

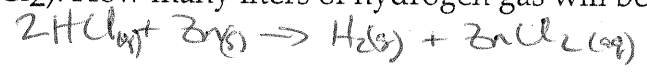
Key

CHEMISTRY UNIT 3 Review

1. Dissolving P_4O_{10} in water produces phosphoric acid (H_3PO_4). What mass of phosphoric acid is produced from 552 g of water? $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$

$$552g H_2O \left(\frac{1 \text{ mol } H_2O}{18.02g} \right) \left(\frac{4 H_3PO_4}{6 H_2O} \right) \left(\frac{98.00g}{1 \text{ mol } H_3PO_4} \right) = \boxed{12.00 \text{ kg}}$$

2. 23.0 liters of hydrochloric acid (HCl) reacts with zinc to form hydrogen gas and zinc chloride ($ZnCl_2$). How many liters of hydrogen gas will be produced at STP?



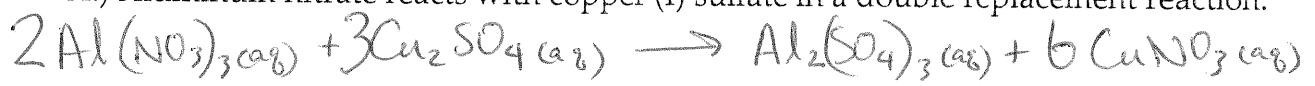
$$23.0 \text{ L HCl} \left(\frac{1 \text{ mol HCl}}{22.4 \text{ L}} \right) \left(\frac{1 H_2}{2 HCl} \right) \left(\frac{22.4 \text{ L}}{1 \text{ mol } H_2} \right) = \boxed{11.5 \text{ L } H_2(g)}$$

3. 10.0 grams of an aqueous zinc chloride reacts with a sodium sulfide solution in a double replacement reaction. Write and balance this equation and then calculate the molecules of sodium chloride produced. $ZnCl_2(aq) + Na_2S(aq) \rightarrow ZnS(s) + 2NaCl(aq)$

$$10g ZnCl_2 \left(\frac{1 \text{ mol } ZnCl_2}{136.28g} \right) \left(\frac{2 NaCl}{1 ZnCl_2} \right) \left(\frac{58.44g}{1 \text{ mol } NaCl} \right) = \boxed{8.58g NaCl}$$

4. Complete and balance the following reactions

A.) Aluminum nitrate reacts with copper (I) sulfate in a double replacement reaction.



B.) Zinc reacts with silver phosphate in a single replacement reaction.



5. Find the empirical formula for a compound that contains 48.6% carbon, 43.2% oxygen, and 8.11% hydrogen.

$$48.6g C \left(\frac{1 \text{ mol } C}{12.01} \right) = 4.05 \text{ mol } C \div 2.7 = 1.5 \text{ mol } C \times 2 = 3 \text{ mol } C$$

$$8.11g H \left(\frac{1 \text{ mol } H}{1.01g H} \right) = 8.02 \text{ mol } H \div 2.7 = 3 \text{ mol } H \times 2 = 6 \text{ mol } H$$

$$43.2g O \left(\frac{1 \text{ mol } O}{16.00g} \right) = 2.7 \text{ mol } O \div 2.7 = 1 \text{ mol } O \times 2 = 2 \text{ mol } O$$

$\boxed{C_3O_2H_6}$

6. The molecular mass of the compound in #5 is 222.0 g/mol. What is the molecular formula for the compound?

$$EF \text{ mass} = 74.098 \text{ g/mol}$$

$$\frac{222.0 \text{ g/mol}}{74.098 \text{ g/mol}} = 2.996 \Rightarrow 3$$

$$3(C_3O_2H_6) = \boxed{C_9O_6H_{18}}$$

7. Phosphorus, when reacted with oxygen gas in a synthesis reaction yields diphosphorus pentoxide. If the reaction is begun with 205 grams of phosphorus and 12.6 L of oxygen gas, how much product can be made? How much of the excess reactant is remaining at the end of the reaction? (use either grams or liters depending on which reactant is in excess)



$$205g P \left(\frac{1 \text{ mol P}}{30.97} \right) \left(\frac{2 \text{ mol } P_2O_5}{4 \text{ mol P}} \right) \left(\frac{141.94g}{1 \text{ mol } P_2O_5} \right) = 469.77g P_2O_5$$

$$O_2 = 12.6L \left(\frac{1 \text{ mol } O_2}{22.4L} \right) \left(\frac{2 P_2O_5}{5 O_2} \right) \left(\frac{141.94g}{1 \text{ mol } P_2O_5} \right) = 31.94g P_2O_5 = \boxed{31.9g P_2O_5}$$

$$12.6L O_2 \left(\frac{1 \text{ mol } O_2}{22.4L} \right) \left(\frac{4 P}{5 O_2} \right) \left(\frac{30.97}{1 \text{ mol P}} \right) = 13.9g P \text{ used} \quad 205g - 13.9g = \boxed{191g P \text{ remaining}}$$

8. Find the empirical formula for the compound that has: K = 24.6%, Mn = 34.8%, O = 40.6%

$$24.6g K \left(\frac{1 \text{ mol K}}{39.01g} \right) = 0.63 \text{ mol K} \div 0.63 = 1$$

$$34.8g Mn \left(\frac{1 \text{ mol Mn}}{54.94g} \right) = 0.63 \text{ mol Mn} \div 0.63 = 1$$

$$40.6g O \left(\frac{1 \text{ mol O}}{16.00g} \right) = 2.54 \text{ mol O} \div 0.63 = 4.03 = 4$$



9. A standard laboratory preparation of iodine is the following reaction:



% yield = $\frac{\text{Actual}}{\text{Theoretical}}$

When 62.55 g of NaI are used with excess amounts of the other reactants, the actual yield of iodine (I₂) was 39.78 g. What is the percent yield?

$$62.55g NaI \left(\frac{1 \text{ mol NaI}}{149.89g} \right) \left(\frac{1 I_2}{2 NaI} \right) \left(\frac{253.8g}{1 \text{ mol } I_2} \right) = \frac{52.96g I_2}{52.96g I_2}$$

$$\frac{39.78g I_2}{52.96g I_2} (100) = \boxed{75\% \text{ yield}}$$

10. Coal gasification is a process that converts coal into methane gas. If this reaction has a percent yield of 85.0%, how much methane can be obtained from 1250 g of carbon?

$$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} (100) \quad 2C + 2H_2O \rightarrow CH_4 + CO_2$$

$$1250g C \left(\frac{1 \text{ mol C}}{12.01g} \right) \left(\frac{1 CH_4}{2 C} \right) \left(\frac{16.05g}{1 \text{ mol } CH_4} \right) = 835g CH_4$$

$$\frac{\%}{100} (\text{theoretical}) = \text{actual}$$

$$\frac{85.0\%}{100} (835g) = 709.8g CH_4$$

$$\left(\frac{85.0\%}{100} \right) (835g) = \boxed{709.8g CH_4}$$

B 10) What is the charge on Iron (III) ion?

- a. -3
b. +3
c. +2
d. -2

C 11) What do you call ions that are made up of more than one atom?

- a. Cations
b. Neutral ions
c. Polyatomic ions
d. Monoatomic ions

A 12) What is the name of the ion that has the symbol $C_2O_2^{2-}$?

- a. Oxalate
b. Cyanide
c. Peroxide
d. Carbonate

A 13) What is the name of the ion that has the symbol WO_4^{2-} ?

- a. Tungstate
b. Wolfstein
c. Vanadate
d. Cyanide

B 14) What is the only polyatomic ion that has a positive charge?

- a. Cyanided
b. Ammonium
c. Sulfate
d. Sodium

A 15) In naming ionic compounds, which do you write first?

- a. The cation
b. The anion
c. The one with the shorter name
d. It doesn't matter

C 16) Which of the following represents the best chemical formula for the compound calcium nitrate?

- a. $CaNO_3$
b. $Ca(NO_2)_3$
c. $Ca(NO_3)_2$
d. $Ca(NO_3)_3$

C 17) Which of the following represents the best chemical formula for the compound ammonium carbonate?

- a. $(NH_4)CO_3$
b. NH_4CO_3
c. $(NH_4)_2CO_3$
d. $NH_4(CO_3)_2$

D 18) Which of the following represents the best chemical formula for the compound lead (IV) carbonate?

- a. Pb_2CO_3
b. Pb_4CO_3
c. $Pb_2(CO_3)_4$
d. $Pb(CO_3)_2$

D 19) Which of the following is the correct formula for barium citrate?

- a. $BaC_6H_5O_7$
b. $Ba_2C_6H_5O_7$
c. $Ba(C_6H_5O_7)_2$
d. $Ba_3(C_6H_5O_7)_2$

A 20) Which type of reaction breaks bigger molecules into smaller molecules?

- a. Decomposition
b. Single displacement
c. Combustion
d. Synthesis

C 21) Which type of reaction requires O_2 as a reactant?
a. Decomposition
b. Single displacement
c. Combustion
d. Synthesis

B 22) Which type of reaction replaces the cation in an ionic compound?
a. Decomposition
b. Single displacement
c. Combustion
d. Synthesis

D 23) Which type of reaction starts out with smaller molecules and combines them to form a larger molecule?
a. Decomposition
b. Single displacement
c. Combustion
d. Synthesis

A 24) Which type of reaction is shown by the equation below?
 $CH_3OH \rightarrow CO + 2H_2$

a. Decomposition
b. Single displacement
c. Combustion
d. Synthesis

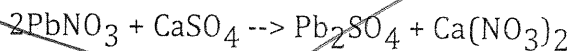
C 25) Which type of reaction is shown by the equation below?
 $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

a. Decomposition
b. Single displacement

c. Combustion
d. Synthesis

*in reverse
(don't worry about
this one)*

~~26) Which type of reaction is shown by the equation below?~~

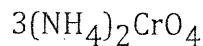


~~a. Decomposition
b. Single displacement~~

~~c. Combustion
d. Synthesis~~

dbl replacement

Use the following symbol to answer questions 27 through 30.



D 27) How many atoms of hydrogen (H) are present?

a. 4
b. 8
c. 16
d. 24

3C 28) How many atoms of chromium (Cr) are present?

a. 1
b. 2
c. 3
d. 4

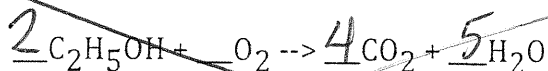
D 29) How many atoms of nitrogen (N) are present?

a. 1
b. 2
c. 3
d. 6

D 30) How many molecules of ammonium (NH_4) are present?

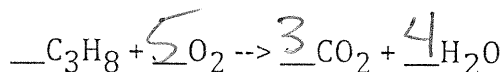
- a. 1
b. 2
c. 3
d. 6

~~31) What are the missing coefficients in the following equation?~~



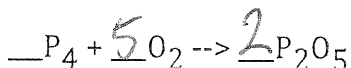
- ~~a. 0, 2, 2, 3
b. 1, 2, 2, 3
c. 0, 3, 2, 3
d. 1, 3, 2, 3~~

D 32) What are the missing coefficients in the following equation?



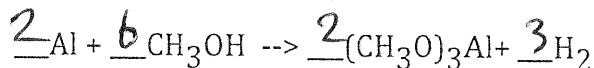
- a. 2, 4, 3, 4
b. 0, 5, 3, 4
c. 1, 6, 3, 4
d. 1, 5, 3, 4

A 33) What are the missing coefficients in the following equation?



- a. 1, 5, 2
b. 0, 5, 2
c. 1, 6, 3
d. 1, 5, 3

D 34) What are the missing coefficients in the following equation?



- a. 1, 3, 1, 1
b. 2, 5, 2, 3
c. 1, 6, 2, 3
d. 2, 6, 2, 3

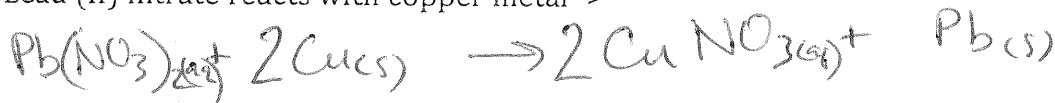
D 35) In the ionic compound zinc phosphate (ZnPO_4), which is the cation?

- a. P
b. O
c. 4
d. Zn

II. Short Answer

1. **Writing Chemical Equations.** Please re-write the following sentences into complete, balanced chemical equations.

a. Lead (II) nitrate reacts with copper metal \rightarrow



c. tetracarbon decahydride reacts with oxygen gas \rightarrow



d. barium chloride reacts with potassium carbonate →



e. Iron (II) sulfide reacts with hydrogen chloride →



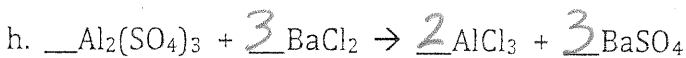
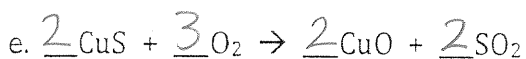
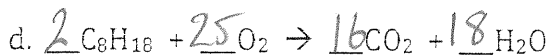
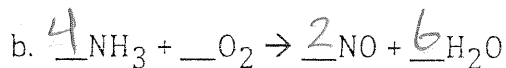
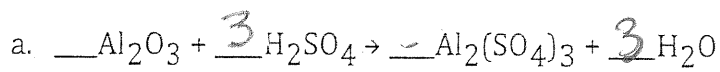
f. Zinc metal reacts with hydrogen sulfate →



g. mercury (II) oxide breaks down into mercury metal and oxygen gas.



2. **Balancing Equations.** Balance the following equations



3. Lab Question:

You heat a sample of potassium chlorate, after heating it changes color and loses mass. What type of reaction has taken place? What is the balanced chemical equation for this reaction? How could you prove the identity of the gaseous product?

Solve the following problems.

1. How many moles is 6.98×10^{22} atoms?

$$6.98 \times 10^{22} \text{ atoms} \left(\frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \right) = \boxed{0.116 \text{ mol}}$$

2. How many atoms are present in 12.2 moles of sodium metal?

$$12.2 \text{ mol Na} \left(\frac{6.02 \times 10^{23} \text{ atoms Na}}{1 \text{ mol Na}} \right) = \boxed{7.34 \times 10^{24} \text{ atoms Na}}$$

3. How many moles are in 1.02×10^{28} atoms of barium?

$$1.02 \times 10^{28} \text{ atoms Ba} \left(\frac{1 \text{ mol Ba}}{6.02 \times 10^{23} \text{ Ba atoms}} \right) = 16943.5 \text{ mol Ba} \Rightarrow \boxed{16.9 \text{ kmol Ba}}$$

4. How many grams of Ba are in the sample in #3?

$$1.02 \times 10^{28} \text{ Ba atoms} \left(\frac{1 \text{ mol Ba}}{6.02 \times 10^{23} \text{ Ba atoms}} \right) \left(\frac{137.33 \text{ g}}{1 \text{ mol Ba}} \right) = 2326853.8 \text{ g Ba} \Rightarrow \boxed{2,330 \text{ kg Ba}}$$

Identify the types of rxns below.

Double Replacement (DR), Single Replacement (SR), Synthesis (S), Decomposition (D)
or Combustion (C).

