AP Chemistry
Problem Set
Gases

1. Calculate the volume occupied at 87.0°C and 950. torr by a quantity of gas which occupied 20.0 L at 27.0°C and 570. torr.
2. What is the volume of 16 g of sulfur dioxide at 20.0°C and 740 torr pressure?
3. A sample of gas occupies 3.8 L at 15°C and 1.00 atm. What does the temperature need to be for the gas to occupy 8.3 L at 1.00 atm?
4. Calculate the volume of O_2 present in a sample containing 0.89 moles of oxygen gas at a temperature of 40°C and a pressure of 1.00 atm.
5. The density of liquied nitrogen is 0.808 g/mL at –196°C. What volume of nitrogen gas at STP must be liquefied to make 10.0 L of liquid nitrogen?
6. A hydrocarbon was analyzed to be 85.7 mass percent carbon and 14.3 mass percent hydrogen. At 26°C and 745 torr pressure a sample with a volume of 1.13 L had a mass of 19.04 g. Determine the molecular formula.
7. An unknown gas has a density of 7.06 g/L at a pressure of 1.50 atm and 280 K. Calculate the molar mass of the gas.
8. HCl (g) can be prepared by reaction of NaCl with H_2SO_4. What mass of NaCl is required to prepare enough HCl to fill a 340. mL cylinder to a pressure of 151 atm at 20.0°C.
9. A sample of 26.81 mL of 0.1000 M HCl reacts completely with a rock containing 3.164 g $CaCO_3$. What would be the maximum theoretical volume of CO_2 collected at 30° C and 1.00 atm?
10. A 27.7 mL sample of CO_2 was collected over water at 25.0°C and 1.00 atm. What is the pressure in torr due to CO_2(g)? (The vapor pressure of water at 25.0 °C is 23.8 torr.) What will the volume of CO_2 (g) be at the same temperature and pressure after removing the water vapor?
11. A gaseous mixture of O_2, H_2, and N_2 has a total pressure of 1.50 atm and contains 8.20 g of each gas. Find the partial pressure of each has in the mixture.
12. The mole fraction of argon in dry air is 0.00934. How many liters of air at STP will contain enough argon to fill a 35.4 L cylinder to a pressure of 150. atm at 20°C?
13. Assume that the mole fraction of nitrogen in air is 0.8902. Calculate the partial pressure of N_2 in the air when the atmospheric pressure is 820 torr.
14. Calculate the rate of effusion of PH_3 molecules through a small opening if NH_3 molecules pass through the same opening at a rate of 8.02 cm^3/s. Assume the same temperature and equal partial pressures of the two gases.
15. Arrange the following according to expected values for b in the van der Waals equation:
    a. He, CO_2, H_2O, HF, SF_6
16. Put the following gases in order from smallest to largest according to van der Waal's constant "a".
    a. H_2, N_2, CH_4, Ne, H_2O
17. Calculate the pressure exerted by 1 mole of Xe (g) using the ideal gas law and van der Waal's equation:

a. In a 100.0 L container at 23^{o}C
b. In a 1.000 L container at 23^{o} C

18. Why are all gases not perfect gases?
19. If a barometer were built using water instead of Hg, how would the column of water be if the pressure were 1 atm, knowing that the density of water is 13.6 time lower than that of mercury?
20. A chemist weighed out 5.14 g of a mixture containing unknown amounts of BaO (s) and CaO(s) and placed the sample in a 1.50 L flask containing CO_2 (g) at 30.0^{o}C and 750 torr. After the reaction to form $BaCO_3$ (s) and $CaCO_3$ (s) was completed, the pressure of CO_2 (g) remaining was 230. torr. Calculate the mass percentages of CaO and BaO in the mixture.

Answers

1. 1.44 L
2. 6.18 L
3. 356 ^{o}C
4. 23 L
5. 6.46 x 10^{3} :
6. C_3H_6
7. 108 g/mol
8. 125 g
9. 33.4 mL = 0.0334 L CO_2
10. 736 torr, 26.8 mL
11. O_2- 0.0831 atm; H_2 = 1.32 atm; N_2 = 0.0952 atm
12. 5.30 x 10^{5} L
13. 730 torr
14. 5.67 cm^3/s
15. He, HF, H_2O, CO_2, SF_6
16. Ne, H_2, N_2,CH_4, H_2O
17. a. ideal- 0.243 atm, van der Waal's =0.243 atm b. ideal – 24.3 atm, van der Waal's = 21.4 atm
18. Gases generally do not follow the law of ideal gases, but more closely approach the behavior of an ideal gas at low pressure and high temperatures.
19. 10.3. m
20. 13.4 % CaO, 86.6% BaO