Extra Test Review

Percent Composition. Percentage composition is determined by finding the formula mass of a compound, multiplying the mass of each element by 100, and dividing the product by the formula mass of the compound. Use the periodic table to find the masses of individual elements. See the ***Sample Problem*** bto the rightelow

Sample Problem: Find the percentage composition of $MgCO_3$.

Formula Mass		Percentage Composition	
Mg = 24 × 1 =	24	% Mg = 24 × 100 ÷ 84 =	29
C = 12 × 1 =	12	% C = 12 × 100 ÷ 84 =	14
O = 16 × 3 =	48	% O = 48 × 100 ÷ 84 =	57
	84		100

Chemical Equations. Chemical equations provide a shorthand way to easily describe what occurs during a chemical reaction. In a typical chemical equation, the reactants are written on the left, while the products are written on the right. The reactants and products are separated by an arrow, or yield sign, which indicates that reactants yield products. (**REACTANTS** → **PRODUCTS**) There are other symbols as well that show the state of the chemicals involved in the reaction. They are: (*s*) or ↓ for a solid precipitate; (ℓ) for a liquid; (*g*) or ↑ for a gas; and (*aq*) for dissolved in water or aqueous. Symbols can also be used to show other factors involved in the reaction such as sources of energy used. These include: Δ for heat or ↑| for light. These symbols are written above or below the yield sign because they are neither reactants nor products. The complete equation shows the identity of the reactants and products using chemical formulas and symbols, the phases of the reactants and products, any energy changes involved in the reaction, and the mole ratios of all the substances indicated by the coefficients. Equations may occasionally be written omitting information about phases or energy changes. The example below shows a complete chemical equation with all the components.

The equation shows that the reactant is solid potassium chlorate, the products are solid potassium chloride and oxygen gas, manganese dioxide is a catalyst, and the reaction is endothermic. Symbols for manganese dioxide and heat are shown above and below the yield sign because they are neither reactants nor products.

$$2KClO_3(s) \xrightarrow[\Delta]{\mathbf{MnO_2}(s)} 2KCl(s) + 3O_2(g)$$

Reaction Types. Chemical reactions can be grouped into four basic types. They are direct combination or synthesis, decomposition, single replacement or substitution, and double replacement or exchange of ions.

An example of **synthesis** is shown below: Synthesis often results in the formation of only one product from two reactants, but not always. Combustion, as in the following example, $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O$, is also a form of synthesis because the oxygen combines with both the metal and the nonmetal to form two oxides.

$$\mathbf{N_2}(g) + \mathbf{3H_2}(g) \xrightarrow[\Delta]{catalyst} \mathbf{2NH_3}(g)$$

Decomposition is the reverse of synthesis. One reactant breaks apart to form several products. This is what happens when hydrogen peroxide decomposes over time to leave behind plain, ordinary water [$2H_2O_2(aq) \rightarrow 2H_2O(\ell) + O_2(g)$].

During a **single replacement** reaction, a more active metal replaces a less active metal in a compound, or a more active nonmetal replaces a less active nonmetal in a compound. This is what happens when a metal becomes corroded by an acid [$2Fe(s) + 6HCl(aq) \rightarrow 2FeCl_3(aq) + 3H_2(g)$]. In single replacement reactions, an element is reacting with a compound.

Double replacement reactions occur between aqueous compounds. The cations and anions switch partners. If an insoluble precipitate forms, the reaction is an end reaction, otherwise the result is an aqueous mixture of ions. An example of a double replacement reaction is $AgNO_3(aq) + NaCl(aq) \rightarrow NaNO_3(aq) + AgCl(s)$.

Patterns of the Reaction Types

Legend:
- **A** and **C** = *metals*
- **B** and **D** = *nonmetals*

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Direct combination (synthesis)
A + B → AB *or*
AB + D → AD + BD

Decomposition
AB → A + B

Single Replacement (substitution)
AB + C → CB + A *or*
AB + D → AD + B

Double Replacement (Exchange of Ions)
AB + CD → AD + CB

Answer the questions below by circling the number of the correct response

1. A 60. gram sample of $LiCl \cdot H_2O$ is heated in an open crucible until all of the water has been driven off. What is the total mass of LiCl remaining in the crucible? (1) 18 g (2) 42 g (3) 24 g (4) 60 g

2. What is the percentage by mass of bromine in $CaBr_2$? (1) 20% (3) 40% (3) 60% (4) 80%

3. The percent by mass of Li in $LiNO_3$ (formula mass = 69) is closest to (1) 6% (2) 10% (3) 18% (4) 20%

4. The percent by mass of oxygen in CO is approximately (1) 73% (2) 57% (3) 43% (4) 17%

5. The percent by mass of aluminum in Al_2O_3 is approximately (1) 18.9 (2) 35.4 (3) 47.1 (4) 52.9

6. The percent by mass of oxygen in Na_2SO_4 (formula mass = 142) is closest to (1) 11% (2) 22% (3) 45% (4) 64%

7. The percent by mass of hydrogen in NH_3 is equal to (1) $\frac{17}{1} \times 100$ (2) $\frac{1}{17} \times 100$ (3) $\frac{17}{3} \times 100$ (4) $\frac{3}{17} \times 100$

8. What is the percent by mass of hydrogen in NH_3 (formula mass = 17.0)? (1) 5.9% (2) 17.6% (3) 21.4% (4) 82.4%

9. The percent by mass of nitrogen in $Mg(CN)_2$ is equal to (1) $^{14}/_{76} \times 100$, (2) $^{14}/_{50} \times 100$, (3) $^{28}/_{76} \times 100$, (4) $^{28}/_{50} \times 100$.

10. What is the percent by mass of oxygen in Fe_2O_3 (formula mass = 160)? (1) 16% (2) 30.% (3) 56% (4) 70.%

11. The percent by mass of carbon in CO_2 is equal to (1) $^{44}/_{12} \times 100$, (2) $^{12}/_{44} \times 100$, (3) $^{28}/_{12} \times 100$, (4) $^{12}/_{28} \times 100$

12. What is the percent by mass of oxygen in CH_3OH? (1) 50.0 (2) 44.4 (3) 32.0 (4) 16.0

13. The approximate percent by mass of potassium in $KHCO_3$ is (1) 19 %, (2) 24 %, (3) 39 %, (4) 61 %

14. What is the percent by mass of hydrogen in CH_3COOH (formula mass = 60.)? (1) 1.7% (2) 6.7% (3) 5.0% (4) 7.1%

15. What is the percentage by mass of oxygen in CuO? (1) 16% (2) 25% (3) 20% (4) 50%

16. A 10.0 gram sample of a hydrate was heated until all the water of hydration was driven off. The mass of anhydrous product remaining was 8.00 grams What is the percent of water in the hydrate? (1) 12.5% (2) 20.0% (3) 25.0% (4) 80.0%

17. Which compound contains the greatest percentage of oxygen by mass? (1) BaO (2) MgO (3) CaO (4) SrO

18. The precent by mass of oxygen in MgO (formula mass = 40) is closest to (1) 16% (2) 40% (3) 24% (4) 60%

19. The symbol (aq) after a chemical formula means (1) solid or precipitate, (2) liquid, (3) gas, (4) aqueous or dissolved.

20. In the reaction, $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$, the reactants are (1) AgCl and $NaNO_3$, (2) $AgNO_3$ and NaCl, (3) Ag and Na, (4) Cl and NO_3

Answer questions 21–22 by referring to the equation below:

$$2KClO_3(s) \xrightarrow[\Delta]{MnO_2(s)} 2KCl(s) + 3O_2(g)$$

21. The symbol Δ under the yield sign indicates that (1) the reaction is exothermic, (2) the reaction is endothermic, (3) a solid precipitate forms, (4) heat is a product of the reaction.

22. $MnO_2(s)$ is written above the yield sign because $MnO_2(s)$ is (1) a reactant, (2) a product, (3) neither a reactant nor a product, (4) both a reactant and a product.

For each of the reactions described in questions 23-29, write the correct number to indicate whether the reaction type is (1) DECOMPOSITION, (2) SYNTHESIS, (3) SINGLE REPLACEMENT, or (4) DOUBLE REPLACEMENT

23. A reaction occurs in which only one reactant is present.

24. A metal reacts with an acid. ($2Fe + 6HCl \rightarrow 2FeCl_3 + 3H_2$)

25. Magnesium burns.

26. Two salt solutions react with each other.

27. Two elements unite to form a compound.

28. A compound breaks down.

29. $HCl + NaOH \rightarrow NaCl + H_2O$

Answers _____

1. 2	6. 3	11. 2	16. 2	21. 2	26. 4
2. 4	7. 4	12. 1	17. 2	22. 3	27. 2
3. 2	8. 2	13. 3	18. 2	23. 1	28. 1
4. 2	9. 3	14. 2	19. 4	24. 3	29. 4
5. 4	10. 2	15. 3	20. 2	25. 2	