Dr. Taylor **Chapter 11 Homework** **Chem 111 Spring 2012**

PV = nRT where R = 0.08206 L atm/ mol K **760 torr = 760 mmHg = 1 atm** **0C = 273K**

1. A sample of chlorine gas occupies a volume of 946 mL at a pressure of 726 mmHg. What is the pressure of the gas (in mmHg) if the volume is reduced at constant temperature to 154 mL?

2. A sample of carbon monoxide gas occupies 3.20 L at 125 ^{0}C. At what temperature will the gas occupy a volume of 1.54 L if the pressure remains constant?

3. What is the volume (in liters) occupied by 49.8 g of HCl at STP?

4. What is the volume of CO_2 produced at 37^0 C and 1.00 atm when 5.60 g of glucose are used up in the reaction:
   $C_6H_{12}O_6$ (*s*) + $6O_2$ (*g*) $\rightarrow$ $6CO_2$ (*g*) + $6H_2O$ (*l*)

5. A sample of natural gas contains 8.24 moles of CH_4, 0.421 moles of C_2H_6, and 0.116 moles of C_3H_8. If the total pressure of the gases is 1.37 atm, what is the partial pressure of propane (C_3H_8)?

6. Argon is an inert gas used in lightbulbs to retard the vaporization of the filament. A certain lightbulb containing argon at 1.20 atm and 18 ^{0}C is heated to 85 ^{0}C at constant volume. What is the final pressure of argon in the lightbulb (in atm)?

7. Which of the following is/are characteristic(s) of gases?
   A. High compressibility
   B. Relatively large distances between molecules
   C. Formation of homogeneous mixtures regardless of the nature of gases

8. A gas sample has a volume of 9.8 L at 720 torr. If the temperature is constant, what volume does the gas sample have at 1.5 atm?

9. A gas has a volume of 255 mL at 725 torr. What volume will the gas occupy at 365 torr if the temperature of the gas does not change?

10. A gas has a volume of 3.86 L at a temperature of 45 °C. What will the volume of the gas be if its temperature is raised to 80 °C while its pressure is kept constant?

11. A sample of a gas has a pressure of 850 torr at 285 °C. To what Celsius temperature must the gas be heated to double its pressure if there is no change in the volume of the gas?

12. A sample of helium at a pressure of 740 torr and in a volume of 2.58 L was heated from 24.0 to 75.0 °C. The volume of the container expanded to 2.81 L. What was the final pressure in torr of the helium?

13. What must be the new volume of a sample of nitrogen (in L) if 2.68L at 745 torr and 24 ˚C is heated to 375 ˚C under conditions that let the pressure change to 760 torr?

14. A 2.50-L sample of neon has a pressure of 1.59 atm at 45.0°C. What volume would the sample have if the pressure is 725 Torr and the temperature 22.0°C?

15. What is the volume (in L) of 20.0 g of oxygen gas at 39°C and 2.13 atm?

16. What volume of $CO_2(g)$ at 25°C and 760 Torr is produced when 1.00 kg of calcium carbonate is used to neutralize a sulfuric acid spill? The equation for the reaction is

$$CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(s) + CO_2(g) + H_2O(l)$$

17. Air bags used in automobiles are rapidly filled with nitrogen gas by the reaction below.

$$6NaN_3(s) + 2Fe_2O_3(s) \rightarrow 3Na_2O_2(s) + 4Fe(s) + 9N_2(g)$$

How many moles of NaN_3 are required to produce 40.00 L of $N_2(g)$ at 20.00°C and 800.0 Torr?

18. Standard temperature and pressure, STP, refer to
    A. 0°C and 1 atm
    B. 0°C and 202 kPa
    C. 25°C and 1 atm
    D. 0°C and 1 Pa
    E. 298 K and 760 Torr

19. Calculate the volume of carbon dioxide produced at STP by the combustion of 1.25 moles of propane, $C_3H_8(g)$.

20. A gas mixture contains 0.0500 moles of hydrogen, 0.0400 moles of carbon dioxide, and 0.0325 moles of nitrogen in a 2.00 L flask. If the total pressure in the flask is 1000.0 Torr, what is the partial pressure of carbon dioxide?

21. A 750-mL sample of nitrogen was collected by displacement of water from a container at 30°C and an atmospheric pressure of 742 Torr. If the vapor pressure of water at 30°C is 31.8 Torr, calculate the number of moles of nitrogen gas produced.

22. A mixture of three gases has a total pressure of 1,380 mmHg at 298 K. The mixture is analyzed and is found to contain 1.27 mol CO_2, 3.04 mol CO, and 1.50 mol Ar. What is the partial pressure of Ar?

23. Deviations from the ideal gas law are greater at
    A. low temperatures and low pressures.
    B. low temperatures and high pressures.
    C. high temperatures and low pressures.
    D. high temperatures and high pressures.

Answers:

1. $P_1 V_1 = P_2 V_2$ $\quad P2 = \frac{P1V1}{V2} = \frac{(726\ mm\ Hg)(946\ mL)}{(154\ mL)} = 4460\ mm\ Hg$

2. $\frac{V1}{T1} = \frac{V2}{T2}$ Rearranging: $T2 = \frac{V2T1}{V1} = \frac{(1.54\ L)(398.15\ K)}{3.2\ L} = 192\ K$
   TEMPERATURE MUST BE IN KELVIN

3. $PV = nRT$ $\quad P = 1\ atm \quad T = 0\,^{\circ}C$ or $273\ K$
   rearranging $V = \frac{nRT}{P} \quad n = 49.8\ g \times \frac{1\ mol\ HCl}{36.5\ g} = 1.37\ mol$
   $V = 30.6\ L$

4. g $C_6H_{12}O_6 \rightarrow$ mol $C_6H_{12}O_6 \rightarrow$ mol $CO_2 \rightarrow$ V CO_2

   $5.60\ g\ C_6H_{12}O_6 \times \frac{1\ mol\ C6H12O6}{180\ g\ C6H12O6} \times \frac{6\ mol\ CO2}{1\ mol\ C6H12O6} = 0.187\ mol\ CO2$

   $V = \frac{nRT}{P} = 4.76\ L$

5. $Pi = Xi\ PT \quad PT = 1.37\ atm$
   $Xi = \frac{0.116}{8.24 + 0.421 + 0.116} = 0.0.0137$
   $Pi = 0.0181\ atm$

6. 1.48 atm
7. 7. A, B and C
8. 8. 6.2 L
9. 507 mL
10. 4 L (T MUST BE IN K)
11. 840 °C
12. 8.0×10^2 torr
13. 5.7 L
14. 3.9 L
15. 7.5 L
16. 244 L
17. 1.167 Mol NaN_3
18. A
19. 84.0 L
20. 0.430 atm
21. 0.0282 mol
22. 356 mmHg
23. A