Name_____ 4/25/2012

/ **Regents Review: Periodic Table and Stoichiometry**

1. Given the balanced equation representing a reaction:

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell) + \text{energy}$$

In this reaction there is a conservation of

A) mass, only
B) mass and charge, only
C) charge and energy, only
D) charge, energy, and mass

2. Which ion has the largest radius?

A) Na^+ B) Mg^{2+} **C) K^+** D) Ca^{2+}

3. Which characteristics both generally decrease when the elements in Period 3 on the Periodic Table are considered in order from left to right?

A) nonmetallic properties and atomic radius
B) nonmetallic properties and ionization energy
C) metallic properties and atomic radius
D) metallic properties and ionization energy

4. Which element has the greatest density at STP?

A) calcium B) carbon C) chlorine **D) copper**

5. Given the balanced equation:

$$AgNO_3(aq) + NaCl(aq) \longrightarrow NaNO_3(aq) + AgCl(s)$$

This reaction is classified as

A) synthesis B) decomposition
C) single replacement **D) double replacement**

6. Which is a property of most nonmetallic solids?

A) high thermal conductivity
B) high electrical conductivity
C) brittleness
D) malleability

7. 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 $MgSO_4$.]

A) 11 B) 7 C) 5 D) 4

8. What is the total mass in grams of 0.75 mole of SO_2?

A) 16 g B) 24 g C) 32 g **D) 48 g**

9. Which of the following ions has the smallest radius?

A) F^- B) Cl^- C) K^+ D) Ca^{2+}

10. The molar mass of $Ba(OH)_2$ is

A) 154.3 g B) 155.3 g
C) 171.3 g D) 308.6 g

11. The total number of moles represented by 20 grams of $CaCO_3$ is

A) 1 B) 2 C) 0.1 **D) 0.2**

12. What is the gram formula mass of $Ca_3(PO_4)_2$?

A) 196 g B) 214 g C) 245 g **D) 310. g**

13. An element that has a low first ionization energy and good conductivity of heat and electricity is classified as a

A) metal B) metalloid
C) nonmetal D) noble gas

14. Given two formulas representing the same compound:

Formula A CH_3 **Formula B** C_2H_6

Which statement describes these formulas?

A) Formulas A and B are both empirical.
B) Formulas A and B are both molecular.
C) Formula A is empirical, and formula B is molecular.
D) Formula A is molecular, and formula B is empirical.

15. What can be concluded if an ion of an element is smaller than an atom of the same element?

A) The ion is negatively charged because it has fewer electrons than the atom.
B) The ion is negatively charged because it has more electrons than the atom.
C) The ion is positively charged because it has fewer electrons than the atom.
D) The ion is positively charged because it has more electrons than the atom.

16. Which statement describes the composition of potassium chlorate, $KClO_3$?

A) The proportion by mass of elements combined in potassium chlorate is fixed.
B) The proportion by mass of elements combined in potassium chlorate varies.
C) Potassium chlorate is composed of four elements.
D) Potassium chlorate is composed of five elements.

17. An atom in the ground state contains a total of 5 electrons, 5 protons, and 5 neutrons. Which Lewis electron-dot diagram represents this atom?

A) B) **C)** D)

18. Which list includes elements with the most similar chemical properties?

A) Br, Ga, Hg B) Cr, Pb, Xe
C) O, S, Se D) N, O, F

19. What is the total number of moles of atoms present in 1 gram formula mass of $Pb(C_2H_3O_2)_2$?

A) 9 B) 14 C) 3 **D) 15**

20. The gram-formula mass of NO_2 is defined as the mass of

A) one mole of NO_2 B) one molecule of NO_2
C) two moles of NO D) two molecules of NO

21. The percent composition by mass of magnesium in $MgBr_2$ (gram-formula mass = 184 grams/mole) is equal to

A) $\frac{24}{184} \times 100$ B) $\frac{160.}{184} \times 100$ C) $\frac{184}{24} \times 100$ D) $\frac{184}{160.} \times 100$

22. A student obtained the following data to determine the percent by mass of water in a hydrate.

Mass of empty crucible + cover	11.70 g
Mass of crucible + cover + hydrated salt before heating	14.90 g
Mass of crucible + cover + anhydrous salt after thorough heating	14.53 g

What is the approximate percent by mass of the water in the hydrated salt?

A) 2.5% **B) 12%** C) 88% D) 98%

23. In which type of reaction do two or more substances combine to produce a single substance?

A) synthesis B) decomposition
C) single replacement D) double replacement

24. A compound has an empirical formula of CH_2 and a molecular mass of 56. What is its molecular formula?

A) CH_2 B) C_2H_4 C) C_3H_6 **D) C_4H_8**

25. An aqueous solution of XCl_2 contains colored ions. Element X could be

A) Ba B) Ca **C) Ni** D) Bi

26. The elements on the Periodic Table are arranged in order of increasing

A) atomic mass **B) atomic number**
C) molar mass D) oxidation number

27. Which list of elements consists of metalloids, only?

A) B, Al, Ga B) C, N, P
C) O, S, Se **D) Si, Ge, As**

28. Base your answer to the following question on Given the balanced equation:

$$2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$$

What is the total number of moles of $O_2(g)$ that must react completely with 5.00 moles of $C_4H_{10}(g)$?

A) 10.0 B) 20.0 C) 26.5 **D) 32.5**

29. Given the incomplete equation:

$$4Fe + 3O_2 \longrightarrow 2X$$

Which compound is represented by X?

A) FeO **B) Fe_2O_3** C) Fe_3O_2 D) Fe_3O_4

30. Base your answer to the following question on 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 $C_3H_8(g)$?

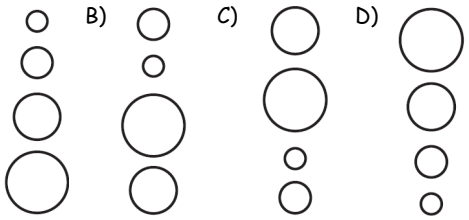
A) .30 mol B) 1.5 mol C) 4.5 mol **D) 7.5 mol**

31. A compound has an empirical formula of HCO_2 and a molecular mass of 90. grams per mole. What is the molecular formula of this compound?

A) HCO **B) $H_2C_2O_4$** C) $H_4C_4O_8$ D) $H_6C_6O_{12}$

32. Which grouping of circles, when considered in order from the top to the bottom, best represents the relative size of the atoms of Li, Na, K, and Rb, respectively?

A) B) C) D)



33. Based on Reference Table S, atoms of which of these elements have the strongest attraction for the electrons in a chemical bond?

A) Al B) Si C) P **D) S**

34. Given the unbalanced equation:

$$__Mg(ClO_3)_2(s) \rightarrow __MgCl_2(s) + __O_2(g)$$

What is the coefficient of O_2 when the equation is balanced correctly using the smallest whole number coefficients?

A) 1 B) 2 **C) 3** D) 4

35. The percentage by mass of Br in the compound $AlBr_3$ is closest to

A) 10.% B) 25% C) 75% **D) 90.%**

36. Base your answer to the following question on Given the unbalanced equation:

$$__Fe_2O_3 + __CO \longrightarrow __Fe + __CO_2$$

When the equation is correctly balanced using the smallest whole-number coefficients, what is the coefficient of CO?

A) 1 B) 2 **C) 3** D) 4

37. Which list of elements contains a metal, a metalloid, a nonmetal, and a noble gas?

A) Be, Si, Cl, Kr B) C, N, Ne, Ar
C) K, Fe, B, F D) Na, Zn, As, Sb

38. A hydrate is a compound that includes water molecules within its crystal structure. During an experiment to determine the percent by mass of water in a hydrated crystal, a student found the mass of the hydrated crystal to be 4.10 grams. After heating to constant mass, the mass was 3.70 grams. What is the percent by mass of water in this crystal?

A) 90.% B) 11% **C) 9.8%** D) 0.40%

39. What are two properties of most nonmetals?

A) high ionization energy and poor electrical conductivity
B) high ionization energy and good electrical conductivity
C) low ionization energy and poor electrical conductivity
D) low ionization energy and good electrical conductivity

40. When the equation

$$__Al_2(SO_4)_3 + __ZnCl_2 \rightarrow __AlCl_3 + __ZnSO_4$$

is correctly balanced using the smallest whole number coefficients, the sum of the coefficients is

A) 9 B) 8 C) 5 D) 4

41. What is the empirical formula for a compound with the molecular formula $C_6H_{12}Cl_2O_2$?

A) $CHClO$ B) CH_2ClO
C) C_3H_6ClO D) $C_6H_{12}C_{12}O_2$

42. An atom of argon in the ground state tends not to bond with an atom of a different element because the argon atom has

A) more protons than neutrons
B) more neutrons than protons
C) a total of two valence electrons
D) a total of eight valence electrons

43. Given the balanced equation representing a reaction:

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Which type of reaction is represented by this equation?

A) decomposition B) double replacement
C) single replacement D) synthesis

44. As the elements in Group 17 are considered in order of increasing atomic number, the chemical reactivity of each successive element

A) decreases B) increases
C) remains the same

45. If an element, X, can form an oxide that has the formula X_2O_3, then element X would most likely be located on the Periodic Table in the same group as

A) Ba B) Cd **C) In** D) Na

46. Compared to a phosphorus atom, a P^{3-} ion has

A) more electrons and a larger radius
B) more electrons and a smaller radius
C) fewer electrons and a larger radius
D) fewer electrons and a smaller radius

47. At STP, both diamond and graphite are solids composed of carbon atoms. These solids have

A) the same crystal structure and the same properties
B) the same crystal structure and different properties
C) different crystal structures and the same properties
D) different crystal structures and different properties

48. What is the mass in grams of 2.0 moles of NO_2?

A) 92 B) 60. C) 46 D) 30.

49. Samples of four Group 15 elements, antimony, arsenic, bismuth, and phosphorus, are in the gaseous phase. An atom in the ground state of which element requires the least amount of energy to remove its most loosely held electron?

A) As **B) Bi** C) P D) Sb

50. Which equation represents a decomposition reaction?

A) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
B) $Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$
C) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
D) $KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(l)$

51. Base your answer to the following question on the information below.

Given: Samples of Na, Ar, As, Rb

Explain your answer in terms of the Periodic Table of the Elements.

Base your answers to questions **52** through **54** on the information below.

A metal, M, was obtained from a compound in a rock sample. Experiments have determined that the element is a member of Group 2 on the Periodic Table of the Elements.

52. Explain why the radius of a positive ion of element M is smaller than the radius of an atom of element M.

53. Using the symbol M for the element, write the chemical formula for the compound that forms when element M reacts with iodine.

54. Explain, in terms of electrons, why element M is a good conductor of electricity.

55. Base your answer to the following question on the information below.

Some dry chemicals can be used to put out forest fires. One of these chemicals is $NaHCO_3$. When $NaHCO_3(s)$ is heated, one of the products is $CO_2(g)$, as shown in the balanced equation below.

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

Show a correct numerical setup for calculating the percent composition by mass of carbon in the product Na_2CO_3.

Base your answers to questions **56** through **59** on the information below

The table below lists physical and chemical properties of six elements at standard pressure that correspond to known elements on the Periodic Table. The elements are identified by the code letters, D, E, G, J, L, and Q.

Properties of Six Elements at Standard Pressure

Element D Density 0.00018 g/cm^3 Melting point –272°C Boiling point –269°C Oxide formula (none)	Element E Density 1.82 g/cm^3 Melting point 44°C Boiling point 280°C Oxide formula E_2O_5	Element G Density 0.53 g/cm^3 Melting point 181°C Boiling point 1347°C Oxide formula G_2O
Element J Density 0.0013 g/cm^3 Melting point –210°C Boiling point –196°C Oxide formula J_2O_5	Element L Density 0.86 g/cm^3 Melting point 64°C Boiling point 774°C Oxide formula L_2O	Element Q Density 0.97 g/cm^3 Melting point 98°C Boiling point 883°C Oxide formula Q_2O

56. Letter Z corresponds to an element on the Periodic Table other than the six listed elements. Elements G, Q, L, and Z are in the same group on the Periodic Table, as shown in the diagram below.

G

Q

L

Z

Based on the trend in the melting points for elements G, Q, and L listed in the "Properties of Six Elements at Standard Pressure" table, estimate the melting point of element Z, in degrees Celsius.

57. What is the total number of elements in the "Properties of Six Elements at Standard Pressure" table that are solids at STP?

58. An atom of element G is in the ground state. What is the total number of valence electrons in this atom?

59. Identify, by code letter, the element that is a noble gas in the "Properties of Six Elements at Standard Pressure" table.

Base your answers to questions **60** through **62** 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.

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

60. Write the IUPAC name for washing soda.

61. Identify the type of chemical reaction represented by the equation.

62. 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.

63. Base your answer to the following question on the information below.

Glycine, NH_2CH_2COOH, is an organic compound found in proteins. Acetamide, CH_3CONH_2, is an organic compound that is an excellent solvent. Both glycine and acetamide consist of the same four elements, but the compounds have different functional groups.

In the space below, calculate the gram-formula mass of glycine. Your response must include both a numerical setup and the calculated result.

Base your answers to questions **64** and **65** on the table below.

First Ionization Energy of Selected Elements

Element	Atomic Number	First Ionization Energy (kJ/mol)
lithium	3	520
sodium	11	496
potassium	19	419
rubidium	37	403
cesium	55	376

64. Explain, in terms of atomic structure, why cesium has a lower first ionization energy than rubidium.

65. State the trend in first ionization energy for the elements in the table as the atomic number increases.

66. Base your answer to the following question on the information below.

A safe level of fluoride ions is added to many public drinking water supplies. Fluoride ions have been found to help prevent tooth decay. Another common source of fluoride ions is toothpaste. One of the fluoride compounds used in toothpaste is tin (II) fluoride.

A town located downstream from a chemical plant was concerned about fluoride ions from the plant leaking into its drinking water. According to the Environmental Protection Agency, the fluoride ion concentration in drinking water cannot exceed 4 ppm. The town hired a chemist to analyze its water. The chemist determined that a 175-gram sample of the town's water contains 0.000 250 grams of fluoride ions.

Draw a Lewis electron-dot diagram for a fluoride ion.

67. Base your answer to the following question on the information below.

The nucleus of one boron atom has five protons and four neutrons.

Determine the total charge of the boron nucleus.

68. Base your answer to the following question on the information below.

Two sources of copper are cuprite, which has the IUPAC name copper(I) oxide, and malachite, which has the formula $Cu_2CO_3(OH)_2$. Copper is used in home wiring and electric motors because it has good electrical conductivity. Other uses of copper not related to its electrical conductivity include coins, plumbing, roofing, and cooking pans.Aluminum is also used for cooking pans.

At room temperature, the electrical conductivity of a copper wire is 1.6 times greater than an aluminum wire with the same length and cross-sectional area. At room temperature, the heat conductivity of copper is 1.8 times greater than the heat conductivity of aluminum. At STP, the density of copper is 3.3 times greater than the density of aluminum.

Write the chemical formula of cuprite.

Base your answers to questions **69** and **70** on the unbalanced equation provided:

___ $C_3H_8(g)$ + ___ $O_2(g) \rightarrow$ ___ $CO_2(g)$ + ___ $H_2O(g)$

69. Using your balanced equation, show a correct numerical setup for calculating the total number of moles of $H_2O(g)$ produced when 5.0 moles of $O_2(g)$ are completely consumed.

70. Balance the equation using the smallest whole-number coefficients.

71. Fluorine is a Group 17 element. Fluorine is the most electronegative and reactive of all elements. It is a pale yellow, corrosive gas, which reacts with practically all organic and inorganic substances.

a Draw the Lewis electron-dot structure for an atom of fluorine.

b What is the definition (or your interpretation} of the term "electronegativity".

c Explain why the electronegativity of elements in Group 17 decreases as you go down within that group.

72. Base your answer to the following question on the information below.

The atomic and ionic radii for sodium and chlorine are shown in the table below.

Atomic and Ionic Radii

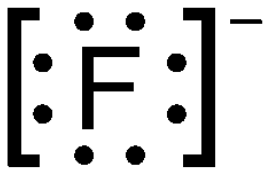
Particle	Radius (pm)
Na atom	190.
Na^+ ion	102
Cl atom	97
Cl^- ion	181

Explain, in terms of atomic structure, why the radius of an Na atom is larger than the radius of an Na^+ ion.

Answer Key

Periodic Table and Forumlas

1. D
2. C
3. C
4. D
5. D
6. C
7. A
8. D
9. A
10. C
11. D
12. D
13. A
14. C
15. C
16. A
17. C
18. C
19. D
20. A
21. A
22. B
23. A
24. D
25. C
26. B
27. D
28. D
29. B
30. D
31. B
32. A
33. D
34. C
35. D
36. C
37. A
38. C
39. A
40. A
41. C
42. D
43. C
44. A
45. C
46. A
47. D
48. A
49. B
50. A
51. Examples: – same number of valance electrons; both are in Group 1
52. Examples: – The ionic radius is smaller because the atom loses two electrons. – The ion has one less occupied energy level.
53. MI_2
54. Examples: – Metals have freely moving valence electrons. – mobile valence electrons – sea of mobile electrons – Electrons are delocalized.
55. $\frac{12}{(2x23)+12+(3x16)}$ x 100

    $\frac{12g/mol}{106g/mol}$ x 100
56. temperature value below 64°C
57. 4
58. 1
59. *D or He*
60. sodium carbonate
61. decomposition
62. 2120. kg
63. • (1)(14.0 g/mol) + (2)(12.0 g/mol) + (2)(16.0 g/mol) + (5)(1.0 g/mol) = 75.0 g/mol • (1)(14) + (5)(1) + (2)(12) + (2)(16) • 75.0 g/mol
64. Acceptable responses include, but are not limited to: As atomic radius increases, valence electrons are more easily removed. The force of attraction between the nucleus and the valence electrons decreases down the group. cesium has more shells, easier to remove electrons
65. Acceptable responses include, but are not limited to: As atomic number increases, first ionization energy decreases. Ionization energy decreases.
66. 
67. +5
68. Cu_2O
69. Allow credit for a numerical setup consistent with the student's response to previous question
70. Allow credit for $C_5H_{12}(g) + 8\ O_2(g) \rightarrow 5\ CO_2(g) + 6\ H_2O(g)$. Allow credit even if the coefficient "1" is written in front of $C_5H_{12}(g)$
71.
72. • A sodium atom loses the electron in its outer shell, causing the radius of the ion to be smaller than the radius of the atom. • An Na atom has three electron shells, but an Na^+ ion has only two electron shells.