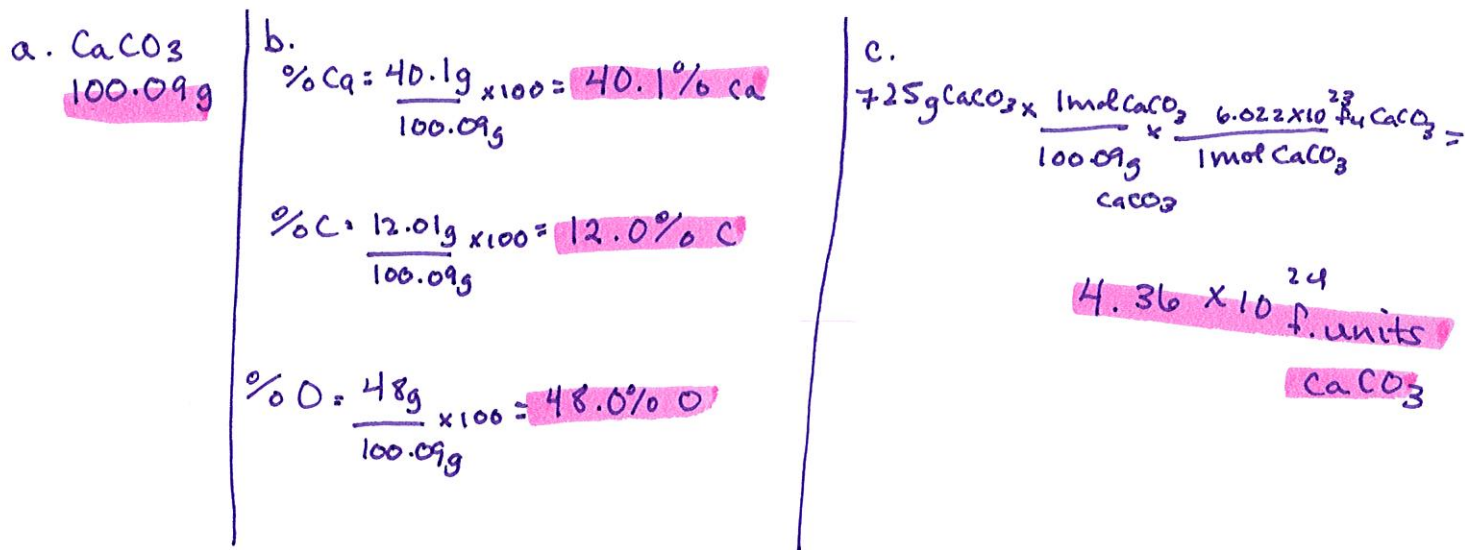


Unit 3 – Part 1 Review

1. Circle the word or phrase that makes the following statements false. Write the correct word or phrase that will make the statement true. If you think the statement is true as written, write true.
 - a. A gram formula mass of Aluminum Oxide contains Avogadro's number of atoms. *formula units*
 - b. A salt with water attached is described as being anhydrous. *a hydrate or hydrated*
 - c. Avogadro's number of molecules of sodium chloride has a mass of 58.5 grams. *formula units*
 - d. The representative particle for ionic compounds is the ion. *Formula unit*
 - e. There are five elements that always exist as diatomic molecules. *7*
 - f. A mole of gold contains 6.02×10^{24} atoms. *6.02×10^{23}*
 - g. A molecule of carbon dioxide has a mass of 44.0 grams. *mole*
 - h. One mole of any gas at STP has a volume of 22.4 L. *True*
 - i. A sample of calcium acetate contains 7.88×10^{26} molecules. *formula units*
 - j. The mass of one mole of chlorine gas is 35.5 grams. *$70.9 \rightarrow \text{Cl}_2$*
 - k. Avogadro's number of molecules of sodium chloride has a mass of 58.5 grams. *formula units*
2. Identify the representative particle for the following.
 - a. CH_4 *molecule*
 - b. CrO_4^{2-} *ion*
 - c. MgS *Formula unit*
 - d. CO_2 *molecule*
 - e. As *atom*
 - f. O_2 *molecule*
 - g. $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ *Formula unit*
 - h. Br^- *ion*
 - i. Xe *atom*
 - j. CoSO_3 *Formula unit*

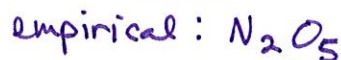
3. Calcium carbonate is the principal mineral found in limestone, marble, chalk, pearls, and the shells of marine animals such as clams.
- Calculate the gram molecular mass of calcium carbonate.
 - Calculate the percent composition of calcium carbonate.
 - How many formula units of calcium carbonate are in 725 grams of calcium carbonate?



4. If the molecular mass of an oxide of nitrogen is 108.0 grams and 4.02 grams of nitrogen combine with 11.48 grams of oxygen, what is the molecular formula of this compound?

$$4.02\text{g N} \times \frac{1\text{mol N}}{14.0\text{g N}} = 0.28714\text{mol} = 1 \times 2 = 2$$

$$11.48\text{g O} \times \frac{1\text{mol O}}{16.0\text{g O}} = 0.7175\text{mol} = 2.5 \times 2 = 5$$



$$2(14) + 5(16) = 108.0\text{g}$$

↓
so, molecular
is also N_2O_5

5. Calcium dihydrogen phosphate is an important fertilizer. What is the percent phosphorus in $\text{Ca}(\text{H}_2\text{PO}_4)_2$?

$$\% \text{P} = \frac{62.0\text{g}}{234.1\text{g}} \times 100 = 26.5\% \text{ P}$$

6. Calcium nitrate forms two different hydrated salts. One contains 24.7% water and the other 30.4% water. What are the formulas for these two hydrated salts?

$$24.7\text{g H}_2\text{O} \times \frac{1\text{mol}}{18.01\text{g}} = 1.3722 = 3$$

$$75.3\text{g Ca}(\text{NO}_3)_2 \times \frac{1\text{mol}}{164.1\text{g}} = 0.45887 = 1$$



$$30.4\text{g H}_2\text{O} \times \frac{1\text{mol}}{18.0\text{g}} = 1.6889 = 4$$

$$69.6\text{g Ca}(\text{NO}_3)_2 \times \frac{1\text{mol}}{164.1\text{g}} = 0.4241 = 1$$



7. Calculate the percent of water in cobalt (II) chloride hexahydrate.

$$\% \text{H}_2\text{O} = \frac{108.09}{237.99} \times 100 = 45.4\% \text{H}_2\text{O}$$

8. Determine the empirical formula of a certain copper sulfide ore if 7.68 g sample of the compound contains 6.13 g of copper.

$$6.13 \text{ g Cu} \times \frac{1 \text{ mol}}{63.5 \text{ g}} = 0.09654 \text{ mol} \quad \frac{0.09654 \text{ mol}}{0.048287} = 2$$

$$1.55 \text{ g S} \times \frac{1 \text{ mol}}{32.1 \text{ g}} = 0.048287 \text{ mol} \quad \frac{0.048287 \text{ mol}}{0.048287} = 1$$



9. Strontium hydroxide can exist as a hydrate. When 6.85g of the hydrate is dried in an oven, 3.13 g of anhydrous strontium hydroxide is formed. Calculate the formula for this hydrate.

$$3.13 \text{ g Sr(OH)}_2 \times \frac{1 \text{ mol}}{121.6 \text{ g}} = 0.02574 \text{ mol} = 1$$



$$3.72 \text{ g H}_2\text{O} \times \frac{1 \text{ mol}}{18.0 \text{ g}} = 0.20667 \text{ mol} = 8$$

10. What is the total mass of a mixture that contains 4.20 moles of gold, 6.42×10^{26} atoms of silver, and 79.25 g of copper?

$$4.20 \text{ mol Au} \times \frac{197.0 \text{ g Au}}{1 \text{ mol Au}} = 827 \text{ g Au}$$

$$827 \text{ g Au}$$

$$115,000 \text{ g Ag}$$

$$79.25 \text{ g}$$

$$6.42 \times 10^{26} \text{ atoms Ag} \times \frac{1 \text{ mol Ag}}{6.022 \times 10^{23} \text{ atoms Ag}} \times \frac{107.9 \text{ g Ag}}{1 \text{ mol Ag}} = 115,000 \text{ g Ag}$$

$115,906 \text{ g total}$

11. The molecular formula of acetylsalicylic acid (aspirin) is $\text{C}_9\text{H}_8\text{O}_4$.

- Calculate the molar mass of aspirin.
- Calculate the number of molecules in one aspirin tablet which has a mass of 0.325 grams.
- How many carbon atoms would there be in one aspirin tablet?

a. $\text{C}_9\text{H}_8\text{O}_4$
180.0g

b. $0.325 \text{ g C}_9\text{H}_8\text{O}_4 \times \frac{1 \text{ mol}}{180.0 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} =$

$1.09 \times 10^{21} \text{ molecules}$
 $\text{C}_9\text{H}_8\text{O}_4$

c. $1.09 \times 10^{21} \text{ molecules C}_9\text{H}_8\text{O}_4 \times \frac{9 \text{ atoms}}{1 \text{ molecule C}_9\text{H}_8\text{O}_4} =$

$9.81 \times 10^{21} \text{ C atoms}$

12. Butane, C₄H₁₀, is a gas at STP. How many hydrogen atoms would there be in 35,000 liters of butane?

$$35,000 \text{ L C}_4\text{H}_{10} \times \frac{1 \text{ mol C}_4\text{H}_{10}}{22.4 \text{ L C}_4\text{H}_{10}} \times \frac{6.022 \times 10^{23} \text{ molecules C}_4\text{H}_{10}}{1 \text{ mol C}_4\text{H}_{10}} \times \frac{10 \text{ H atoms}}{1 \text{ molecule C}_4\text{H}_{10}} = 7.5 \times 10^{27} \text{ H atoms}$$

13. A sample of bromine is determined to contain 8.09×10^{24} molecules. What is the mass of this sample of bromine?

$$8.09 \times 10^{24} \text{ molecules Br}_2 \times \frac{1 \text{ mol Br}_2}{6.022 \times 10^{23} \text{ molecules Br}_2} \times \frac{159.8 \text{ g Br}_2}{1 \text{ mol Br}_2} = 2,150 \text{ g Br}_2$$

14. A sample of aluminum oxide is known to contain 4.33×10^{22} formula units. How many moles does this represent for this sample of aluminum oxide?

$$4.33 \times 10^{22} \text{ f.u. Al}_2\text{O}_3 \times \frac{1 \text{ mol Al}_2\text{O}_3}{6.022 \times 10^{23} \text{ f.u.}} = 0.0719 \text{ mol Al}_2\text{O}_3$$

15. What is the mass for the sample of aluminum oxide in question 14?

$$0.0719 \text{ mol Al}_2\text{O}_3 \times \frac{102.0 \text{ g Al}_2\text{O}_3}{1 \text{ mol}} = 7.33 \text{ g Al}_2\text{O}_3$$

16. What is the total number of ions in a sample of magnesium hydroxide that has a mass of 750.0 grams?

17. Determine the molecular formula from the following data.

- 30.43%N, 69.57%O, Molecular Mass = 92
- 40.00%C, 6.67%H, 53.33%O, Molecular Mass = 60
- 74.0%C, 8.6%H, 17.3%N, Molecular Mass = 162

$$750 \text{ g} \times \frac{1 \text{ mol}}{58.3 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ f.u.}}{1 \text{ mol}} \times \frac{3 \text{ ions}}{1 \text{ f.u.}} = 2.32 \times 10^{25} \text{ ions}$$

a. $30.43 \text{ g N} \times \frac{1 \text{ mol}}{14 \text{ g}} = \frac{2.17}{2.17} = 1$

$69.57 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = \frac{4.35}{2.17} = 2$

E.F. = NO₂
MM = 46
x ?
92

? = 2

N₂O₄ → molecular formula

b. $40 \text{ g C} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = \frac{3.33}{3.33} = 1$

$6.67 \text{ g H} \times \frac{1 \text{ mol}}{1.0079 \text{ g}} = \frac{6.62}{3.33} = 2$

$53.33 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = \frac{3.33}{3.33} = 1$

E.F. = CH₂O
MM = 30

x ?
60
? = 2

C₂H₄O₂ → molecular formula

c. $74 \text{ g C} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = \frac{6.16}{1.23} = 5$

$8.6 \text{ g H} \times \frac{1 \text{ mol}}{1.0079 \text{ g}} = \frac{8.53}{1.23} = 7$

$17.3 \text{ g N} \times \frac{1 \text{ mol}}{14.01 \text{ g}} = \frac{1.23}{1.23} = 1$

C₅H₇N₁ → E.F.
MM = 81

x ?
162
x ? = 2

C₁₀H₁₄N₂ → molecular formula

18. When a sample of mercuric oxide weighing 0.982 g is heated until all the oxygen is expelled, 0.909 g of mercury remained. What is the formula of the oxide?

$$0.909 \text{ g Hg} \times \frac{1 \text{ mol}}{200.59 \text{ g}} = \frac{4.53 \times 10^{-3}}{4.53 \times 10^{-3}} = 1$$



$$0.073 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = \frac{4.56 \times 10^{-3}}{4.53 \times 10^{-3}} = 1$$

19. How much mass would be lost by 2.61 g of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ if heated until the water of hydration had been liberated?

$$2.61 \text{ g BaCl}_2 \cdot 2\text{H}_2\text{O} \quad \begin{array}{l} \text{total} \\ \text{\% H}_2\text{O} \end{array} \quad 2.61 \text{ g} \times 0.1475 = \boxed{0.385 \text{ g H}_2\text{O}} \quad \text{Lost Mass}$$

$$\% \text{ H}_2\text{O} = \frac{36.02}{244.25} \times 100 = 14.75\%$$

H_2O

$$\begin{array}{r} 2.61 \text{ g total} \\ - 0.385 \text{ g H}_2\text{O} \\ \hline 2.23 \text{ g remain} \end{array}$$

20. Determine the formula of a hydrated salt which has the composition 27.8% Mn, 35.9% Cl, and 36.4% H_2O .

$$27.8 \text{ g Mn} \times \frac{1 \text{ mol}}{54.938 \text{ g}} = \frac{0.506 \text{ mol}}{0.506} = 1$$

$$35.9 \text{ g Cl} \times \frac{1 \text{ mol}}{35.453 \text{ g}} = \frac{1.01 \text{ mol}}{0.506} = 2$$

$$36.4 \text{ g H}_2\text{O} \times \frac{1 \text{ mol}}{18.01 \text{ g}} = \frac{2.02}{0.506} = 4$$



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 - e. As
 - f. O_2
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