Chem 1
Problem Set Ch.5

Key begins on page 3.

1. A sample of oxygen (O_2) occupies 32.0 cubic feet at 758 mm Hg. Calculate its volume at 635 mm Hg, temperature reamaining constant.

V = _____

2. Fifteen liters of hydrogen (H_2) under 2.50 atm of pressure is contained in a cylinder with a moveable piston. The piston is moved until the gas occupies 1.00 liters. If the temperature remains constant, what is the new pressure in the cylinder.

P = _____

3. A sample of chlorine gas (Cl_2) occupies 38.0 mL at 20°C. What would its volume be at 45°C, pressure remaining constant?

V = _____

4. A mass of gas at 55°C and 745 mm Hg occupies 350.0 mL. What would be its volume at STP?

V = _____

5. What is the density of oxygen gas (O_2) at STP?

D = _____

6. What would be the volume of 11.0 grams N_2O at STP?

V = _____

7. A certain gas measures 546 mL at a pressure of 1.00 atm and a temperature of -75°C. Calculate the volume it would occupy at 1.50 atm and 30°C.

V = _____

8. If 200.0 mL of gas weighs 0.344 grams at STP, what is its molecular weight?

MW = _____

9. If 2.50 grams N_2 is introduced into an empty 3.50 liter container at 50°C, what will be the pressure of the gas?

P = _____

10. What volume will be occupied by 2.60 moles of oxygen gas at 27°C and 730 mm Hg?

V = _____

CHEM 1
Practice Problems Ch.5

1. A sample of oxygen occupies 40.0 cubic feet at 758 mm Hg. Calculate its volume at 635 mm Hg, temperature remaining constant. **(47.7 cubic feet)**

2. Ten (10.0) liters of hydrogen under 1.00 atm pressure is contained in a cylinder with a moveable piston. The piston is moved until the gas occupies only 2.00 liters. What is the new pressure of the cylinder? **(5 atm)**

3. A sample of chlorine gas occupies 38.0 mL at 20°C. What would be its volume at 45°C, pressure remaining constant? **(41.2 mL)**

4. A mass of gas at 50°C and 785 mm Hg occupies 350.0 mL. What would its volume be at STP? **(306 mL)**

5. A certain gas measures 546 mL at a pressure of 1.00 atm and a temperature of -80°C. Calculate the volume it would occupy at 1.50 atm and 30°C. **(571 mL)**

6. Exactly 500.0 mL of nitrogen gas is collected over water at 25°C and 755 mm Hg. Calculate the volume of dry nitrogen at standard conditions. **(441 mL)**

7. If the density of a certain gas at 30°C and 768 mm Hg is 1.253 g/L, what would its density be at standard conditions? **(1.38 g/L)**

8. What is the density of oxygen gas at STP? **(1.43 g/L)**

9. What would be the volume of 11.0 grams N_2O at STP? **(5.6 L)**

10. Determine the density of H_2S gas at 27°C and 2.00 atm. **(2.77 g/L)**

11. If 200.0 mL of a gas weighs 0.268 grams at STP, what is its molecular mass? **(30.0 g/mol)**

12. A mixture of gases at 760 mm Hg total pressure contains 65% nitrogen, 15% oxygen and 20% carbon dioxide by volume. What is the partial pressure of each gas? **(N_2; 494 mm, O_2; 114 mm, CO_2; 152 mm)**

13. Which has the faster rate of diffusion, CH_4 or SO_2? How much faster? **(CH_4 diffuses twice as fast as SO_2)**

14. If 2.50 grams nitrogen gas are introduced into an empty 3.00 L container at -80°C, what will be the pressure of the gas? **(0.472 atm or 359 mm Hg)**

15. A sample of chloroform weighing 0.528 grams is collected in a flask having a volume of 127.0 mL. At 75°C, the pressure of the gas in the flask is 754 mm Hg. Calculate the molecular mass of chloroform. **(120 g/mol)**

16. Calculate the molecular mass of a gas, 5.20 grams of which occupies a volume of 1140 mL at 78°C and a pressure of 780 mm Hg. **(128 g/mol)**

17. What volume will be occupied by 1.00 grams oxygen measured **over water** at 27°C and 730 mm Hg? **(830 mL)**

18. A compound has the formula C_8H_{18}. What volume will 0.500 grams of the gas occupy at 735 mm Hg and 99°C? **(138 mL)**

CHEM 130

Gas Laws Problem Set Name: KEY

1. A sample of oxygen gas (O_2) occupies 32.0 cubic feet at 758 mm Hg. Calculate its volume at 635 mm Hg, temperature remaining constant.

$$V_2 = \frac{P_1 V_1}{P_2} = \frac{(758\ mm)(32\ ft^3)}{(635\ mm)}$$

V= 38.2 ft^3.

2. Fifteen liters of hydrogen (H_2) under 2.5 atm of pressure is contained in a cylinder with a moveable piston. The piston is moved until the gas occupies 1.00 liters. If the temp. remained constant, what is the new pressure in the cylinder?

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{2.5\ ATM\ (15\ L)}{(1\ L)} = 37.5\ ATM.$$

P= 37.5 ATM.

3. A sample of chlorine gas (Cl_2) occupies 38.0 ml at 20°C. What would its volume be at 45°C, pressure remaining constant?

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{38\ mL\ (318\ K)}{(293\ K)} =$$

V= 41.2 mL.

4. A mass of gas at 55°C and 745 mmHg occupies 350.0 ml. What would its volume be at STP?

$$V_2 = \frac{V_1 P_1 T_2}{P_2 T_1} = \frac{350\ mL\ (745\ mm)(273\ K)}{(760\ mm)(328\ K)} =$$

V= 285.6 mL

5. What is the density of oxygen gas (O_2) at STP?

$$D_{STP} = \frac{32\ g/mol}{22.4\ L/mol} =$$

D= 1.43 g/L.

6. What would be the volume of 11.0 grams N_2O at STP?

$$11.0\ g\left(\frac{1\ mol}{44\ g}\right) = 0.25\ mol \qquad (0.25\ mol)(22.4\ L/mol) =$$

V= 5.6 L.

7. A certain gas measures 546 ml at a pressure of 1.00 atm and a temperature of -75°C. Calculate the volume it would occupy at 1.5 atm and 30°C.

$$V_2 = \frac{V_1 P_1 T_2}{P_2 T_1} = \frac{(546\ mL)(1\ ATM)(303\ K)}{(1.5\ ATM)(198\ K)}$$

V= 557 mL.

8. If 200.0 ml of gas weighs 0.344 grams at STP, what is its molecular weight?

$$MW = \frac{(0.344\ g)\left(.0821\ \frac{L\cdot ATM}{mol\ K}\right)(273\ K)}{(1\ ATM)(.200\ L)} =$$

MW= 38.6 g/mol

9. If 2.50 grams N_2 is introduced into an empty 3.50 liter container at 50°C, what will be the pressure of the gas?

$$2.50\ g\ N_2\left(\frac{1\ mol}{28\ g}\right) = .0893\ mol \qquad P = \frac{nRT}{V} = \frac{(0.0893\ mol)\left(.0821\ \frac{L\cdot ATM}{mol\ K}\right)(323\ K)}{3.50\ L}$$

P= 0.676 ATM

10. What volume will be occupied by 2.60 moles oxygen gas at 27°C and 730 mm Hg?

$$V = \frac{nRT}{P} = \frac{(2.60\ mol)\left(62.4\ \frac{L\cdot mm}{mol\ K}\right)(300\ K)}{(730\ mm)}$$

V= 66.7 LITERS.

PRACTICE GAS LAW SOLUTIONS C130 1/2

1.) BOYLES LAW $P_1V_1 = P_2V_2$

$(758\text{mm})(40.0\text{ft}^3) = (635\text{mm})V_2$ $\quad V_2 = 47.7\ \text{ft}^3$.

2.) BOYLES LAW $P_1V_1 = P_2V_2$

$(1\text{ATM})(10\text{L}) = P_2(2\text{L})$ $\quad P_2 = 5\text{ATM}$.

3.) CHAS. LAW. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$38\text{ml}/293°\text{K} = V_2/318°\text{K}$ $\quad V_2 = 41.2\ \text{ml}$.

4.) COMBINED $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ (STP)

$\frac{(785\text{mm})(350\text{ml})}{323°\text{K}} = \frac{(760\text{mm})(V_2)}{273°\text{K}}$ $\quad V_2 = 306\ \text{ml}$.

5.) COMBINED $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(1\text{ATM})(546\text{ml})}{193°\text{K}} = \frac{(1.5\text{ATM})(V_2)}{303°\text{K}}$ $\quad V_2 = 571\ \text{ml}$.

6.) (VAPOR PRESS of H_2O @ 25°C = 23.8 mm).

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(755\text{mm} - 23.8)(500\text{ml})}{(298°\text{K})} = \frac{(760)(V_2)}{273°\text{K}}$ $\quad V_2 = 441\text{ml}$

NOTE: CORRECTION OF TOT. P FOR H_2O VAPOR

$M.W. = \frac{(\text{mass gas})(R)(T)}{PV} = \frac{(.158g)(.0821)(348)}{(.992\,ATM)(.127\,l)} \approx 120$

$\frac{754}{760}$

7.) 1ST FIND M.W. OF GAS

$$MW = \frac{D \cdot R \cdot T}{P} = \frac{(1.253\,g/l)(62.4\,\frac{l\,mm}{mole\,°K})(303°K)}{(768\,mm)} = \underline{30.85\,g/mol}$$

NOW USE THE M.W. TO CALC. DENSITY AT STP.

$$D_{@STP} = \frac{MW}{22.4} = \frac{30.85\,g/mole}{22.4\,l/mole} = \underline{1.38\,g/l}$$

8.) $D_{@STP} = \frac{MW}{22.4} = \frac{32\,g/mole}{22.4\,l/mole} = \underline{1.43\,g/l}$

9.) $V_{@STP} = n \times 22.4 = \left(\frac{11.0\,g\,NO}{44\,g/mole}\right)\left(\frac{22.4\,l}{mole}\right) = \underline{5.6\,l}.$

10.) $D = \frac{P\,MW}{RT} = \frac{(2\,ATM)(34.1\,g/mole)}{(.0821\,\frac{l\,ATM}{mole\,°K})(800°K)} = 2.77\,g/l.$

11.) $MW = \frac{g\,RT}{PV} = \frac{(.268\,g)(.0821\,\frac{l\,ATM}{mol\,°K})(273°K)}{(1\,ATM)(.200\,l)} = 30.0\,g/mol.$

NOTE: CHANGE TO l.

12.) $P = \frac{nRT}{V} = \frac{(2.50g/28\,g/mol)(.0821\,\frac{l\,ATM}{mol\,°})(193°K)}{3.00\,l} = 0.472\,ATM.$

16.) $MW = g\,RT/PV = \frac{(5.20g)(62.4\,\frac{l\,ATM}{mol\,°})(351°K)}{(1.140\,l)(780\,mm)} = 128\,g/mole.$

17.) ($V.P._{H_2O}$ @ 27°C = 26.7 mm) $\left({}^{1.00g\,O_2}/_{32\,g/mole}\right) = .03125\,mol\,O_2$

$$V = \frac{nRT}{P} = \frac{(.03125\,mol\,O_2)(62.4\,\frac{l\,mm}{mol\,°})(300°K)}{(730 - 26.7\,mm)} = .830\,l.$$

OR 830 ml

18.) $C_8H_{18} = 114\,g/mole$ $\left({}^{0.500g}/_{114\,g/mole} = 4.39 \times 10^{-3}\,mol\right)$

$$V = \frac{nRT}{P} = \frac{(4.39 \times 10^{-3}\,mol)(62.4\,\frac{l\,mm}{mole\,°})(372°K)}{(735\,mm)} = 138\,ml$$