Test Review № 7

Finding the Charge on Polyvalent Metals. Many transition metals have more than one oxidation state. They are called polyvalent. The fact that a metal is polyvalent becomes important when the compound is named. In order to properly name a compound, it is necessary to first check the *Periodic Table* to see if the metal is polyvalent. If it is, you need to figure out the oxidation state of the metal by checking to see which one will make the sum of the oxidation states in the compound add up to zero. The process is shown in the box to the left. The process is only applied for metals that have more than one oxidation state.

The Stock System . The stock system is a set of rules for naming compounds of metals and non metals. The metal always comes first in the name and the formula. Monatomic metal ions, those consisting of only one type of atom, come in two varieties – univalent and polyvalent. For univalent metal ions, those having only one oxidation state, the name of the ion is exactly the same as that of the element that formed it. For polyvalent metal ions, those having multiple oxidation states, a roman numeral indicates the oxidation state. Polyatomic metal ions, those consisting of more than one type of element such as NH_4^+, ammonium, are found on *Table E*.

The nonmetal always comes last in the name and in the formula. For monatomic nonmetal ions, delete the last part of the elements name and add "IDE". Polyatomic nonmetal ions, such as SO_4^{-2} (sulfate) or OH^- (hydroxide) are found on *Table E*.

To write the name from the formula, it is necessary to first check the *Periodic Table* to see if the metal is polyvalent. If it is, you need to figure out the oxidation state of the metal by checking to see which one will make the sum of the oxidation states in the compound add up to zero. To write the formulas from the name, you need to look up the oxidation states of the ions, and apply the crossover rule

Binary Covalent Compounds. Two nonmetals can combine to form compounds. When two nonmetals combine, they form covalent bonds. The nonmetal with the lower electronegativity behaves like a metal and has a positive oxidation state. In carbon dioxide (CO_2), the carbon behave like a metal while the oxygen behaves like a nonmetal. The metal is written first in the name and the formula. The name of the metal is the same as the name of the element. If there is more than one atom of the metal, the number of atoms is indicated with a prefix. (See the list of prefixes below.) The nonmetal is written last in the name and formula..The name of the nonmetal is the same as the name of the element minus the final syllable or two, plus IDE.The number of nonmetal atoms is indicated with a prefix (even when there is only one). Writing formulas for these compounds is easy, because the prefix tells the subscript.

Number of Atoms	Prefix
1	mono
2	di
3	tri
4	tetra
5	penta
6	hexa
7	hepta
8	octa
9	nona
10	deca

Finding the Formula Mass

Find the formula mass of $CuSO_4$

Step 1: Look up the mass of each element on the *Periodic Table* and round it off.
Step 2: Multiply each element's atomic mass by its subscript to get the product.
Step 3: Add the products together to get the total

Element	Atomic Mass		Subscript		Product
Cu	64	×	1	=	64
S	32	×	1	=	32
O	16	×	4	=	64
			TOTAL		160

Formula Mass. The masses of ionic and covalent compounds are found the same way–from the formula. The atomic masses of the elements in the compound and the formula are used to determine the mass. The mass determined from the formula is called a formula mass. A molecular mass is a type of formula mass. The terms are sometimes used interchangeably. Formula masses are determined by following the steps in the box to the right. The results are in atomic mass units (amu)

Empirical Formulas. The chemical formula for a molecular compound shows the number and type of atoms present in a molecule. Ionic crystals are a collections of ions. The chemical formula for an ionic compound shows the ratio ions in the compound. The ratio of ions in the formula for an ionic compound is always in lowest terms. A chemical formula in which the ratio of the elements are in lowest terms is called an empirical formula. The molecular formula for glucose ($C_6H_{12}O_6$) is not an empirical formula. All the subscripts are divisible by six. When the subscripts are divided by six, the empirical formula for glucose, CH_2O, is obtained. Some molecular formulas, such as the one for carbon dioxide, CO_2, are already empirical formulas without being reduced.

Sample Problem

A compound with an empirical formula of CH_2O has a molecular mass of 90 amu. What is its molecular formula?

Step 1: Determine the empirical formula mass.

CH_2O

C = 12 × 1 = 12

H = 1 × 2 = 2

O = 16 × 1 = 16

30

Step 2: Divide the molecular mass by the empirical formula mass to determine the multiple.

$\frac{90}{30} = 3$

Step 3: Multiply the empirical formula by the by the multiple to find the molecular formula

$[CH_2O] \times 3 = C_3H_6O_3$

There are two skills you need to learn in order to work with empirical formulas: Finding the empirical formula from the molecular formula; and finding the molecular formula from the empirical formula and the molecular mass. To find the empirical formula from the molecular formula, divide all the subscripts by the greatest common factor. To find the molecular formula from the empirical formula and the molecular mass.

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*** below

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*

— ◆ —

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

Conservation of Mass. Matter is neither created nor destroyed. During a chemical reaction the mass does not change. A properly written equation shows conservation of mass. Balancing the equation will make it show conservation of mass. **Balancing Equations.** The equation at the top of the box to the right does *not* show conservation of mass. Starting with two molecules of hydrogen, as shown in the equation at the bottom of the box by writing a **coefficient** 2 in front of the hydrogen and forming two molecules of water by writing a **coefficient** 2 in front of the water shows conservation. Coefficients are used to **balance** equations. Coefficients make the number of atoms of each type the same on the reactant and product side. As a result, coefficients make the mass the same on the reactant and product side of the equation. Balancing is done by counting the number and type of atoms on the reactant and product side of the equation and making them equal.

$H_2 + O_2 \rightarrow H_2O$
$2 + 32 \neq 18$

$2H_2 + O_2 \rightarrow 2H_2O$
$2(2) + 32 = 2(18)$
$36 = 36$

Moles. A mole is a formula mass expressed in grams. (1 mole = 1 gram formula mass). Atomic mass units are too small to measure on a laboratory balance, but grams are not. An atom of carbon has a mass of 12 amu and a molecule of glucose has a mass of 180 amu. Each mass represents one particle. Since the mass ratios in formula masses and gram formula masses are the same (12 amu:180 amu::12 g:180 g), the ratio of particles must still be the same (1mole:1 mole). The gram formula mass (GFM) is the number of grams in 1 mole. This results in the mathematical relationships shown above and to the right.

Substance	Formula Mass	Gram Formula Mass
carbon	12 amu	12 g
sodium chloride (NaCl)	58 amu	58 g
glucose ($C_6H_{12}O_6$)	180 amu	180 g

1. $GFM = \frac{g}{mole}$
2. $g = GFM \times mole$
3. $mole = \frac{g}{GFM}$

Sample Problem

How many moles of oxygen are consumed when 0.6 moles of hydrogen burns to produce water?

Step 1: Write a balanced equation and determine the mole ratios from the equation

Step 2: Identify the known and the unknown

	$2\,H_2(g)$	+ $O_2(g)$	→ $2\,H_2O$
mole ratio	2	1	2
moles	known 0.6	unknown x	

Step 3: Set up a proportion and solve for the unknown

- $\frac{2}{0.6mol} = \frac{1}{x}$
- $2x = 0.6mol$
- $x = 0.3mol$

Formulas from Masses. The molecular formula for a compound can be determined from the percentage composition by assuming the sample has a mass of 100 g. Using the percentages, the number of grams out of 100 can be determined for each component. This can be converted to moles by dividing by the GFM. The mole ratio and empirical formula can be determined by dividing each number of moles by the smallest number of moles. The atomic masses are added together to find the empirical formula mass. The empirical formula mass is divided into the molecular weight to find the number of times "n," the formula is repeated. Finally, "n" is multiplied by the empirical formula to find the molecular formula. See the ***Sample Problem*** to the right.

Stoichiometry. Stoichiometry is the branch of chemistry that deals with the application of the laws of definite proportions and of the conservation of mass and energy to chemical activity. It shows the quantitative relationship between constituents of a chemical reaction. Stoichiometric calculations are based on several assumptions. It is assumed that the reaction has no side reactions, the reaction goes to completion, and the reactants are completely consumed. One type of problem that can be solved stoichiometrically is based on the mole ratios of a balanced equation. A sample problem is shown to the left.

Sample Problem

Find the molecular formula for a compound composed of 5.9% hydrogen and 94.1% oxygen and having a molecular weight of 34 amu.

Step 1: Assume a 100 g sample

Step 2: Find the mass of each element in the sample

mass of H = 5.9 % of 100 g = 5.9 g

mass of O = 94.1 % of 100 g = 94.1 g

Step 3: Convert grams to moles

moles of H = $\frac{5.9g}{1g/mol}$ = 5.9 moles

moles of O = $\frac{94.1g}{16g/mol}$ = 5.9 moles

Step 4: Find the mole ratio by dividing both numbers by the smaller number

5.9 ÷ 5.9 = 1 H

5.9 ÷ 5.9 = 1 O

empirical formula = HO

Step 5: Find the empirical formula mass

atomic mass of H = 1

atomic mass of O = 16

EFM = 17

Step 6: Find the number of times, "n," the empirical formula is repeated and multiply through

$\frac{\text{M.W.}}{\text{EFM}} = n = \frac{34}{17} = 2$

molecular formula $(HO)_n = (HO)_2 = H_2O_2$

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

1. In which compound is the oxidation state of iron +3? (1) $FeCl_2$ (2) FeO (3) $FePO_4$ (4) FeS_2O_3

2. What is the formula for a compound of NH_4 and CO_3? (1) NH_4CO_3 (2) $(NH_4)_2CO_3$ (3) $NH_4(CO_3)_2$ (4) NH_3CO_4

3. What is the correct formula for copper II nitrate? (1) $Cu(NO_3)_2$ (2) Cu_3N_2 (3) Cu_2NO_3 (4) Cu_2N_3

4. What is the correct name for BaO? (1) barium oxide (2) barium oxygen (3) barium II oxide (4) barium oxalate

5. The formula for zinc hydroxide is (1) $Zn(OH)_2$, (2) $ZnOH_2$, (3) ZnH_2, (4) Zn_2H.

6. The formula for ammonium carbonate is (1) $(NH_3)_2(CO_4)_3$, (2) $NH_2(CO_3)_4$, (3) $(NH_4)_3CO$, (4) $(NH_4)_2CO_3$.

7. The formula for iron II sulfide is (1) $Fe_2(SO_4)_3$, (2) FeS, (3) Fe_2S_3 (4) $FeSO_4$.

8. The name of the compound $CuCO_3$ is (1) copper II carbonate, (2) copper I carbonate, (3) copper III carbonate, (4) copper oxide.

9. The formula for barium nitrate is (1) Ba_3NO_2, (2) Ba_3N_2, (3) $Ba(NO_3)_2$, (4) BaN.

10. The name of the compound H_2S is (1) hydrogen II sulfate, (2) hydrogen sulfate, (3) helium I sulfide, (4) hydrogen sulfide.

11. Which is the compound whose formula is P_2O_5? (1) potassium dioxide (2) dipotassium pentoxide (3) phosphorus dioxide (4) diphosphorus pentoxide

12. The formula for sulfur hexafluoride is (1) SHF, (2) SF, (3) SF_6, (4) S_6F.

13. The IUPAC name for N_2O_3 is (1) dinitrogen trioxide, (2) nitrogen oxide, (3) nitrogen trioxide, (4) dinitrogen oxide.

14. The prefix used to show there are four atoms of an element in a binary covalent compound is (1) quadra, (2) recta, (3) hepta, (4) tetra.

15. Which of the following is a binary covalent compound? (1) Na_2O (2) P_2S_5 (3) Hg_2Cl_2 (4) KI

16. The molecular mass of CO_2 is the same as the molecular mass of (1) CO (2) C_2H_6 (3) SO_2 (4) C_3H_8

17. Which is an empirical formula? (1) C_2H_2 (2) Al_2Cl_6 (3) C_2H_4 (4) K_2O

18. Which is an empirical formula? (1) CH_2 (2) C_3H_6 (3) C_2H_4 (4) C_4H_8

19. A compound with a molecular mass of 34 contains hydrogen and oxygen in a ratio of 1:1. The molecular formula of the compound is (1) HO (2) OH (3) H_2O_2 (4) HOH

20. The empirical formula of a compound is CH. Its molecular mass could be (1) 21 (2) 51 (3) 40 (4) 78

21. What is the empirical formula of the compound whose molecular formula is $C_6H_{12}O_6$? (1) $C_{12}H_{24}O_{12}$ (2) $C_2H_4O_2$ (3) $C_6H_{12}O_6$ (4) CH_2O

22. A compound contains nitrogen and oxygen in a ratio of 1:1. The molecular mass of the compound could be (1) 14 (2) 16 (3) 30 (4) 40

23. What is the ratio by mass of sulfur to oxygen in SO_2? (1) 1:1 (2) 1:2 (3) 1:3 (4) 1:4

24. What is the mass in amu of 1.00 molecule of O_2 gas? (1) 11.2 (2) 16.0 (3) 22.4 (4) 32.0

25. What is the formula mass of $CuSO_4 \cdot 5H_2O$? (1) 160. amu (2) 178 amu (3) 186 amu (4) 250. amu

26. What is the molecular formula of a compound whose empirical formula is CH_4 and molecular mass is 16? (1) CH_4 (2) C_4H_8 (2) C_2H_4 (4) C_8H_{18}

27. The formula mass of NH_4Cl is (1) 22.4 amu (2) 53.5 amu (3) 28.0 amu (4) 95.5 amu

28. An example of an empirical formula is (1) C_2H_2, (2) H_2O_2, (3) C_2Cl_2, (4) $CaCl_2$

29. A compound has an empirical formula of CH_2 and a molecular mass of 56. Its molecular formula is (1) C_2H_4, (2) C_3H_6, (3) C_4H_8, (4) C_5H_{10}.

30. The empirical formula of a compound is CH_2 and its molecular mass is 70. What is the molecular formula of the compound? (1) C_2H_2 (2) C_2H_4 (3) C_4H_{10} (4) C_5H_{10}

31. Which formulas could represent the empirical formula and the molecular formula of a given compound? (1) CH_2O, $C_4H_6O_4$ (2) CHO $C_6H_{12}O_6$ (3) CH_4, C_3H_8 (4) CH_2, C_3H_6

32. The empirical formula of a compound is CH_4. The molecular formula of the compound could be (1) CH_4, (2) C_2H_6, (3) C_3H_8, (4) C_4H_{10}

33. A compound has an empirical formula of CH_3 and a molecular mass of 30. What is its molecular formula? (1) CH_3 (2) C_2H_6 (3) CH_{18} (4) C_3H_9

34. A compound has the empirical formula NO_2. Its molecular formula could be (1) NO_2 (2) N_2O (3) N_4O_2 (4) N_4O_4

35. 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

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

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

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

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

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

41. 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) $\frac{3}{17} \times 100$

42. 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%

43. 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) $^{28}/_{50} \times 100$.

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

45. 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) $^{12}/_{28} \times 100$

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

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

48. 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%

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

50. When the equation $H_2 + N_2 \rightarrow NH_3$ is completely balanced using smallest whole numbers, the sum of all the coefficients will be (1) 6 (2) 7 (3) 3 (4) 12

51. 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%

52. When the equation $H_2 + Fe_3O_4 \rightarrow Fe + H_2O$ is completely balanced using *smallest* whole numbers the coefficient of H_2 would be (1) 1 (2) 2 (3) 3 (4) 4

53. When the equation $\_\_C_2H_4 + \_\_O_2 \rightarrow \_\_CO_2 + \_\_H_2O$ is correctly balanced, using *smallest* whole-numbered coefficients, the sum of all the coefficients is (1) 16 (2) 12 (3) 8 (4) 4

54. When the equation $NH_3 + O_2 \rightarrow HNO_3 + H_2O$ is completely balanced using smallest whole numbers, the coefficient of O_2 would be (1) 1 (2) 2 (3) 3 (4) 4

55. When the equation $\_\_Na(s) + \_\_H_2O(\ell) \rightarrow \_\_NaOH(aq) + \_\_H_2(g)$ is correctly balanced using smallest whole numbers, the coefficient of the water is (1) 1 (2) 2 (3) 3 (4) 4

56. Given the reaction: $N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g)$
What is the ratio of moles of $H_2(g)$ consumed to moles of $NH_3(g)$ produced? (1) 1:2 (2) 2:3 (3) 3:2 (4) 6:6

57. When the equation $\_\_Al(s) + \_\_O_2(g) \rightarrow \_\_Al_2O_3(s)$ is correctly balanced using the smallest whole numbers, the coefficient of Al(s) is (1) 1 (2) 2 (3) 3 (4) 4

58. Given the unbalanced equation:
$Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow Al(OH)_3 + CaSO_4$., when the equation is completely balanced using the smallest whole-number coefficients, the sum of the coefficients is (1) 15 (2) 9 (3) 3 (4) 4

59. Which quantity is equivalent to 39 grams of LiF? (1) 1.0 mole (2) 2.0 moles (3) 0.30 mole (4) 1.5 moles

60. What is the total number of molecules contained in 0.50 mole of O_2 at STP [*NOTE:* 1 mol = 6.0×10^{23} particles]? (1) 6.0×10^{23} (2) 4.5×10^{23} (3) 3.0×10^{23} (4) 1.5×10^{23}

61. At STP, what mass of CH_4 has the same number of molecules as 64 grams of SO_2? (1) 16 g (2) 32 g (3) 64 g (4) 128 g

62. What is the total number of moles contained in 115 grams of C_2H_5OH? (1) 1.00 (2) 1.50 (3) 3.00 (4) 2.50

63. How many moles of water are contained in 0.250 mole of $CuSO_4 \cdot 5H_2O$? (1) 1.25 (2) 40.0 (3) 4.50 (4) 62.5

64. What is the mass of 3.0×10^{23} atoms of neon [*NOTE:* 1 mol = 6.0×10^{23} particles]? (1) 1.0 g (2) 10. g (3) 0.50 g (4) 20. g

65. Which represents the greatest mass of chlorine (1) 1 mole of chlorine (2) 1 atom of chlorine (3) 1 gram of chlorine (4) 1 molecule of chlorine

66. What is the total mass of iron in 1.0 mole of Fe_2O_3? (1) 160 g (2) 72 g (3) 112 g (4) 56 g

67. What is the mass, in grams, of 1.0 mole of $(NH_4)_2S$? (1) 50. (2) 54 (3) 64 (4) 68

68. What is the gram atomic mass of the element chlorine? (1) 17 g (2) 35 g (3) 52 g (4) 70. g

69. The mass in grams of 1.00 mole of $CaSO_4 \cdot 2H_2O$ is (1) 172 g (2) 154 g (3) 136 g (4) 118 g

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

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

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

73. 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 74–75 by referring to the equation below:

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

74. 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.

75. $MnO_2(s)$ 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.

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76. A compound consists of 85% silver and 15% fluorine by mass. What is its empirical formula? (1) AgF (2) Ag_2F (3) AgF_2 (4) Ag_6F

For each of the reactions described in questions 77-83, write the correct number to indicate whether the reaction type is (1) DECOMPOSITION, (2) DIRECT COMBINATION, (3) SINGLE REPLACEMENT, or (4) DOUBLE REPLACEMENT

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

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

79. Magnesium burns.

80. Two salt solutions react with each other.

81. Two elements unite to form a compound.

82. A compound breaks down.

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

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84. Regarding statement B which is meant to explain statement A below:
    A. One mole of HBr has a greater mass than one mole of NO_2
    BECAUSE
    B. One molecule of HBr has a greater mass than one molecule of NO_2 ;
    which of the following statements is correct? (1) Both A and B are true, but B does NOT explain A. (2) Both A and B are true, and B does explain A. (3) Both A and B are false. (4) A is true and B is false. (5) A is false and B is true.

85. The formula for calcium nitrate is $Ca(NO_3)_2$. What is its approximate formula weight? (1) 64 amu (2) 164 amu (3) 240 amu (4) 310 amu (5) 380 amu.

86. An unknown substance is found to have a composition of 9% magnesium and 91% iodine by weight. The empirical formula for the substance is (1) MgI, (2) Mg_2I_2, (3) Mg_2I, (4) MgI_2, (5) Mg_3I_2

87. A sample of ammonia has a mass of 56.6 g. How many molecules are in this sample? (1) 3.32 molecules (2) 17.03×10^{24} molecules (3) 6.78×10^{23} molecules (4) 2.00×10^{24} molecules (5) 1.78×10^{24} molecules

88. For which compound does 0.256 mole weigh 12.8 g? (1) C_2H_4O (2) CO_2 (3) CH_3Cl (4) C_2H_6 (5) none of these

89. How many oxygen atoms are there in 1.55 ng of $Ca_3(PO_4)_2$? (1) 3.01×10^{12} (2) 1.20×10^{13} (3) 3.01×10^{18} (4) 1.21×10^{16} (5) 2.41×10^{13}

90. A sample of aluminum contains 5.83×10^{20} atoms. How many grams are present in this sample? (1) 0.0261 g (2) 0.000963 g (3) 27.0 g (4) 0.854 g (5) 1.57×10^{22} g

91. What is the molar mass of fluorapatite, $Ca_5(PO_4)_3F$? (1) 286.1 (2) 430.2 (3) 677.0 (4) 504.3 (5) 398.6

92. Ammonium carbonate contains what percent nitrogen by mass? (1) 14.6% (2) 17.9% (3) 29.2% (4) none of these

93. Phenol is a compound that contains 76.57% carbon, 6.43% hydrogen, and 17.0% oxygen. The empirical formula of phenol is (1) CHO (2) CH_2O (3) C_3H_3O (4) C_2HO (5) C_6H_6O

Answers

1.	3	17.	4	33.	2	49.	3	65.	1	81.	2				
2.	2	18.	1	34.	1	50.	1	66.	3	82.	1				
3.	1	19.	3	35.	2	51.	2	67.	4	83.	4				
4.	1	20.	4	36.	4	52.	4	68.	2	84.	2				
5.	1	21.	4	37.	2	53.	3	69.	1	85.	2				
6.	4	22.	3	38.	2	54.	2	70.	2	86.	4				
7.	2	23.	1	39.	4	55.	2	71.	2	87.	4				
8.	1	24.	4	40.	3	56.	3	72.	4	88.	3				
9.	3	25.	4	41.	4	57.	4	73.	2	89.	1				
10.	4	26.	1	42.	2	58.	2	74.	2	90.	1				
11.	4	27.	2	43.	3	59.	4	75.	3	91.	4				
12.	3	28.	4	44.	2	60.	3	76.	1	92.	3				
13.	1	29.	3	45.	2	61.	1	77.	1	93.	5				
14.	4	30.	4	46.	1	62.	4	78.	3						
15.	2	31.	4	47.	3	63.	1	79.	2						
16.	4	32.	1	48.	2	64.	2	80.	4						