CST REVIEW

1. **Percent Error** What is the formula? Write an example.
2. What is the formula for density?
3. What is the density of a solid block with a mass of 432 grams and dimensions 2 cm x 4 cm x 6 cm on each edge?
4. Metric Conversions **(memorize)**

   1 kilometer = _____ meter (m)   1 meter = _____ cm   1 meter = _____ mm
   1kilogram = _____ gram (g)   1 gram = _____ cg   1 gram = _____ mg

   What is the number 305.0 expressed in proper *scientific notation* and with the correct number of sig figs?
5. Distinguish between *hypothesis* and *theory* as scientific terms.
6. List the steps in the scientific method.
7. The periodic table displays the elements in increasing _____ _____ and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.
8. Write the atomic number & ave. atomic mass for Nickel (Ni).
9. **Memorize: mass number = protons + neutrons**
10. The nucleus of the atom is much smaller than the atom yet contains most of its _____.
11. What particles form the nucleus of an atom? _____ & _____
12. Describe an electron.
13. **Know how to use the <u>periodic table</u> to identify metals, semimetals, & nonmetals.**
14. Identity the following as a metal, semimetal, or nonmetal.

    Ar _____ Sc _____ B _____ S _____ Li _____
15. For the nonmetals only, which is an active non-metal and which is an inactive non-metal?
16. **Know how to use the periodic table to determine the number of electrons available for bonding.**
17. How many valence electrons in each group? 1A ___   3A ____   6A ____   8A ____   7A ____   Cl _____   Sr _____N

    _____
18. **Know how many valence electrons are needed for an atom to fill its octet or be most stable?**
19. Know how to use the periodic table to identify alkali metals, alkaline earth metals, transition metals, halogens, and noble gases. **Give examples**
20. **Know the difference between groups/families and periods.** What elements have similar properties to magnesium?
21. **Trends** in ionization energy, electronegativity, and the relative sizes of atoms. **Write examples**.
22. How many *neutrons* in the following isotopes?

    $^{16}_{8}O$ _____ $^{80}_{35}$ _____ $^{14}_{6}C$ _____ $^{12}_{6}C$ _____ $^{20}_{10}Ne$ _____
23. If 85% of the isotopes of an element have a mass of 44.0 amu and 15% of the isotopes have a mass of 47 amu, what is the atomic mass of the element? **Show work**
24. Atoms combine to form molecules by _____ electrons to form covalent bonds or by exchanging/transferring electrons to form _____ bonds.
25. Are the following **ionic** or **molecular** compounds? Al_2O_3 _____ CO_2 _____ N_4F_3 _____
26. **Name them.** _____   _____   _____
27. **What type of bonds are formed when two or more non-metal atoms combine?**
28. Chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, NH_2CH_2COOH, N_2, Cl_2, and many large biological molecules are _____ bonds.
29. Identify the following as a monatomic gas or a diatomic molecule.

    Ar _____   I _____   N _____   Ne _____
30. Salt crystals, such as NaCl, are repeating patterns of _____ and _____ ions held together by electrostatic attraction. Cations are strongly attracted to _____.
31. How many electrons are lost or gained? Mg^{2+} _____ P^{3-} _____ S^{2-} _____ Na^{1+} _____ Cl^{1-}

    _____
32. Write the correct ion pair and the ionic compound the ions form? Then name them.

    K & P   ____ ____ _____   _____
    Al & Cl   ____ ____ _____   _____
    Mg & O   ____ ____ _____   _____

33. List the following in order of increasing ionization energy: Cs, K, Rb, Na, Li
34. List the following in order of increasing electronegativity: K, Br, Ca, As
35. Atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form. Under the same conditions of pressure and temperature, how does a liquid differ from a solid and gas?
36. Draw Lewis dot (electron-dot) structures.   S, Li, P, O, Ne, Mg, K, B, Be, N, Ar
37. The correct electron dot formula for magnesium chloride, carbon dioxide, and hydrogen fluoride are:
38. Draw a polar molecule and a non-polar molecule. Describe each.
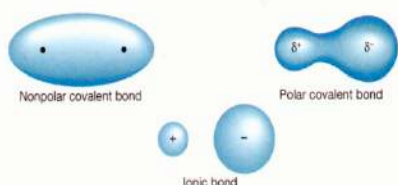
39. **KNOW: the quantity "one mole" is set by defining *one mole of carbon-12 atoms has a mass of exactly 12.000 grams.***
40. How many moles of carbon-12 are contained in exactly 48 grams of carbon-12?
41. How many grams of gold are in 0.5 moles of gold?
42. How many hydrogen atoms are in 5 **molecules** of ethylene glycol, $HOCH_2CH_2OH$?
43. One mole equals ____ particles (atoms or molecules).
44. Standard Temperature and Pressure (STP) are: _____ atm _____ °C _____ K
45. A balloon filled with 1.00 mole $He_{(g)}$ at STP has _____ L, _____ molecules, _____ g
46. How many moles are in 9.0×10^{42} atoms of Potassium (K)?
47. Determine the molar mass of a molecule from its chemical formula and a table of atomic masses.

   $Al(NO_3)_3$ _____ C_9O_{20} _____
 $KClO_3$ _____ $Ba(NO_3)_2$ _____

DEFINE 1. Reactant   2. Product   3. Chemical Equation   4. Coefficient   5. Subscript
   6. Chemical Reaction   7. Conservation of Mass   8. Balanced Equation   9. Mole-Mole Calculation
   10. Stoichiometry   11. Chemical Property   12. Mass – Mass Calculation   13. Physical Property
   14. Mole – Volume Calculation   15. Physical Change
48. According to the law of conservation of mass, how does the mass of the *products* in a chemical reaction compare to the mass of the *reactants*?

Know how to describe chemical reactions by writing balanced equations.
49. A(n) _____ chemical equation has the same number of atoms of each element on each side of the equation.
50. The following chemical equation represents the combustion of butane. ____ C_4H_{10} + ____ O_2 → ____ CO_2 + ____ H_2O When correctly balanced, the coefficient for water is _____.   Using the smallest whole-number coefficients, what is the *sum* of the coefficients? _____

51. When the equation ____ $KClO_3$ → ____ KCl + ____ O_2 is balanced using whole-number coefficients, what is the coefficient of O_2? _____ What is the sum of the coefficients? _____

52. Balance the equation ____ Zn + ____ HCl → ____ $ZnCl_2$ + ____ H_2
53. Interpret the above equation on the micro level and macro level.

54. What is the balanced equation for the combustion of octane (C_8H_{18})?

        ___ C_8H_{18} + ___ O_2 → ___ CO_2 + ___ H_2O
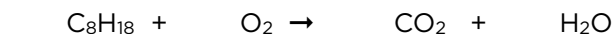
Know how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses (Periodic Table) and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.

Mass to Mole Problems SHOW WORK

55. How many moles of Pt are contained in 975 g of platinum (Pt)?

56. What is the total number of moles contained in 59.5 grams of NH_3?

Mole to Mass Problems SHOW WORK

57. What quantity is equivalent to 3.2 moles of AgCl?

        a. 0.022 g AgCl   b. 140 g AgCl   c. 1.0 g AgCl   d. 460 g AgCl

Particles to Moles SHOW WORK

58. How many moles are in 1.32 x 10^{25} atoms of Potassium (K)?

Moles to Particles   SHOW WORK

59. How many molecules are in 0.75 mole of Br_2?

Mixed Mole Problems SHOW WORK

60. How many atoms are contained in 97.6 g of platinum (Pt)?

61. What is the total mass of 1.80 x 10^{24} atoms of oxygen gas (O_2)?

Know how to calculate the masses of reactants and products in a chemical reaction from the masses of one of the reactants or products and the relevant atomic masses.

62. Describe the law of Conservation of Mass

Mole – Mole Problems SHOW WORK

63. In the reaction $2CO_{(g)}$ + $O_{2(g)}$ → $2CO_{2(g)}$, what is the ratio of moles of oxygen used to moles of CO_2 produced?

64. In the reaction $2Al_2O_3$ → $4Al$ + $3O_2$, what is the mole ratio of aluminum Al to Al_2O_3?

65. Calculate the number of moles of Al_2O_3 that are produced when 3.0 mol of Fe is produced in the following reaction. $2Al_{(s)}$ + $3FeO_{(s)}$ → $3Fe_{(s)}$ + $Al_2O_{3\ (s)}$

66. For the reaction C + $2H_2$ → CH_4, how many moles of hydrogen are required to produce 5 mol of methane, CH_4?

Liter – Liter Problems SHOW WORK

67. At STP, how many liters of oxygen are required to react completely with 3.6 liters of hydrogen to form water? $2H_{2(g)}$ + $O_{2(g)}$ → $2H_2O_{(g)}$

68. At STP, the volume occupied by 44 grams of a gas is 11.2 Liters. The gram molecular mass (molar mass) of this gas is closest to

        a. 44 g   b. 22 grams   c. 88 grams   d. 22.4 grams

Mass – Mass Problems SHOW WORK

69. In the reaction $4Al$ + $3O_2$ → $2Al_2O_3$, how many grams of Al are needed to produce exactly 6 moles of Al_2O_3?

70. How many grams of chromium are needed to react with an excess of $CuSO_4$ to produce 192 g Cu?
 $2Cr_{(s)}$ + $3CuSO_{4\ (aq)}$ → $Cr_2(SO_4)_{3\ (aq)}$ + $3Cu_{(s)}$
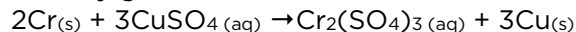
71. In the following reaction, how many grams of Fe_2O_3 are required to completely react with 168 grams of CO? Fe_2O_3 + $3CO$ → $2Fe$ + $3CO_2$

72. Which type of stoichiometric calculation does not require the use of the molar mass?

A. mass-mass problems   B. mass-particles problems   C. volume-volume problems

73. Describe the kinetic theory of gases.
74. A 10 g mass of krypton occupies 15.0 L at a pressure of 12 atm. Does the volume of the krypton increase or decrease when the pressure decreases to 6 atm._____
75. Convert -82 °C to degrees Kelvin.
76. What Kelvin temperature is equal to 62 °C?
77. Standard temperature: _____ °C _____ K
78. Standard pressure: _____ kPa _____ atm _____ mmHg _____ lbs/in²
79. What temperature represents absolute zero?
80. The temperature of a substance is a measure of its particles' _____
81. The tendency of molecules to move towards areas of lower concentration is called _____
82. A sample of a gas occupies 12.0 L at a temperature of 150. K. If the pressure remains constant and the temperature is raided to 450. K, the volume of the gas sample would be?
83. At constant temperature, the pressure on 62 L of a gas is decrease from 6 atmospheres to 4 atmospheres. What will be the new volume of the gas?
84. Identify the graph which represents how the volume of a given mass of gas varies with an increase in temperature at constant pressure.
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86. Identify the graphs as Boyle's law or Charles's law.
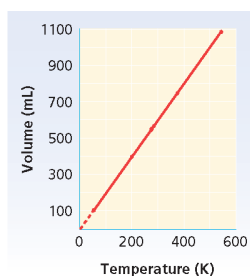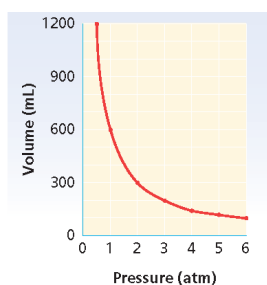
87. Describe exothermic chemical reactions.
88. Give an example of an exothermic chemical reaction.
89. What phase change(s) is/are exothermic?
90. Describe endothermic chemical reactions.
91. Give an example of an endothermic chemical reaction.
92. What phase change(s) is/are endothermic?
93. The melting of a substance is accomplished by the _____ of energy.
94. If 6.0 grams of water at 1.0°C absorbs 144 joules of heat, what will be the change in temperature of the water?
95. Describe diffusion.
96. How many joules of energy are needed to completely melt 15.0 grams of ice to water at 0°C?
97. A 15.0 gram sample of a substance (NOT water) absorbs 4,500 joules of heat energy to melt completely at its melting temperature. What is the heat of fusion of the substance?

The graph below, shows the relationship between temperature and time as heat is added to one mole of a substance at a rate of 250 joules per minute. The substance is in the solid phase at 0 minutes.
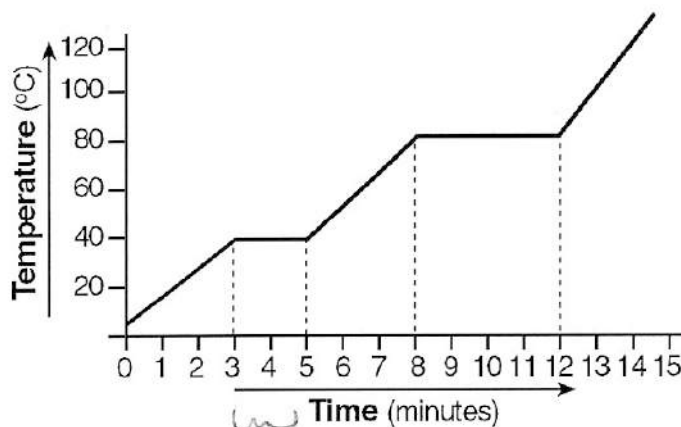
98. From the time that the solid begins to melt, the minimum number of joules required to completely melt the one mole sample is _____.

99. From the time that the liquid begins to vaporize, the minimum number of joules required to completely vaporize the one mole sample is _____.

100. List and explain the three parts of the Kinetic Molecular Theory.

101. Define pressure.

102. Convert: 900 torr = _____ kPa   2.75 atm = _____ torr

103. Define STP and list its values (6 values)

104. Define diffusion

105. Define temperature

106. Convert: 0 K = _____ °C   -43 °C = _____K   273 °C= _____K

107. Define absolute zero and list its measurements (both K and °C)

108. Boyle's law says that as volume decreases the pressure _____ (decrease/increase).

109. A gas at 1.0 atm has its volume raised from 2.0L to 8.0 L. What is the new pressure?

110. Charles' law states that as temperature increases the volume _____ (decrease/increase).

111. If a balloon has a volume of 6L at 50K, what will its volume be at 250K?

112. Gay-Lussac's Law says that as temperature increases the pressure _____ (decrease/increase).

113. If a gas has a pressure of 500 torr at 200K, what will the new pressure be at 600K?

114. Write the Combined Gas Law.

115. A gas has a volume of 2.0 L at 2.0 atm and 300K. What will its volume be if the pressure becomes 3.0 atm at 450 K?

116. Define energy.

117. Define heat (q).

118. Define exothermic reaction and be able to recognize its potential energy graph.

119. Define endothermic reaction and be able to recognize its potential energy graph.

120. Which side of the chemical equation does energy appear on for exothermic and endothermic reactions?

121. Define a calorie. Be able to convert from calories to joules.

122. Define specific heat capacity.

123. How many calories of heat would need to be absorbed by 50 g. of water to raise the temperature of the water from 50 °C to 60 °C?

124. If a 10g sample of water absorbs 168 joules of energy at 5 °C, what will be the change in temperature?

Solutions

125. Define solution. Give two examples.

126. In the term NaCl (aq), what does the (aq) stand for and what does it mean.

127. Define solute. Give two examples. Identify the solute in question #2.

128. Define solvent. Give two examples. Identify the solvent in question #2.

129. Define solubility (normally expressed as grams of solute/ 100g solvent)

130. Draw a series of picture showing the dissolving process (at least three). Explain in a paragraph the dissolving process.

131. Draw a water molecule and show the partial charges of each atom.

132. Which atom(s) in a water molecule will surround a sodium (Na) ion in an aqueous solution? Which atom(s) in a water molecule will surround a chlorine (Cl) ion in an aqueous solution?

133. Which of the following form electrolytes in solution?

   NaCl   CH$_4$ (NH$_4$)$_3$PO$_4$ Benzoic acid   Sugar

134. Raising the temperature of a solvent does what to the speed at which the solute dissolves?

135. Increasing the surface area of a solute does what to the speed at which the solute dissolves?

136. Decreasing the partial pressure of a gas above a solution will do what to the gasses solubility in a liquid?

137. A 650mL solution contains 4moles of NaCl. What is the concentration of the solution in g/L?

138. 85.6g of calcium chloride are dissolved in enough water to make a 250mL solution. What is the molarity of the solution?

139. 45g of sugar are dissolved in 405g of water. What is the concentration of the solution in part per million (ppm)?

140. There are 1.6 moles of magnesium chloride in 0.37 kg of solution. What is the % composition?

Acids and Bases

141. Describe how acids and bases each taste.

142. What color do acids and bases each turn litmus paper?

143. What is produced when an acid reacts with a base?

144. What is produced when an acid reacts with a metal?

145. According to Arrhenius, what kind of ions does acids and bases each produce in solution?

146. Define an acid and a base according to Bronsted-Lowry.

147. What does the term strong and weak mean when discussing acids and bases?

148. Why is a strong acid more acidic than a weak acid?

149. How many hydrogen ions (H+) would be found floating in a solution if 500 molecules of the strong acid hydrochloric acid (HCl) were put into water?

150. What are the range of values on the pH scale of acids and bases?

151. Solution A has a pH of 5 and solution B has a pH of 2. Which solution is more acidic? How many times more acidic is it?

152. Why is water neutral?

Reaction Rates and Equilibrium

153. What two variables are used to measure the rate of a   chemical reaction?

154. What happens to the concentration of the reactants as the reaction proceeds?

155. What happens to the concentration of the products as the reaction proceeds?

156. What is collision theory?

157. The greater the number of _____, the _____ the reaction rate will be.

158. What are the three factors that will affect the reaction rate?

159. How is the reaction rate affected if the temperature of the reaction is decreased? Why?

160. How is the reaction rate affected if the concentration of the reactants is increased? Explain.

161. If the volume of the container that is holding the reactants is reduced, how will that affect the rate of the reaction? Explain.

162. What is activation energy?

163. What happens if reactant molecules do not have enough energy when they collide?

164. What does a catalyst do?

165. How does a catalyst accomplish its job?

166. What is an enzyme?

167. What does it mean if a reaction is considered reversible?

168. When a reaction is at equilibrium, what can be said about the forward and reverse reaction rate?

169. If the reverse reaction rate is measured at 3.0M/S at equilibrium, what is the rate of the forward reaction?

170. The following reaction has reached equilibrium: $A + B \leftrightarrow C$

The concentration of reactant B is measured at 0.20M. What will be the concentration of reactant B 20 minutes later?

171. What is Le Chatelier's principal?

172. The following reaction is at equilibrium: $N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)} + 22.0$ **kcal**

   Use Le Chatelier's principle to predict which way the reaction will shift and what will happen to the concentrations of each reactant and product when the following disruptions are made:

   More N_2 is added
   Some N_2 is removed
   More H_2 is added
   Some H_2 is removed
   Some NH_3 is added
   Temperature increases (heat is added)
   Temperature decreases (heat is removed)
   The pressure is decreased
   The pressure is increased