Molar Conversions

63. For the following, determine the molar mass of each compound:

A) $MgCl_2$ 95.21 g/mol

B) $Mg(OH)_2$ 58.33 g/mol

C) $Ca(NO_3)_2$ 164.06 g/mol

64. Determine the percent composition by mass of sodium for the following two compounds.

NaBr: $\%Na = \frac{22.99\ g/mol}{102.89\ g/mol} \times 100$

$\%Na = 22.34\%$

Na_2S: $\%Na = \frac{45.98\ g/mol}{78.05\ g/mol} \times 100$

$\%Na = 58.91\%$

65. Determine the number of moles in 2.5 grams of O_2

$2.5\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} = 0.078\ mol\ O_2$

66. Determine the number of grams in 2.5 moles of O_2

$2.5\ mol\ O_2 \times \frac{32.00\ g\ O_2}{1\ mol\ O_2} = 80.\ g\ O_2$

67. Determine the number of particles in 2.5 moles of O_2

$2.5\ mol\ O_2 \times \frac{6.02 \times 10^{23}\ mc\ O_2}{1\ mol\ O_2} = 1.5 \times 10^{24}\ mc\ O_2$

68. Determine the number of grams in 2.5×10^{23} formula units of NaCl

$2.5 \times 10^{23}\ f.u\#O_2 \times \frac{1\ mol\ O_2}{6.02 \times 10^{23}\ mcO_2} \times \frac{32.00\ g\ O_2}{1\ mol\ O_2} = 13\ g\ O_2$

69. Determine the moles of 200 grams of CaO

$200\ g\ CaO \times \frac{1\ mol\ CaO}{56.08\ g\ CaO} = 4\ mol\ CaO$

70. Determine the number of atoms in 36 grams of Carbon.

$36\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{6.02 \times 10^{23}\ atoms\ C}{1\ mol\ C} = 1.8 \times 10^{24}\ atoms\ C$

71. A compound, Ammonium Bromate has the following percent composition by mass. Determine the empirical formula for the compound.

NH_4BrO_3

9.59 % Nitrogen	2.76 % Hydrogen	54.74 % Bromine	32.89 % Oxygen
$9.59\ g\ N \times \frac{1\ mol\ N}{14.01\ g\ N} = \frac{0.685\ mol\ N}{0.685\ mol} = 1$	$2.76\ g\ H \times \frac{1\ mol\ H}{1.01\ g\ H} = \frac{2.73\ mol\ H}{0.685\ mol} = 4$	$54.74\ g\ Br \times \frac{1\ mol\ Br}{79.9\ g\ Br} = \frac{0.685\ mol\ Br}{0.685\ mol} = 1$	$32.89\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = \frac{2.05\ mol\ O}{0.685\ mol} = 3$

72. You have determined that an empirical formula of a compound is CH_2O. What would be the molecular formula for glucose if its molecular mass is 180 grams/mol?

	Empirical	Molecular
Formula	CH_2O	$C_6H_{12}O_6$
mass	30 g/mol	180 g/mol

Empirical and molecular formulas are related by MASS.

$\frac{180\ g/mol}{30\ g/mol} = 6$

73. An empirical formula for an Alkane would be C_2H_6. What would be the molecular formula for Decane, with a molecular mass of 150.4 g/mol?

	Empirical	Molecular
Formula	C_2H_6	$C_{10}H_{30}$
Mass	30.08 g/mol	150.4 g/mol

Solutions and Dilutions

74. What is the percent by mass of a NaCl if 5.68 grams of the salt is dissolved in 150 mL of water?

$$\%\,NaCl = \frac{NaCl}{NaCl + H_2O} \times 100 \qquad \%\,NaCl = \frac{5.68\,g}{155.68\,g} \times 100 = \boxed{3.65\%}$$

75. How many grams of $KClO_4$ is dissolved into a 175 grams of solution that is 3.5 % by mass?

$$\%\,KClO_4 = \frac{KClO_4}{KClO_4 + H_2O} \times 100 \qquad 3.5\% = \frac{KClO_4}{175\,g} \times 100 \qquad \boxed{KClO_4 = 6.1\,g}$$

76. How many grams of $AlCl_3$ are required to make a 2.25M solution in 30.0 mL of water?

$$30.0\,mL \times \frac{1\,L}{1000\,mL} \times \frac{2.25\,mol\,AlCl_3}{1\,L} \times \frac{133.33\,g\,AlCl_3}{1\,mol\,AlCl_3} = 9.00\,g\,AlCl_3$$

77. What volume of 12*M* HCl is needed to prepare 250 mL of 0.20*M* HCl?

$$M_1V_1 = M_2V_2 \qquad (12M)(V_1) = (0.20M)(250\,mL) \qquad V_1 = 4.2\,mL$$

78. A solution contains 8.3 moles of NaCl in 1250 mL of water. What is its molarity?

$$M = \frac{mol}{L} \qquad M = \frac{8.3\,mol}{1.250\,L} \qquad M = 6.6\,\frac{mol}{L}$$

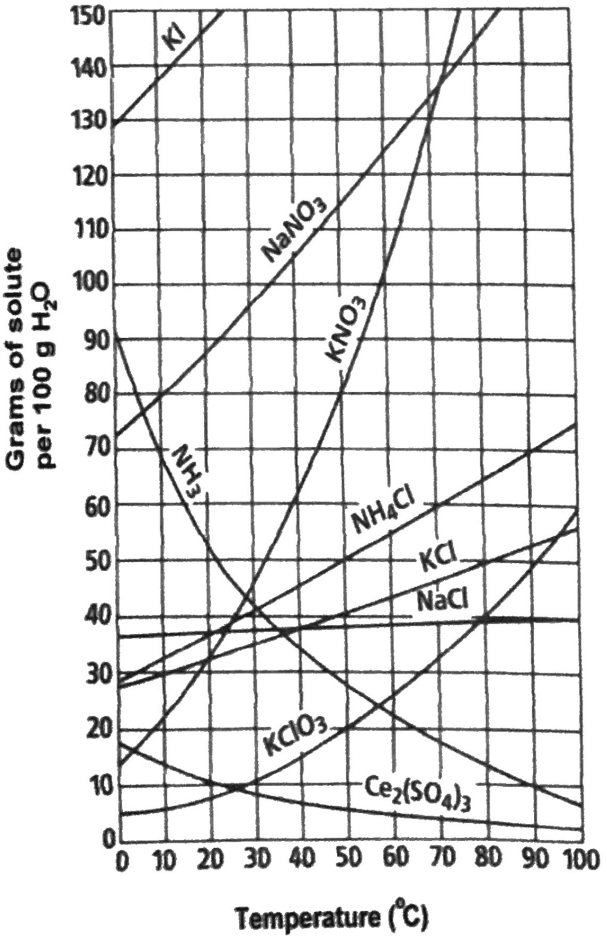
79. If 150 mL of water is added to 250 mL of a 3.1 M solution, what is the molarity of the new solution?

$$M_1V_1 = M_2V_2 \qquad (M_1)(400\,mL) = (250mL)(3.1M) \qquad M_1 = 1.9\,\frac{mol}{L}$$

80. How much water is added to 500. mL of 6.8 M solution to dilute it to a molarity of 3.2 M? $1062.5 - 500mL$

$$M_1V_1 = M_2V_2 \qquad (6.8M)(500\,mL) = (3.2M)(V_2) \qquad V_{added} = \boxed{560\,mL}$$

Use the solubility graph to the right to answer the following questions:



81. What is the **least** soluble compound at 20 °C?

$KClO_3$

82. According the slop of the line for NH_3, we can assume that it is a gas.

83. 60 grams of KNO_3 are dissolved at 50° C. How many grams of KNO_3 would need the be added to saturate the solution at this temperature?

20 grams

84. What two salts have the same degree of solubility at 19° C?

NaCl / NH_4Cl

85. A saturated solution of potassium nitrate is prepared at 60° C using 100. mL of water. How many grams of solute will precipitate out of the solution if the temperature is suddenly cooled to 30° C?

55 grams

86. If 50. mL of water that is saturated with $KClO_3$ at 25° C is solely evaporated to dryness, how many grams of the dry salt would be recovered?

5 grams

87. Which of the salts has the greatest solubility at 10° C?

KI

Stoichiometry

88. If you have 12 grams of Nitrogen, how many moles of Ammonia (NH_3) will you have?

___N_2 + 3 H_2 → 2 NH_3

$12\,g\,N_2 \times \frac{1\,mol\,N_2}{28.02\,g\,N_2} \times \frac{2\,mol\,NH_3}{1\,mol\,N_2} = 0.86\,mol\,NH_3$

89. If you have 3.5 moles of Hydrogen, how many grams of Ammonia(NH_3) will you produce?

$3.5\,mol\,H_2 \times \frac{2\,mol\,NH_3}{3\,mol\,H_2} \times \frac{17.04\,g\,NH_3}{1\,mol\,NH_3} = 40.\,g\,NH_3$

90. 4.5 moles of Calcium are used, how many moles of Lithium will be produced?

___Ca + 2 LiF → ___CaF_2 + 2 Li

$4.5\,mol\,Ca \times \frac{2\,mol\,Li}{1\,mol\,Ca} = 9.0\,mol\,Li$

91. 45.8 grams of Lithium Fluoride will produce how many grams of Calcium Fluoride?

$45.8\,g\,LiF \times \frac{1\,mol\,LiF}{25.94\,g\,LiF} \times \frac{1\,mol\,CaF_2}{2\,mol\,LiF} \times \frac{78.08\,g\,CaF_2}{1\,mol\,CaF_2} = 68.9\,g\,CaF_2$

92. If an experiment yields 3.56 grams of product, and the mass expected from calculations is 4.2 grams, what is your percent yield?

$\frac{3.56\,g}{4.2\,g} \times 100 = 84.7\,\%\ yield$

93. What is a limiting reactant?

The reactant that produces the lowest amount of product.

94. **HONORS:** If 5.6 grams of hydrochloric acid is reacted with 10.4 grams of calcium hydroxide, how many grams of water will be produced? What is the limiting reactant? $2HCl + Ca(OH)_2 \rightarrow 2H_2O + CaCl_2$

$5.6\,g\,HCl \times \frac{1\,mol\,HCl}{36.46\,g\,HCl} \times \frac{2\,mol\,H_2O}{2\,mol\,HCl} \times \frac{18.02\,g\,H_2O}{1\,mol\,H_2O} = \boxed{2.8\,g\,H_2O}$ LR IS HCl

$10.4\,g\,Ca(OH)_2 \times \frac{1\,mol\,Ca(OH)_2}{74.1\,g\,Ca(OH)_2} \times \frac{2\,mol\,H_2O}{1\,mol\,Ca(OH)_2} \times \frac{18.02\,g\,H_2O}{1\,mol\,H_2O} = 5.1\,g\,H_2O$

Acids & Bases

State whether the following are acids or bases, or both.

95. Have a sour taste. Acids

96. Has a pOH of 8.5 Bases Acids

97. Feel slippery Base

98. Has a pH of 8.5. Base

99. Damaging to skin if concentrated Both

100. Turns blue litmus paper red Acid

101. Produces hydronium ions according to Arrhenius Acid

102. Produces hydroxide ions according to Arrhenius Base

103. Donates protons according to Bronsted-Lowry Acid

104. Accepts protons according to Bronsted-Lowry Base

105. Can produce hydrogen gas if reacting with metals Acid

106. Found in Milk of Magnesia Base

107. **HONORS:** A solution has an H+ concentration of 1.27×10^{-12} M. What is the pOH of the solution? Is it an acid or base?

$pH = -\log(1.27 \times 10^{-12}\,M)$ $\quad pH + pOH = 14$

$pH = 11.9$ $\quad 14 - 11.9 = pOH$ $\quad pOH = 2.1$

108. **HONORS:** A solution has a pOH of 3.46. What is the pH of the solution?

$pH + pOH = 14$ $\quad pH = 14 - 3.46$ $\quad pH = 10.54$

Gas Laws

109. What are the five principles of kinetic molecular theory?

① gases are tiny particles
② Temperature is proportional to average KE.
③ collisions produce pressure

110. Some students believe that teachers are full of hot air. If Ms. K inhales 2.2 liters of gas at a temperature of 18° C and it heats to a temperature of 38° C in her lungs, what is the new volume of the gas?

$\frac{V_1}{V_2} = \frac{T_1}{T_2}$ $\quad \frac{2.2L}{V_2} = \frac{291K}{311K}$ $\quad V_2 = 2.4L$

111. What is the Ideal Gas Law? What units do you have to use when using the Ideal Gas Law?

$PV = nRT$ $\quad P = atm$ $\quad n = mol$ $\quad V = L$ $\quad T = K$

112. A gas has a volume of 400.0 mL at 3.00 °C and 120.0 torr. What would the volume of the gas be at 117.0 °C and 3350.0 torr of pressure?

$\frac{P_1V_1}{P_2V_2} = \frac{n_1R_1T_1}{n_2R_2T_2}$ $\quad \frac{(120\,torr \times \frac{1atm}{760\,torr})(.400L)(390K)}{(3350\,torr \times \frac{1atm}{760\,torr})(276K)} = V_2 = 0.0202L$

113. If there is a gas at 440.0 mmHg with a volume of 350.0 mL, what volume does this change to when the pressure is changed to 1.5 atm?

$P_1V_1 = P_2V_2$ $\quad \frac{(440.0mmHg \times \frac{1atm}{760\,mmHg})(0.3500L)}{1.5\,atm} = V_2 = 0.135L$

114. If a gas is closed in a container at 23.0 °C then pressurized from 855 torr to 1422 torr, what will the new temperature of the gas be?

$\frac{P_1}{P_2} = \frac{T_1}{T_2}$ $\quad \frac{(855\,torr \times \frac{1atm}{760\,torr})}{(1422\,torr \times \frac{1atm}{760\,torr})} = \frac{(296K)}{T_2}$ $\quad T_2 = 492K$

115. How much pressure would 0.389 moles of Neon gas exert on a 275 mL container at 32°C?

$P = \frac{nRT}{V}$ $\quad P = \frac{0.389\,mol\,(0.08206\,\frac{L \cdot atm}{mol \cdot K})(305K)}{0.275L} = 35.4atm$

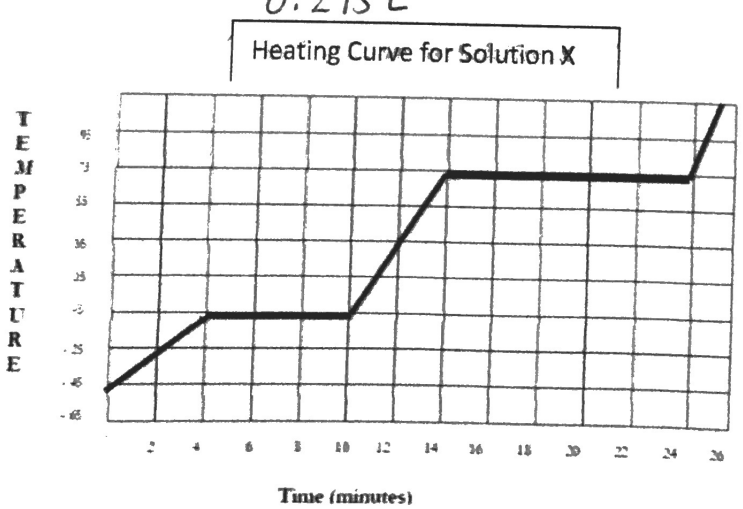
Thermochemistry

Use the heating curve to the right to answer the following questions:

116. During what times would solid be found in the beaker?
0 - 10 min

117. During what times would liquid be found in the beaker?
4 - 24 min

118. During what times would gas be found in the beaker?
14 - 20 min



Indicate whether a heating curve would be *flat* or *rising*.

119. liquid is boiling Flat

120. solid is warming Rising

121. solid is melting Flat

122. kinetic energy (temp) is increasing Rising

123. Only gas exists Rising

Describe the following processes as endothermic or exothermic, and describe if heat is absorbed or released:

124. Freezing exo, release

125. Condensing exo, release

126. Melting endo, absorb

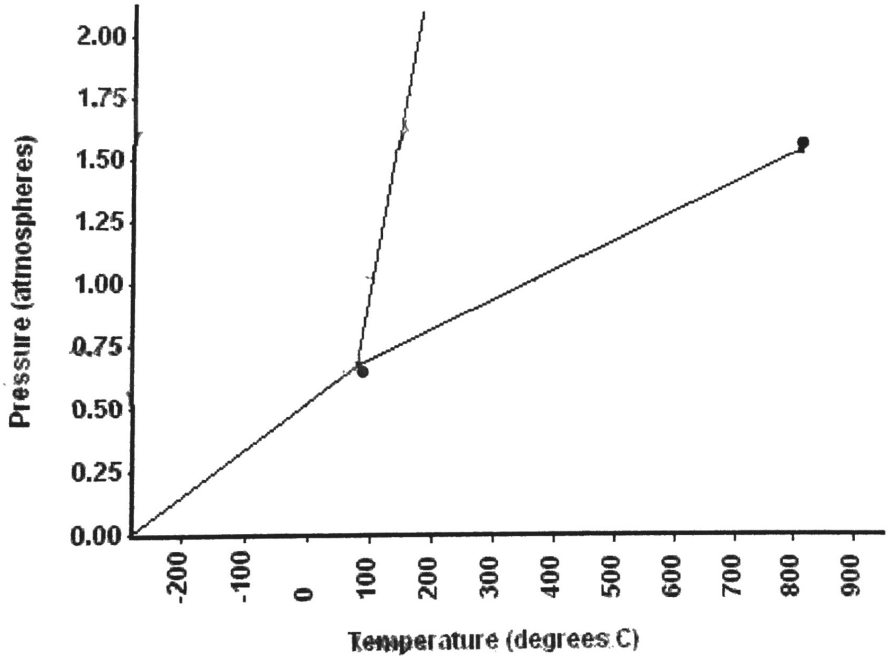
127. Vaporizing endo, absorb

128. Depositing exo, release

129. Subliming endo, absorb

HONORS: Refer to the phase diagram below when answering the questions

NOTE: "*Normal*" refers to STP – Standard Temperature and Pressure.



130. What are the values for temperature and pressure at STP? T= 273, P= 1 atm

131. What is the *normal* freezing point of this substance? 100 °C

132. What is the *normal* boiling point of this substance? 350 °C

133. What is the phase (s, l, g) of a substance at 0.5 atm and 100 °C? S

134. What is the phase (s, l, g) of a substance at 1.5 atm and 200 °C? L

135. If this substance was at a pressure of 2.0 atm, at what temperature would it melt? 150°

136. If this substance was at a pressure of 2.0 atm, at what temperature would it boil? Never!