2014 STOICH/RXNS/EMPIRICAL FORMULA REVIEW PRACTICE TEST

_____ 1. When the following equation is balanced, what are the appropriate coefficients in the equation?

2 C_8H_{18} (l) + 25 O_2 (g) → 16 CO_2 (g) + 18 H_2O (G)

_____ 2. The molecular weight of ~~sucrose~~ caffeine ($C_8H_{10}N_4O_2$), caffeine is_____ amu.

8(12.01) + 10(1.01) + 4(14.01) + 2(16.00) = 194.22 amu

_____ 3. When the following equation is balanced, the coefficients are_____.

4 NH_3 (g) + 7 O_2 (g) → 4 NO_2 (g) + 6 H_2O (g)

_____ 4. Which one(s) of the following do(es) ***not*** occur as diatomic molecules in elemental form?

Sulfur, nitrogen, hydrogen, bromine, oxygen, iron, carbon

_____ 5. In a chemical reaction the limiting reagent will be the substance _____.

that is used up, causing the rxn to stop.

_____ 6. In addition to atoms, the only quantity conserved (is equal on both sides of an equation) in every chemical reaction is _____.

energy OR mass

_____ 7. The ____ in a balanced equation reveals the mole ratios of the substances involved.

Coefficients.

_____ 8. In using balanced equations to solve mass-mass problems, the mass of each reactant is first converted to _____.

moles!

_____ 9. What is the volume of a mole of a gas at standard temperature and pressure (STP)?

22.41L

_____ 10. In mass-mass problems, the steps to follow are best summarized as going from _____.

mass ÷ MM → moles, ↔ mole ratio → moles of another reagent, → × M.M. → mass of product

_____ 11. The excess reactant in a completed chemical reaction will be the substance _____.

that is left over after the reaction, or in excess.

_____ 12. What step is the first to complete in every single stoichiometric problem?

Balance the DANG EQUATION 1st!

_____13. Considering the following balanced equation:

$$CaC_2\,(s) + 2H_2O\,(l) \rightarrow Ca(OH)_2\,(aq) + C_2H_2\,(g)$$

If 2.45 moles of CaC_2 are added to water, how many liters of C_2H_2 will form at STP?

$$2.45\,mol\,CaC_2 \times \frac{1\,mol\,CaC_2}{64.10\,g\,CaC_2} \times \frac{1\,mol\,C_2H_2}{1\,mol\,CaC_2} \times \frac{22.4\,L}{1\,mol\,C_2H_2} = \boxed{0.957\ L\,C_2H_2}$$

Stoichiometry calculations: *You must use dimensional analysis and show all of your work!*

Questions 14 & 15 will refer to the following *unbalanced* equation.

$$\underset{(1)}{2}\ C_5H_{12}\ (g) + \underset{(8)}{16}\ O_2\ (g) \rightarrow \underset{(5)}{10}\ CO_2\ (g) + \underset{(6)}{12}\ H_2O\ (g)$$

14. If 32.15 grams of C_5H_{12} were burned with unlimited O_2, how many moles of H_2O would form?

$$32.15\ g\ C_5H_{12} \times \frac{1\ mol\ C_5H_{12}}{72.17\ g\ C_5H_{12}} \times \frac{6\ mol\ H_2O}{1\ mol\ C_5H_{12}} = 2.673\ mol\ H_2O$$

15. If 65.7 L of O2 were burned with excess C_5H_{12}, how many grams of CO2 would form?

$$65.7\ L\ O_2 \times \frac{1\ mol\ O_2}{22.41\ L\ O_2} \times \frac{5\ mol\ CO_2}{8\ mol\ O_2} \times \frac{44.01\ g\ CO_2}{1\ mol\ CO_2} = 80.6\ g\ CO_2$$

Questions 16 & 17 will be based on the following *balanced* equation:

$$\underline{2}\ C_2H_6\ (g) + \underline{7}\ O_2\ (g) \rightarrow \underline{4}\ CO_2\ (g) + \underline{6}\ H_2O\ (l)$$

16. If 12.06 grams of C_2H_6 were burned with 96.5 grams of O_2. What is the limiting reagent?

C_2H_6 is the limit!

$$12.06\ g\ C_2H_6 \times \frac{1\ mol\ C_2H_6}{30.08\ g\ C_2H_6} \times \frac{4\ mol\ CO_2}{2\ mol\ C_2H_6} = .8019\ mol\ CO_2$$

$.8019 < 1.72$

$$96.5\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} \times \frac{4\ mol\ CO_2}{7\ mol\ O_2} = 1.72\ mol\ CO_2$$

17. How many molecules of CO_2 will be formed when the reaction in question 16 takes place?

$$0.8019\ mol\ CO_2 \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol\ CO_2} = 4.83 \times 10^{23}\ molecules\ of\ CO_2$$

% Composition, Empirical and Molecular Formula Problems.

18. The following percentages are based on mass. The chemical aspirin, acetylsalicylic acid, contains 59.99% Carbon, 4.48% Hydrogen, and 35.52% Oxygen. A) What is the empirical formula of this compound?

$59.99\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} = \frac{4.995}{2.22}\ mol\ C = 2.25\ C$

$4.48\ g\ H \times \frac{1\ mol\ H}{1.01\ g\ H} = \frac{4.44\ mol\ H}{2.22} = 2\ mol\ H$

$35.52\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = \frac{2.22\ mol\ O}{2.22} = 1\ O$

$\times 4$ $C_9H_8O_4$

B) If the molar mass of this compound is 180.17 g/mol, what is the molecular formula?

9×12.01
$+\ 8 \times 1.01$
$+\ 4 \times 16.00$
180.17

Molecular Formula is The same $C_9H_8O_4$

19. What is the percent composition of the elements in iron(III)oxalate, $Fe_2(C_2O_4)_3$?

$\frac{55.85(2)}{375.76\ g} = \frac{111.70}{375.76} \times 100 = \%\ Fe =$ 29.73 % Fe

$\frac{72.06\ g\ C}{375.76\ g} \times 100 =$ 19.18 % Carbon

$\frac{192\ g\ O}{375.76\ g} \times 100 =$ 51.10 % Oxygen

Reaction families and Descriptive Chemistry

For questions 20-27, first predict the products and then balance the equation.

20. Solid calcium metal is strongly heated in oxygen gas.

$2\,Ca(s) + O_{2(g)} \xrightarrow{\Delta} 2\,CaO(s)$

21. What reaction family is taking place in question 20? synthesis/combination.

22. An aqueous solution of potassium peroxide (O_2^{2-}) is decomposed.

$2\,K_2O_2 \rightarrow 2\,K_2O_{(s)} + O_{2(g)}$

23. What reaction family is taking place in question 22? decomposition.

24. A piece of solid magnesium metal is placed in a beaker of aqueous hydrochloric acid.

$Mg_{(s)} + 2\,HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2(g)}$

25. What reaction family is taking place in question 24? single replacement.

26. Liquid nonane (C_9H_{20}) is burned in the presence of oxygen gas.

$C_9H_{20_{(l)}} + 14\,O_{2(g)} \xrightarrow{\Delta} 9\,CO_{2_{(g)}} + 10\,H_2O_{(g)}$

27. What reaction family is taking place in question 26? combustion!