Problem Set 3: Ideal Gas Law - Applications and Stoichiometry

1

47. Complete the following table for an ideal gas.

	P (atm)	V (L)	n (mol)	T
a.	5.00		2.00	155°C
b.	0.300	2.00		155 K
c.	4.47	25.0	2.01	
d.		2.25	10.5	75°C

2

51. The steel reaction vessel of a bomb calorimeter, which has a volume of 75.0 mL, is charged with oxygen gas to a pressure of 14.5 atm at 22°C. Calculate the moles of oxygen in the reaction vessel.

3

52. A 5.0-L flask contains 0.60 g O_2 at a temperature of 22°C. What is the pressure (in atm) inside the flask?

4

61. An ideal gas is contained in a cylinder with a volume of 5.0×10^2 mL at a temperature of 30.°C and a pressure of 710. torr. The gas is then compressed to a volume of 25 mL, and the temperature is raised to 820.°C. What is the new pressure of the gas?

5

63. A sealed balloon is filled with 1.00 L helium at 23°C and 1.00 atm. The balloon rises to a point in the atmosphere where the pressure is 220. torr and the temperature is −31°C. What is the change in volume of the balloon as it ascends from 1.00 atm to a pressure of 220. torr?

6

10.36 A neon sign is made of glass tubing whose inside diameter is 2.5 cm and whose length is 5.5 m. If the sign contains neon at a pressure of 1.78 torr at 35 °C, how many grams of neon are in the sign? (The volume of a cylinder is $\pi r^2 h$.)

7

10.37 Calculate the number of molecules in a deep breath of air whose volume is 2.25 L at body temperature, 37 °C, and a pressure of 735 torr.

8

49. Suppose two 200.0-L tanks are to be filled separately with the gases helium and hydrogen. What mass of each gas is needed to produce a pressure of 2.70 atm in its respective tank at 24°C?

9

10.40 An aerosol spray can with a volume of 250 mL contains 2.30 g of propane gas (C_3H_8) as a propellant. **(a)** If the can is at 23 °C, what is the pressure in the can? **(b)** What volume would the propane occupy at STP? **(c)** The can says that exposure to temperatures above 130 °F may cause the can to burst. What is the pressure in the can at this temperature?

10

10.42 Many gases are shipped in high-pressure containers. Consider a steel tank whose volume is 65.0 L and which contains O_2 gas at a pressure of 16,500 kPa at 23 °C. **(a)** What mass of O_2 does the tank contain? **(b)** What volume would the gas occupy at STP? **(c)** At what temperature would the pressure in the tank equal 150.0 atm? **(d)** What would be the pressure of the gas, in kPa, if it were transferred to a container at 24 °C whose volume is 55.0 L?

11

66. A student adds 4.00 g of dry ice (solid CO_2) to an empty balloon. What will be the volume of the balloon at STP after all the dry ice sublimes (converts to gaseous CO_2)?

12

10.46 Rank the following gases from least dense at 1.00 atm and 298 K to most dense under these same conditions: SO_2, HBr, CO_2. Explain.

13	14
10.49 (a) Calculate the density of NO_2 gas at 0.970 atm and 35 °C. (b) Calculate the molar mass of a gas if 2.50 g occupies 0.875 L at 685 torr and 35 °C.	77. An unknown diatomic gas has a density of 3.164 g/L at STP. What is the identity of the gas?
15	**16**
10.112 Cyclopropane, a gas used with oxygen as a general anesthetic, is composed of 85.7% C and 14.3% H by mass. (a) If 1.56 g of cyclopropane has a volume of 1.00 L at 0.984 atm and 50.0 °C, what is the molecular formula of cyclopropane?	67. Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This causes sodium azide (NaN_3) to decompose explosively according to the following reaction: $2NaN_3(s) \longrightarrow 2Na(s) + 3N_2(g)$ What mass of $NaN_3(s)$ must be reacted to inflate an air bag to 70.0 L at STP?
17	**18**
10.55 The metabolic oxidation of glucose, $C_6H_{12}O_6$, in our bodies produces CO_2, which is expelled from our lungs as a gas: $C_6H_{12}O_6(aq) + 6\,O_2(g) \longrightarrow 6\,CO_2(g) + 6\,H_2O(l)$ a) Calculate the volume of dry CO_2 produced at body temperature (37 °C) and 0.970 atm when 24.5 g of glucose is consumed in this reaction. b) Calcaulte the volume of oxygen at 1 atm and 298 K gas needed to completely oxidize 50.0 g of glucose.	Ethanol (C_2H_5OH) burns in air: $\_\_C_2H_5OH\ (l) + \_\_O_2\ (g) \rightarrow \_\_ CO_2\ (g) + \_\_ H_2O\ (g)$ Balance the equation and determine the volume of air in Liters at 35.0°C and 790. mm Hg required to burn 227 grams of ethanol. Assume that air is 21.0 percent O_2 by volume.
19	**20**
In alcoholic fermentation, yeast converts glucose to ethanol and carbon dioxide: $C_6H_{12}O_6\ (s) \rightarrow 2\ C_2H_5OH\ (l) + 2\ CO_2\ (g)$ If 5.97 g of glucose are reacted and 1.44 L of CO_2 gas are collected at 293 K and 0.984 atm, what is the percent yield of the reaction?	10.113 Consider the combustion reaction between 25.0 mL of liquid methanol (density = 0.850 g/mL) and 12.5 L of oxygen gas measured at STP. The products of the reaction are $CO_2(g)$ and $H_2O(g)$. Calculate the number of moles of H_2O formed if the reaction goes to completion.