Name: **Stoichiometry Review**

1. Which type of formula represents the simplest whole-number ratio of atoms of the elements in a compound?

   1) molecular formula
   2) condensed formula
   3) empirical formula
   4) structural formula

2. Given two formulas representing the same compound:

   Formula A CH_3
   Formula B C_2H_6
   Which statement describes these formulas?

   1) Formulas *A* and *B are both empirical.*
   2) Formulas *A* and *B are both molecular.*
   3) Formula *A is empirical, and formula B is molecular.*
   4) Formula *A is molecular, and formula B is empirical.*

3. What is the empirical formula of a compound that has a carbon-to-hydrogen ratio of 2 to 6?

   1) CH_3 2) C_2H_6 3) C_3H 4) C_6H_2

4. Which pair consists of a molecular formula and its corresponding empirical formula?

   1) C_2H_2 and CH_3CH_3
   2) C_6H_6 and C_2H_2
   3) P_4O_{10} and P_2O_5
   4) SO_2 and SO_3

5. Which formula is both a molecular and an empirical formula?

   1) $C_6H_{12}O_6$ **3) C_3H_8O**
   2) $C_2H_4O_2$ 4) C_4H_8

6. What is the gram-formula mass of $(NH_4)_3PO_4$?

   1) 112 g/mol **3) 149 g/mol**
   2) 121 g/mol 4) 242 g/mol

7. A 1.0-mole sample of krypton gas has a mass of

   1) 19 g 2) 36 g 3) 39 g **4) 84 g**

8. The gram-formula mass of H_2O is defined as the mass of

   1) one mole of H_2O
   2) one molecule of H_2O
   3) two moles of H_2O
   4) two molecules of H_2O

9. What is the gram formula mass of Li_2SO_4?

   1) 54 g 2) 55 g **3) 110 g** 4) 206 g

10. What is the total number of oxygen atoms in the formula $MgSO_4 \cdot 7\ H_2O$? [The • represents seven units of H_2O attached to one unit of $MgSO_4$.]

    1) 11 2) 7 3) 5 4) 4

11. The gram-formula mass of a compound is 48 grams. The mass of 1.0 mole of this compound is

    1) 1.0 g 2) 4.8 g **3) 48 g** 4) 480 g

12. Which sample contains a mole of atoms?

    1) 23 g Na 3) 42 g Kr
    2) 24 g C 4) 78 g K

13. A compound has a molar mass of 90. grams per mole and the empirical formula CH_2O. What is the molecular formula of this compound?

    1) CH_2O **3) $C_3H_6O_3$**
    2) $C_2H_4O_2$ 4) $C_4H_8O_4$

14. A substance has an empirical formula of CH_2 and a molar mass of 56 grams per mole. The molecular formula for this compound is

    1) CH_2 2) C_4H_6 **3) C_4H_8** 4) C_8H_4

15. Which quantity can be calculated for a solid compound, given only the formula of the compound and the Periodic Table of the Elements?

    1) the density of the compound
    2) the heat of fusion of the compound
    3) the melting point of each element in the compound
    4) the percent composition by mass of each element in the compound

16. Which compound has the highest precent composition by mass of strontium?

    1) $SrCl_2$ 2) SrI_2 **3) SrO** 4) SrS

17. What is the percent composition by mass of sulfur in the compound $MgSO_4$ (gram-formula mass = 120. grams per mole)?

    1) 20% **2) 27%** 3) 46% 4) 53%

18. What is the percent composition by mass of nitrogen in NH_4NO_3 (gram-formula mass = 80.0 grams/mole)?

    1) 17.5% 3) 52.5%
    2) 35.0% 4) 60.0%

19. During all chemical reactions, mass, energy, and charge are

    1) absorbed 3) formed
    2) conserved 4) released

20. The coefficients in a balanced chemical equation represent

1) the mass ratios of the substances in the reaction
2) the mole ratios of the substances in the reaction
3) the total number of electrons in the reaction
4) the total number of elements in the reaction

21. Given the balanced equation representing a reaction:

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
What is the *minimum* number of moles of O_2 that are needed to completely react with 16 moles of NH_3?

1) 16 mol 3) 64 mol
2) 20. mol 4) 80. mol

22. Given the balanced equation representing a reaction:

$$Al_2(SO_4)_3 + 6NaOH \rightarrow 2Al(OH)_3 + 3Na_2SO_4$$

The mole ratio of $NaOH$ to $Al(OH)_3$ is

1) 1:1 2) 1:3 **3) 3:1** 4) 3:7

23. Given the balanced equation representing a reaction:
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

What is the total number of moles of $O_2(g)$ required for the complete combustion of 1.5 moles of $C_3H_8(g)$?

1) .30 mol 3) 4.5 mol
2) 1.5 mol **4) 7.5 mol**

24. Given the balanced equation representing a reaction:

$CaO(s) + CO_2(g) \rightarrow CaCO_3(s) + heat$
What is the total mass of CaO(s) that reacts completely with 88 grams of $CO_2(g)$ to produce 200. grams of $CaCO_3(s)$?

1) 56 g 2) 88 g **3) 112 g** 4) 288 g

25. Given the balanced equation representing a reaction:
$2H_2 + O_2 \rightarrow 2H_2O$

What is the total mass of water formed when 8 grams of hydrogen reacts completely with 64 grams of oxygen?

1) 18 g 2) 36 g 3) 56 g **4) 72 g**

26. Given the reaction:

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

The total number of grams of O_2 needed to produce 54 grams of water is

1) 36 **2) 48** 3) 61 4) 75

____ 27. Base your answer to the following question on the information below and on your knowledge of chemistry.

Many breads are made by adding yeast to dough, causing the dough to rise. Yeast is a type of microorganism that produces the catalyst zymase, which converts glucose, $C_6H_{12}O_6$, to ethanol and carbon dioxide gas. The balanced equation for this reaction is shown below.

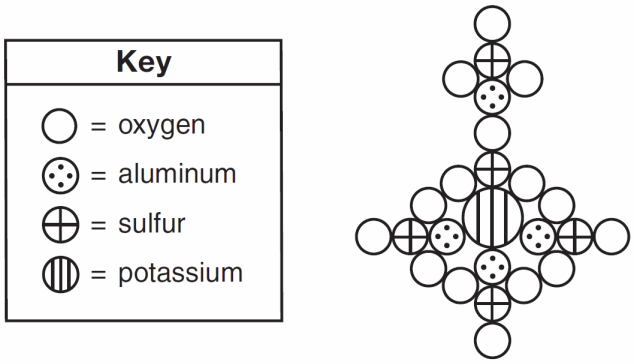
$$C_6H_{12}O_6(aq) \xrightarrow{zymase} 2C_2H_5OH(aq) + 2CO_2(g)$$

Determine the total mass of ethanol produced when 270. grams of glucose reacts completely to form ethanol and 132 grams of carbon dioxide.

____ 28. Base your answer to the following question on the information below.

John Dalton, an early scientist, sketched the structure of compounds using his own symbols for the elements known at the time. Dalton's symbols for four elements and his drawing of potassium aluminum sulfate are represented by the diagram below.

Dalton's Drawing for Potassium Aluminum Sulfate



Today, it is known that the chemical formula for potassium aluminum sulfate is $KAl(SO_4)_2 \bullet 12H_2O$. It is a hydrated compound because water molecules are included within its crystal structure. There are 12 moles of H_2O for every 1 mole of $KAl(SO_4)_2$. The compound contains two different positive ions. The gram-formula mass of $KAl(SO_4)_2 \bullet 12H_2O$ is 474 grams per mole.

Show a numerical setup for calculating the percent composition by mass of water in $KAl(SO_4)_2 \bullet 12H_2O$.

____ 29. Base your answer to the following question on the information below.

Vitamin C, also known as ascorbic acid, is water soluble and cannot be produced by the human body. Each day, a person's diet should include a source of vitamin C, such as orange juice. Ascorbic acid has a molecular formula of $C_6H_8O_6$ and a gram-formula mass of 176 grams per mole.

Show a numerical setup for calculating the percent composition by mass of oxygen in ascorbic acid.

Base your answers to questions **30** and **31** on the information below.

Hydrogen peroxide, H_2O_2, is a water-soluble compound. The concentration of an aqueous hydrogen peroxide solution that is 3% by mass H_2O_2 is used as an antiseptic. When the solution is poured on a small cut in the skin, H_2O_2 reacts according to the balanced equation below.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

____ 30. Determine the gram-formula mass of H_2O_2.

____ 31. Calculate the total mass of H_2O_2 in 20.0 grams of an aqueous H_2O_2 solution that is used as an antiseptic. Your response must include *both* a numerical setup and the calculated result.

_____

____ 32. Base your answer to the following question on the information below.

The Solvay process is a multistep industrial process used to produce washing soda, $Na_2CO_3(s)$. In the last step of the Solvay process, $NaHCO_3(s)$ is heated to 300°C, producing washing soda, water, and carbon dioxide. This reaction is represented by the balanced equation below.

$$2NaHCO_3(s) + \text{heat} \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

Determine the total mass of washing soda produced if 3360. kilograms of $NaHCO_3$ reacts completely to produce 360. kilograms of H_2O and 880. kilograms of CO_2.

_____

Answer Key
Chemical Calculations

1. 3
2. 3
3. 1
4. 3
5. 3
6. 3
7. 4
8. 1
9. 3
10. 1
11. 3
12. 1
13. 3
14. 3
15. 4
16. 3
17. 2
18. 2
19. 2
20. 2
21. 2
22. 3
23. 4
24. 3
25. 4
26. 2
27. 138 g *or* for any value from 137.8 g to 138.3 g, inclusive
28. $\frac{12(2\,\text{g/mol}+16\,\text{g/mol})}{474\,\text{g/mol}} \times 100$ *or* $\frac{216}{474} \times 100$
29. $\frac{6(16\text{ g/mol})}{176\text{ g/mol}} \times 100$

    $\frac{(96)(100)}{176}$
30. 34 g/mol.
31. A correct numerical setup is shown: $3 = \frac{x}{20.0g} \times 100$ *or* (20)(0.03)
32. 2120. kg