Chapter 6 – Review

Name______________________

1. How many atoms in 17 moles of water?

2. Calculate the number of atoms in 40.0 g of neon gas.

3. Calculate the % by mass of carbon in gallium cyanide.

4. How many moles of sulfate would you have in 5 moles of aluminum sulfate?

5. Analysis of a carbohydrate, a molecular compound made of carbon, hydrogen and oxygen determined it to be 62.07 % carbon, 10.34 % hydrogen, and the rest oxygen. The molar mass of this compound is 232 g/mole. Determine the molecular formula of this compound.

6. Determine the empirical formula of a carbon chlorine compound made of 8.53×10^{22} carbon atoms and 3.41×10^{23} chlorine atoms.

7. Calculate the % of water in iron(III) nitrate dihydrate. If you had 3.75 g of this hydrate, what would it weigh after you heated it to remove all the water.

8. Calculate how many atoms of oxygen are in 15.0 g of zinc perchlorate.

9. Determine the formula for of a hydrate that was heated and determined to be 21.7% water. The anhydrate was further analyzed and determined to be 13.8 % aluminum, 49.3 % sulfur, and 36.9 % oxygen. What is the name of this hydrate?

10. Determine the empirical formula for nickel(?) oxide if 18.8 g of nickel was burned. The product had a mass of 23.92 g. What is the Roman numeral in this formula?

11. Suggest the identity of 5.21×10^{21} particles of some gaseous element that weighs 0.173 g. (Hint, determine the molar mass of this gaseous element to help you to identify it.)

12. Determine the mass of one single water molecule.

13. Determine the mass of sulfur in 43.5 g of lead(IV) sulfide.

14. What are the units on avogadro's number? What are the units on any molar mass?

1. In this problem you simply change moles of water to molecules of water, and then convert to the total number of atoms.

$$17mol\left(\frac{6.02\times10^{23}molecules}{1mol}\right)\left(\frac{3atoms}{1molecule}\right)$$ = **3.07 × 10^{25} atoms**

2. Convert grams to moles, then to atoms of neon.

$$40.0g\left(\frac{1mol}{20.18g}\right)\left(\frac{6.02\times10^{23}atoms}{1mol}\right)$$ = **1.19 × 10^{24} atoms**

3. You need to write out the correct formula for gallium cyanide and then calculate the molar mass

$Ga(CN)_3$ 69.72 + 3(12) + 3(14) = 147.72

$$\left(\frac{36}{147.72g}\right)\times100$$ = **24.4%**

4. $Al_2(SO_4)_3$ $5molAl_2(SO_4)_3\left(\frac{3(SO_4^{2-})}{1Al_2(SO_4)_3}\right)$ = 15 moles of $SO_4^{\,2-}$

5. Determine the percentage of oxygen in the compound: 100% − 62.07% – 10.34% = 27.59 % oxygen

Carbon: $62.07g\left(\frac{1mol}{12}\right) = 5.1725$ $\left(\frac{5.1725}{1.724}\right) =\sim 3$

Hydrogen: $10.34g\left(\frac{1mol}{1.01g}\right) = 10.24$ $\left(\frac{10.24}{1.724}\right) =\sim 6$

Oxygen: $27.59g\left(\frac{1mol}{16}\right) = 1.7244$ $\left(\frac{1.724}{1.724}\right) = 1$ Voila. C_3H_6O

Calculate the molar mass of the empirical formula: 3(12) + 6(1) + 16 = 58 $\left(\frac{232}{58}\right) = 4$ **$C_{12}H_{24}O_4$**

6. This problem may seem dramatically different, however, it is just another empirical formula problem, however, in this case, you need to convert items − instead of grams or percentages − to moles.

$8.53\times10^{22}atoms\left(\frac{1mol}{6.02\times10^{23}atoms}\right) = 0.142$ moles $\left(\frac{0.142}{0.142}\right) = 1$

$3.41\times10^{23}atoms\left(\frac{1mol}{6.02\times10^{23}atoms}\right) = 0.566$ $\left(\frac{0.566}{0.142}\right) = 4$ therefore the formula is **CCl_4**

You may notice above that the calculation for the conversion to moles from atoms is exactly the same for both elements, thus you could immediately convert to an atom:atom ratio by dividing the number of atoms by the smaller of the two values. This would let you see the 1:4 ratio.

7. $Fe(NO_3)_3 \bullet 2H_2O$ 55.85 + 3(14) + 9(16) + 2(18) = 277.9

$$\left(\frac{2(18g)}{277.9g}\right)\times100$$ = **12.8% water**

12.8% water means 87.2 % anhydrate, so we know that 87.2 % of the compound is anhydrate.

3.75 g × 0.872 (the percentage represented as a decimal) = **3.27 g of anhydrate would remain after heating**

8. $Zn(ClO_4)_2$ 65.3 + 2(35.5) + 8(16) = 264.3

$$15.0g\left(\frac{1mol}{264g}\right)\left(\frac{6.02\times10^{23}ionicules}{1mol}\right)\left(\frac{8OxyAtoms}{1Zn(ClO_4)_2ionicule}\right)$$ = 2.73 × 10^{23} Oxygen atoms

9. First determine the formula of the anhydrate

$13.8g\left(\frac{1mol}{27g}\right)$ = 0.511 mole $\left(\frac{0.511}{0.511}\right)$ = 1 × 2 = 2

$49.3g\left(\frac{1mol}{32.1g}\right)$ = 1.536 moles $\left(\frac{1.536}{0.511}\right)$ = 3 × 2 = 6

$36.9g\left(\frac{1mol}{16g}\right)$ = 2.306 moles $\left(\frac{2.306}{0.511}\right)$ = 4.5 × 2 = 9 Voila **$Al_2(S_2O_3)_3$**

Next determine the molar mass of the anhydrate $Al_2(S_2O_3)_3$ 2(54) + 6(32.1) + 9(16) = 390.6

Calculate the % of the compound that is anhydrate: 100% − 21.7% = 78.3% g anhydrate

and the calculate moles of anhydrate and moles of water

water $21.7g\left(\frac{1mol}{18.0g}\right)$ = 1.21 mole/0.2 = 6

anhydrate $78.3g\left(\frac{1mol}{390.6g}\right)$ = 0.2 /0.2 = 1 **$Al_2(S_2O_3)_3 \bullet 6H_2O$**

10. 23.92 g – 18.8 = 5.12 g oxygen

oxygen: $5.12g\left(\frac{1mol}{16g}\right)$ = 0.32 moles $\left(\frac{0.32}{0.32}\right)$ = 1

nickel: $18.8g\left(\frac{1mol}{58.69g}\right)$ = 0.32 moles $\left(\frac{0.32}{0.32}\right)$ = 1 thus **NiO nickel(II) oxide**

11. $\left(\frac{0.173g}{5.21\times10^{21}\,particles}\right)\left(\frac{6.02\times10^{23}\,particles}{1mol}\right)$ = **19.98 g/1mole** must be Ne (can't be F, because F is diatomic, F_2 which weighs 38 g/mol)

12. H_2O You know the molar mass of water: 2(1)+(16) = 18g/1mole $\left(\frac{18g}{1mol}\right)\left(\frac{1mol}{6.02\times10^{23}\,molecules}\right)$ = **3×10^{-23}**

13. PbS_2 calculate the % of S in the compound $\left(\frac{64}{271}\right)$ = 0.236

thus the sulfur is 0.236 × 43.5 g = **10.3 g of S** in the 43.5 g of PbS_2

14. Avogadro's number, $\left(\frac{items}{mol}\right)$ and molar mass, $\left(\frac{grams}{mol}\right)$