

Fall Semester Review

Completion

Complete each statement.

1. The study of matter and changes that occur in matter best describes the science of _____.
2. In a bonfire, oxygen allows wood to combust, leaving behind ashes. In this process, oxygen and wood are the reactants, and ashes are the _____.
3. When examining a mineral, hardness and color are two of the properties used for identification. Hardness and color are examples of _____ properties.
4. An apple turning brown after being cut is an example of a _____ change.
5. The melting of butter is a _____ change because it does not produce any new substances.
6. Some iron and sulfur are mixed together, then heated. When the result is cooled, the iron can no longer be separated from the sulfur with a magnet. The result of heating the mixture was the formation of a(n) _____.
7. A sample of matter can be poured from container to container. It takes the shape of its container but only takes up a certain volume. Based on this information, the sample is in the _____ state.
8. Matter that has *neither* a definite volume *nor* a definite shape is in the _____ state.
9. The two types of matter that are pure substances are _____ and _____.
10. An alloy such as a gold ring is an example of a(n) _____ mixture.
11. Gravel is an example of a(n) _____ mixture.
12. The name for the compound P_2O_5 is _____.
13. In writing a formula equation for a reaction that produces hydrogen gas, the correct representation of hydrogen gas is _____.
14. In the chemical equation $2AlCl_3(aq) + 3Pb(NO_3)_2(aq) \rightarrow 3PbCl_2(s) + 2Al(NO_3)_3(aq)$, the state of $PbCl_2$ is a(n) _____.

Name: _____

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15. When the formula equation $\text{CuSO}_4(aq) + \text{Fe}(s) \rightarrow \text{Fe}_2(\text{SO}_4)_3(aq) + \text{Cu}(s)$ is correctly balanced, the coefficient of $\text{CuSO}_4(aq)$ is _____.
16. The reaction represented by the equation $2\text{HgO}(s) \rightarrow 2\text{Hg}(l) + \text{O}_2(g)$ is classified as a(n) _____ reaction.
17. The proportions of the reactants and products involved in a chemical reaction are shown by the _____ in the balanced chemical equation describing the reaction.
18. If two moles of each reactant are available for the reaction described by the following equation, $\text{SiO}_2(s) + 3\text{C}(s) \rightarrow \text{SiC}(s) + 2\text{CO}(g)$, _____ is the substance that is the limiting reactant.
19. If four moles of each reactant are available for the reaction described by the following equation, $\text{SiO}_2(s) + 3\text{C}(s) \rightarrow \text{SiC}(s) + 2\text{CO}(g)$ _____ is the substance that is the excess reactant.
20. The efficiency of a reaction is described by the _____ yield.

Short Answer

21. A measure of the quantity of matter is
22. The vertical columns on the periodic table are called
23. The horizontal rows on the periodic table are called
24. The density of pure diamond is 3.5 g/cm^3 . What is the volume of a diamond with a mass of 0.25 g ?
25. The number of significant figures in the measurement $0.000\ 305 \text{ kg}$ is
26. The number of significant figures in the measured value $0.032\ 0 \text{ g}$ is
27. The number of significant figures in the measurement 2010 cm is
28. What is $1.245\ 633\ 501 \times 10^8$ rounded to four significant figures?
29. How many significant figures would the answer to the following calculation have?
 $3.475 \times 1.97 + 2.4712$ is
30. How many significant digits should be shown in the product of 1.6 cm and 2.4 cm ?
31. Which concept in Dalton's atomic theory has been modified?

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32. Because a few alpha particles bounced back from the foil, Rutherford concluded that they were
33. Rutherford's experiments led him to conclude that atoms contain massive central regions that have
34. An atom is electrically neutral because
35. Isotopes are atoms of the same element that have different
36. An aluminum isotope consists of 13 protons, 13 electrons, and 14 neutrons. Its mass number is
37. What are the radioactive elements with atomic numbers from 90 to 103 called?
38. What are the elements with atomic numbers from 58 to 71 called?
39. Argon, krypton, and xenon are
40. A horizontal row of blocks in the periodic table is called a(n)
41. The electron configuration of cesium, atomic number 55, is $[\text{Xe}] 6s^1$. In what period is cesium?
42. Calcium, atomic number 20, has the electron configuration $[\text{Ar}] 4s^2$. In what period is calcium?
43. Elements to the right side of the periodic table (*p*-block elements) have properties most associated with
44. The elements whose electron configurations end with $s^2 p^5$ in the highest occupied energy level belong to Group
45. Bromine, atomic number 35, belongs to Group 17. How many electrons does bromine have in its outermost energy level?
46. The elements in Group 1 are also known as the
47. Which block in the periodic table contains the alkali metals?
48. The most reactive group of the nonmetals is the
49. The group of soft, silvery, reactive metals, all of which have one electron in an *s* orbital, is known as the
50. The energy required to remove an electron from an atom is the atom's
51. A measure of the ability of an atom in a chemical compound to attract electrons from another atom in the compound is called
52. One-half the distance between the nuclei of identical atoms that are bonded together is called the

53. A positive ion is known as a(n)
54. A negative ion is known as a(n)
55. The electrons available to be lost, gained, or shared when atoms form compounds are called
56. The number of valence electrons in Group 1 elements is
57. The number of valence electrons in Group 17 elements is
58. For groups 13 through 18, the number of valence electrons is equal to the group number
59. If the atoms that share electrons have an unequal attraction for the electrons, the bond is called
60. Which of the following shows the types and numbers of atoms joined in a single molecule of a molecular compound?
61. In a molecule of fluorine, the two shared electrons give each fluorine atom how many electron(s) in the outer energy level?
62. The electron configuration of nitrogen is $1s^2 2s^2 2p^3$. How many more electrons does nitrogen need to satisfy the octet rule?
63. What group of elements satisfies the octet rule without forming compounds?
64. A formula that shows only the types and numbers of atoms combined in a single molecule is called a(n)
65. A chemical bond formed by the attraction between positive ions and surrounding mobile electrons is a(n)
66. If a material can be shaped or extended by physical pressure, such as hammering, which property does the material have?
67. Use VSEPR theory to predict the shape of the carbon tetraiodide molecule, CI_4 .
68. Use VSEPR theory to predict the shape of carbon dioxide, CO_2 .
69. What is the percentage composition of $CuCl_2$?
70. What is the empirical formula for a compound that is 31.9% potassium, 28.9% chlorine, and 39.2% oxygen?
71. A compound's empirical formula is CH. If the formula mass is 26 amu, what is the molecular formula?
72. Explain the differences between qualitative and quantitative observations.

73. Distinguish between precision and accuracy.
74. In terms of the periodic law, explain which two of these elements are most similar: sodium (element 11), phosphorus (element 15), and sulfur (element 16).
75. What can you predict about the properties of xenon and helium, both in Group 18 in the periodic table? Why?
76. Why do most atoms form chemical bonds?
77. Differentiate between an ionic compound and a molecular compound.
78. Explain why metals are good conductors of electricity.
79. Consider the reaction represented by the equation $4\text{CuO}(s) + \text{CH}_4(g) \xrightarrow{\Delta} 4\text{Cu}(s) + \text{CO}_2(g) + 2\text{H}_2\text{O}(g)$. Describe this reaction in terms of states of matter and the conditions required for the reaction to happen.
80. When balancing a chemical equation, why must the formula subscripts remain unchanged?
81. Determine the maximum number of moles of product that can be produced from 7.0 mol Al and 8.0 mol Cl_2 according to the equation $2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$. Describe in words the method used. Then show the calculation(s).
82. Explain the difference between a limiting reactant and an excess reactant.

Essay

83. Describe the steps necessary to solve a mass-mass stoichiometry problem.

Problem

84. How many atoms are present in 8.00 mol of chlorine atoms?
85. How many moles of platinum are equivalent to 1.20×10^{24} atoms?
86. Determine the mass in grams of 5.00 mol of oxygen. The molar mass of oxygen is 16.00 g/mol.
87. Determine the number of moles of helium in 10.0 g of helium. The molar mass of helium is 4.00 g/mol.
88. Calculate the mass in grams of 9.00 mol of potassium (molar mass 39.10 g/mol).
89. Write the electron configuration for nitrogen, atomic number 7.
90. Which element has the following electron configuration: $[\text{Ar}] 4s^2 3d^{10} 4p^5$?

91. Write the noble-gas electron configuration for silicon.
92. Draw the orbital diagram for phosphorus.
93. Draw the orbital diagram for argon.
94. Draw a Lewis structure for carbon disulfide, CS₂.
95. Draw a ball-and-stick model of a water molecule. Label that atoms, include the polarities of the bonds using arrows, and indicate net molecular dipole.
96. The molar mass of aluminum is 26.98 g/mol and the molar mass of fluorine is 19.00 g/mol. Calculate the molar mass of aluminum trifluoride, AlF₃.
97. Write a balanced chemical equation for the following reaction: iron plus copper(I) nitrate yields iron(II) nitrate plus copper.
98. Tell what type of chemical reaction is represented by the following formula equation. Then balance the equation.
$$\text{C}_3\text{H}_8(g) + \text{O}_2(g) \xrightarrow{\Delta} \text{CO}_2(g) + \text{H}_2\text{O}(l)$$
99. Tell what type of chemical reaction is represented by the following formula equation. Then balance the equation.
$$\text{KBr}(aq) + \text{Mg}(\text{OH})_2(aq) \rightarrow \text{KOH}(aq) + \text{MgBr}_2(aq)$$
100. Sulfur in gasoline can produce sulfuric acid, H₂SO₄, according to the two-step process shown below. For each 125 g of sulfur in gasoline, how many moles of H₂SO₄ will be produced?
$$\text{S}(s) + \text{O}_2(g) \rightarrow \text{SO}_2(g)$$

$$2\text{SO}_2(g) + 2\text{H}_2\text{O}(l) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{SO}_4(aq)$$
101. What mass in grams of potassium chloride is produced if 100. g of potassium chlorate decompose according to the following equation?
$$2\text{KClO}_3(s) \xrightarrow{\text{heat}} 2\text{KCl}(s) + 3\text{O}_2(g)$$
102. How many grams of ammonium sulfate can be produced if 30.0 mol of H₂SO₄ react with excess NH₃ according to the equation 2NH₃(aq) + H₂SO₄(aq) → (NH₄)₂SO₄(aq)?
103. The reaction of 100. g of salicylic acid, C₇H₆O₃, with excess acetic anhydride produces 50.0 g of aspirin, C₉H₈O₄, according to the equation below. What is the percentage yield for this reaction?
$$\text{C}_7\text{H}_6\text{O}_3 + \text{C}_4\text{H}_6\text{O}_3 \rightarrow \text{C}_9\text{H}_8\text{O}_4 + \text{C}_2\text{H}_4\text{O}_2$$

Fall Semester Review Answer Section

COMPLETION

1. chemistry
2. product
3. physical
4. chemical
5. physical
6. compound
7. liquid
8. gaseous
9. elements, compounds
10. homogeneous
11. heterogeneous
12. diphosphorus pentoxide
13. $\text{H}_2(\text{g})$
14. solid
15. 3
16. decomposition
17. coefficients
18. carbon (C)
19. silicon dioxide (SiO_2)
20. percentage

SHORT ANSWER

21. mass.
22. groups.
23. periods.
24. 0.071 cm^3
25. 3.
26. 3.
27. 3.
28. 1.246×10^8
29. 3
30. 2
31. Atoms cannot be divided.
32. repelled by densely packed regions of positive charge.
33. a positive charge.
34. the numbers of protons and electrons are equal.
35. masses.
36. 27.

37. the actinides
38. the lanthanides
39. noble gases.
40. period.
41. Period 6
42. Period 4
43. nonmetals.
44. 17.
45. 7
46. alkali metals.
47. *s*
48. halogens.
49. alkali metals.
50. ionization energy.
51. electronegativity.
52. atomic radius.
53. cation.
54. anion.
55. valence electrons.
56. 1.
57. 7.
58. minus 10.
59. polar.
60. molecular formula
61. 8
62. 3
63. noble gas
64. molecular formula.
65. metallic bond.
66. malleability
67. tetrahedral
68. linear
69. 47.27% Cu, 52.73% Cl
70. KClO_3
71. C_2H_2
72. In qualitative observations, the data are descriptive and non-numerical. In quantitative observations, the data are numerical.
73. Precision is how close a set of measurements of the same quantity are. Accuracy is how close a measurement is to the true value.
74. Their locations in the periodic table indicate that phosphorus and sulfur are nonmetals and sodium is a metal. Nonmetals are a group with characteristic properties, so phosphorus and sulfur are the most similar elements of the three.
75. In the periodic table, elements in the same column or group have similar properties. Because helium and xenon are in the same group, they have similar properties.
76. Atoms form chemical bonds to establish a more-stable arrangement. As independent particles, they are at high potential energy. By bonding, they decrease their potential energy, thus becoming more stable.

77. Atoms in a molecular compound share electrons to achieve stability. Atoms in an ionic compound gain or lose electrons to form ions, which combine so that the number of positive and negative charges is equal.
78. The valence electrons in a metal's structure are delocalized, so they can move freely and carry an electric charge throughout the metal.
79. Solid CuO and gaseous CH₄ are combined and heated. The products are solid copper, carbon dioxide gas, and water vapor.
80. Changing the subscript in a formula changes the chemical composition of the compound.
81. Find the limiting reagent first. Assume that the other reactant is in excess when you calculate the moles of product formed from the first reactant. The reactant that gives the smaller amount of product is limiting. It gives the maximum amount of product for the reaction. Set up mole ratios and make them equal to each other.

$$\text{Al: } \frac{2 \text{ mol Al}}{2 \text{ mol AlCl}_3} = \frac{7 \text{ mol Al}}{x \text{ mol AlCl}_3}$$

$$x = 7 \text{ mol AlCl}_3$$

$$\text{Cl}_2 : \frac{3 \text{ mol Cl}_2}{2 \text{ mol AlCl}_3} = \frac{8 \text{ mol Cl}_2}{x \text{ mol AlCl}_3}$$

$$x = 5.3 \text{ mol AlCl}_3$$

This means that chlorine is limiting.

82. In a reaction that goes to completion, a limiting reactant is used up, and an excess reactant is not used up.

ESSAY

83. Write a balanced chemical equation. Convert grams of the given substance to moles, using the molar mass. Find moles of the substance sought, using the mole ratio for the two substances in the balanced chemical equation. Convert moles of the substance sought to grams using the molar mass.

PROBLEM

84. $4.82 \times 10^{24} \text{Cl}$

$$\text{Solution: } 8.00 \text{ mol Cl} \times \frac{6.022 \times 10^{23} \text{ atoms Cl}}{1 \text{ mol Cl}} = 4.82 \times 10^{24} \text{ atoms Cl}$$

85. 1.99 mol Pt

$$\text{Solution: } 1.20 \times 10^{24} \text{ atoms Pt} \times \frac{1 \text{ mol Pt}}{6.022 \times 10^{23} \text{ atoms Pt}} = 1.99 \text{ mol Pt}$$

86. 80.0 g O

$$\text{Solution: } 5.00 \text{ mol O} + \frac{16.00 \text{ g O}}{1 \text{ mol O}} = 80.0 \text{ g O}$$

87. 2.50 mol He

$$\text{Solution: } 10.0 \text{ g He} + \frac{1 \text{ mol He}}{4.00 \text{ g He}} = 2.50 \text{ mol He}$$

88. 352 g K

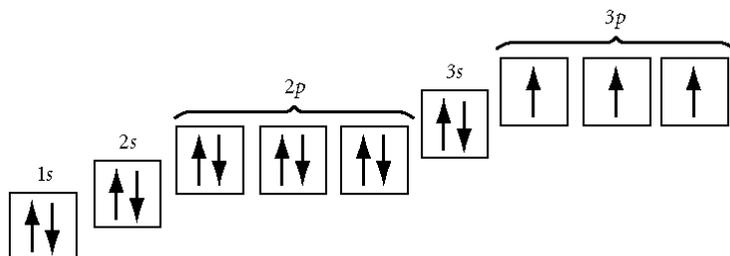
$$\text{Solution: } 9.00 \text{ mol K} + \frac{39.10 \text{ g K}}{1 \text{ mol K}} = 352 \text{ g K}$$

89. $1s^2 2s^2 2p^3$

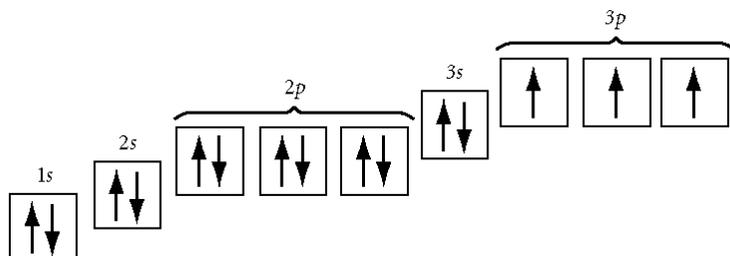
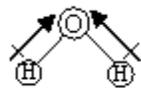
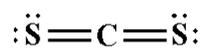
90. bromine

91. $[\text{Ne}] 3s^2 3p^2$

92.



93.

94. 1 C atom with 4 valence electrons $\Rightarrow 1 \times 4 = 4$ 2 S atoms with 6 valence electrons $\Rightarrow 2 \times 6 = 12$ $4 + 12 = 16$ valence electrons

95.

96. 83.98 g/mol AlF_3

Solution:

$$26.98 \text{ g/mol Al} + (3 \times 19.00 \text{ g/mol F}) = 89.3 \text{ g/mol AlF}_3$$

97. $\text{Fe}(s) + 2\text{CuNO}_3(aq) \rightarrow \text{Fe}(\text{NO}_3)_2(aq) + 2\text{Cu}(s)$ 98. combustion, $\text{C}_3\text{H}_8(g) + 5\text{O}_2(g) \xrightarrow{\Delta} 3\text{CO}_2(g) + 4\text{H}_2\text{O}(l)$

99. double-displacement, $2\text{KBr}(aq) + \text{Mg}(\text{OH})_2(aq) \rightarrow 2\text{KOH}(aq) + \text{MgBr}_2(aq)$

100. 3.90 mol H_2SO_4

$$125 \text{ g S} \times \frac{1 \text{ mol SO}_2}{32.06 \text{ g S}} \times \frac{1 \text{ mol SO}_2}{1 \text{ mol S}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol SO}_2} = 3.90 \text{ mol H}_2\text{SO}_4$$

101. 60.8 g KCl

$$100. \text{ g KClO}_3 \times \frac{1 \text{ mol KClO}_3}{122.55 \text{ g KClO}_3} \times \frac{2 \text{ mol KCl}}{2 \text{ mol KClO}_3} \times \frac{74.55 \text{ g KCl}}{1 \text{ mol KCl}} = 60.8 \text{ g KCl}$$

102. 3960 g $(\text{NH}_4)_2\text{SO}_4$

$$30.0 \text{ mol H}_2\text{SO}_4 \times \frac{1 \text{ mol } (\text{NH}_4)_2\text{SO}_4}{1 \text{ mol H}_2\text{SO}_4} \times \frac{132.17 \text{ g } (\text{NH}_4)_2\text{SO}_4}{1 \text{ mol } (\text{NH}_4)_2\text{SO}_4} = 3960 \text{ g } (\text{NH}_4)_2\text{SO}_4$$

103. theoretical yield:

$$100 \text{ g C}_7\text{H}_6\text{O}_3 \times \frac{1 \text{ mol C}_7\text{H}_6\text{O}_3}{138.13 \text{ g C}_7\text{H}_6\text{O}_3} \times \frac{1 \text{ mol C}_9\text{H}_8\text{O}_4}{1 \text{ mol C}_7\text{H}_6\text{O}_3} \times \frac{180.17 \text{ g C}_9\text{H}_8\text{O}_4}{1 \text{ mol C}_9\text{H}_8\text{O}_4} = 130. \text{ g C}_9\text{H}_8\text{O}_4$$

percent yield:

$$\frac{50.0 \text{ g}}{130 \text{ g}} \times 100 = 38.3\%$$