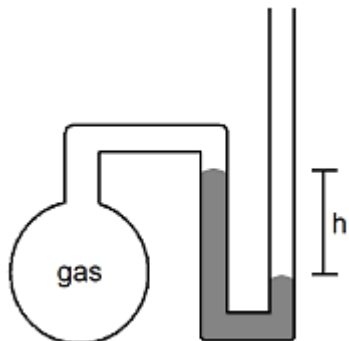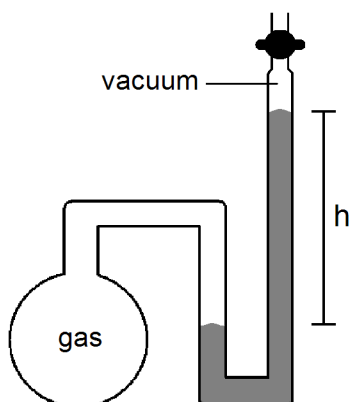# Chapter 05: Gases

1. What is the pressure of the sample of gas trapped in the open-tube mercury manometer shown below if atmospheric pressure is 736 mmHg and h = 9.2 cm?

   A) 92 mmHg   B) 644 mmHg   C) 736 mmHg   D) 828 mmHg

3. What will happen to the height (h) of the mercury column in the manometer shown below if the stopcock is opened, given that the atmospheric pressure is 755 mmHg?

   A)   h will decrease
   B)   h will not change
   C)   h will increase
   D)   not enough information given to answer the question

5. The pressure of a gas sample was measured to be 654 mmHg. What is the pressure in kPa? (1 atm = 1.01325×10^5 Pa)

   A)   87.2 kPa   D) 8.72×10^4 kPa
   B)   118 kPa   E) 8.72×10^7 kPa
   C) 6.63×10^4 kPa

7. Which of these properties 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
   D)   A and B.
   E)   A, B, and C.

9. A sample of nitrogen gas has a volume of 32.4 L at 20°C.   The gas is heated to 220°C at constant pressure.   What is the final volume of nitrogen?
   A)   2.94 L   B)   19.3 L   C)   31.4 L   D)   54.5 L   E)   356 L

11. A sample of N_2 gas occupies 2.40 L at 20°C.   If the gas is in a container that can contract or expand at constant pressure, at what temperature will the N_2 occupy 4.80 L?
    A)   10°C   B)   40°C   C)   146°C   D)   313°C   E)   685°C

13. If the pressure of a gas sample is quadrupled and the absolute temperature is doubled, by what factor does the volume of the sample change?
    A)   8   B)   2   C)   1/2   D)   1/4   E)   1/8

15. A small bubble rises from the bottom of a lake, where the temperature and pressure are 4°C and 3.0 atm, to the water's surface, where the temperature is 25°C and the pressure is 0.95 atm. Calculate the final volume of the bubble if its initial volume was 2.1 mL.
    A)   0.72 mL   B)   6.2 mL   C)   41.4 mL   D)   22.4 mL   E)   7.1 mL

17. 0.820 mole of hydrogen gas has a volume of 2.00 L at a certain temperature and pressure. What is the volume of 0.125 mol of this gas at the same temperature and pressure?
    A)   0.0512 L   B)   0.250 L   C)   0.305 L   D)   4.01 L   E)   19.5 L

19. At what temperature will a fixed mass of gas with a volume of 125 L at 15°C and 750 mmHg occupy a volume of 101 L at a pressure of 645 mm Hg?
    A)   −73°C   B)   10.4°C   C)   2°C   D)   34°C   E)   200°C

21. Calculate the volume occupied by 35.2 g of methane gas (CH_4) at 25°C and 1.0 atm. R = 0.08206 L·atm/K·mol.
    A)   0.0186 L   B)   4.5 L   C)   11.2 L   D)   49.2 L   E)   53.7 L

23. A gas evolved during the fermentation of sugar was collected. After purification its volume was found to be 25.0 L at 22.5°C and 702 mmHg. How many moles of gas were collected?
    A) 0.95 mol   B) 1.05 mol   C) 12.5 mol   D) 22.4 mol   E) 724 mol

25. Calculate the mass, in grams, of 2.74 L of CO gas measured at 33°C and 945 mmHg.
    A) 0.263 g   B) 2.46 g   C) 3.80 g   D) 35.2 g   E) 206 g

27. Gases are sold in large cylinders for laboratory use.   What pressure, in atmospheres, will be exerted by 2,500 g of oxygen gas (O_2) when stored at 22°C in a 40.0 L cylinder?
    A) 3.55 atm   B) 1,510 atm   C) 47.3 atm   D) 7.56×10^4 atm   E) 10.2 atm

29. Calculate the density of $CO_2(g)$ at 100°C and 10.0 atm pressure.
    A) 1.44 g/L   B) 134 g/L   C) 44.0 g/L   D) 53.6 g/L   E) 14.4 g/L

31. Calculate the density, in g/L, of SF_6 gas at 27°C and 0.500 atm pressure.
    A) 3.38×10^{-3} g/L   B) 2.96 g/L   C) 22.4 g/L   D) 32.9 g/L   E) 3.38 kg/L

33. Calculate the density of Ar(g) at −11°C and 675 mmHg.
    A) 1.52 g/L   B) 1.65 g/L   C) −39.3 g/L   D) 39.95 g/L   E) 1254 g/L

35. Which one of these gases is "lighter-than-air"?
    A) Cl_2 B) SO_2 C) PH_3 D) NO_2 E) Ne

37. Determine the molar mass of chloroform gas if a sample weighing 0.389 g is collected in a flask with a volume of 102 cm^3 at 97°C.   The pressure of the chloroform is 728 mmHg.
    A) 187 g/mol   D) 31.6 g/mol
    B) 121 g/mol   E) 8.28×10^{-3} g/mol
   C) 112 g/mol

39. Determine the molar mass of Freon-11 gas if a sample weighing 0.597 g occupies 100. cm^3 at 95°C, and 1,000. mmHg.
    A) 0.19 g/mol   B) 35.3 g/mol   C) 70.9 g/mol   D) 137 g/mol   E) 384 g/mol

41. A 0.271 g sample of an unknown vapor occupies 294 mL at 140°C and 847 mmHg. The empirical formula of the compound is CH_2.   What is the molecular formula of the compound?
    A) CH_2 B) C_2H_4 C) C_3H_6 D) C_4H_8 E) C_6H_{12}

43. A 1.07 g sample of a Noble gas occupies a volume of 363 mL at 35°C and 678 mmHg. Identify the Noble gas in this sample? (R = 0.08206 L·atm/K·mol)
    A) He   B) Ne   C) Ar   D) Kr   E) Xe

45. 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?
    A)   0.258 atm   D)   5,345 mmHg
    B)   301 mmHg   E)   8,020 mmHg
    C)   356 mmHg

47. A sample of carbon monoxide gas was collected in a 2.0 L flask by displacing water at 28°C and 810 mmHg.   Calculate the number of CO molecules in the flask.   The vapor pressure of water at 28°C is 28.3 mmHg.
    A) 5.0×10^{22} B) 5.2×10^{22} C) 3.8×10^{23} D) 5.4×10^{23} E) 3.8×10^{25}

49. What volume of oxygen gas at 320 K and 680 torr will react completely with 2.50 L of NO gas at the same temperature and pressure?
    $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
    A) 1.25 L   B) 2.50 L   C) 3.00 L   D) 1.00 L   E) 5.00 L

51. Gas A and gas B are combined in a flask at initial pressures of 1.0 atm each. The flask is sealed and over time they react to completion to give gas C according to the following chemical equation:
    $2A(g) + B(g) \rightarrow C(g)$
    Assuming the temperature stays constant, what will be the total pressure in the flask after the reaction goes to completion?
    A) 0.33 atm   B) 0.50 atm   C) 0.67 atm   D) 0.75 atm   E) 1.0 atm

53. How many liters of chlorine gas at 25°C and 0.950 atm can be produced by the reaction of 12.0 g of MnO_2 with excess HCl(aq) according to the following chemical equation?
$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$
A) 5.36×10^{-3} L   B) 0.138 L   C) 0.282 L   D) 3.09 L   E) 3.55 L

55. When active metals such as magnesium are immersed in acid solution, hydrogen gas is evolved. Calculate the volume of $H_2(g)$ at 30.1°C and 0.85 atm that can be formed when 275 mL of 0.725 M HCl solution reacts with excess Mg to give hydrogen gas and aqueous magnesium chloride.
A) 3.4×10^{-3} L   B) 2.2 L   C) 2.9 L   D) 5.8 L   E) 11.7 L

57. What mass of $KClO_3$ must be decomposed to produce 126 L of oxygen gas at 133°C and 0.880 atm?   (The other reaction product is solid KCl.)
A) 24.6 g   B) 70.8 g   C) 272 g   D) 408 g   E) 612 g

59. Which statement is *false*?
A) The average kinetic energies of molecules from samples of different "ideal" gases is the same at the same temperature.
B) The molecules of an ideal gas are relatively far apart.
C) All molecules of an ideal gas have the same kinetic energy at constant temperature.
D) Molecules of a gas undergo many collisions with each other and the container walls.
E) Molecules of greater mass have a lower average speed than those of less mass at the same temperature.

61. If equal masses of $O_2(g)$ and HBr(g) are in separate containers of equal volume and temperature, which one of these statements is *true*?
A) The pressure in the O_2 container is greater than that in the HBr container.
B) There are more HBr molecules than O_2 molecules.
C) The average velocity of the O_2 molecules is less than that of the HBr molecules.
D) The average kinetic energy of HBr molecules is greater than that of O_2 molecules.
E) The pressures of both gases are the same.

63. Which of these gas molecules have the *highest average kinetic energy* at 25°C?
A) H_2
B) O_2
C) N_2
D) Cl_2
E) All the gases have the same average kinetic energy.

65. For a substance that remains a gas under the conditions listed, deviation from the ideal gas law would be most pronounced at
    A)   100°C and 2.0 atm.   D)   −100°C and 4.0 atm.
    B)   0°C and 2.0 atm.   E)   100°C and 4.0 atm.
    C)   −100°C and 2.0 atm.

67. Determine the pressure of the gas trapped in the apparatus shown below when the atmospheric pressure is 695 mmHg.
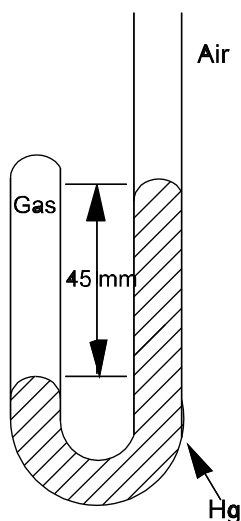
    A)   45 mmHg   B)   650 mmHg   C)   695 mmHg   D)   740 mmHg   E)   760 mmHg

69. 5.00 g of hydrogen gas and 50.0 g of oxygen gas are introduced into an otherwise empty 9.00 L steel cylinder, and the hydrogen is ignited by an electric spark.   If the reaction product is gaseous water and the temperature of the cylinder is maintained at 35°C, what is the final gas pressure inside the cylinder?
    A)   7.86 atm   B)   18.3 atm   C)   2.58 atm   D)   6.96 atm   E)   0.92 atm

71. 10.0 g of gaseous ammonia and 6.50 g of oxygen gas are introduced into a previously evacuated 5.50 L vessel.   If the ammonia and oxygen then react to yield NO gas and water vapor, what is the final density of the gas mixture inside the vessel at 23°C?
    A)   1.68 g/L   B)   3.00 g/L   C)   1.32 g/L   D)   2.20 g/L   E)   16.5 g/L

73. A spacecraft is filled with 0.500 atm of N_2 and 0.500 atm of O_2.   Suppose a micrometeor strikes this spacecraft and puts a very small hole in it's side.   Under these circumstances,
   A) O_2 is lost from the craft 6.9% faster than N_2 is lost.
   B) O_2 is lost from the craft 14% faster than N_2 is lost.
   C) N_2 is lost from the craft 6.9% faster than O_2 is lost.
   D) N_2 is lost from the craft 14% faster than O_2 is lost.
   E) N_2 and O_2 are lost from the craft at the same rate.

75. 1.000 atm of dry nitrogen, placed in a container having a pinhole opening in its side, leaks from the container 3.55 times faster than does 1.000 atm of an unknown gas placed in this same apparatus.   Which of these species could be the unknown gas?
   A) NH_3 B) C_4H_{10} C) SF_6 D) UF_6 E)   Rn

77. Samples of the following volatile liquids are opened simultaneously at one end of a room. If you are standing at the opposite end of this room, which species would you smell first? (Assume that your nose is equally sensitive to all these species.)
   A)   ethyl acetate ($CH_3COOC_2H_5$)   D)   naphthalene ($C_{10}H_8$)
   B)   camphor ($C_{10}H_{16}O$)   E)   pentanethiol ($C_5H_{11}SH$)
   C)   diethyl ether ($C_2H_5OC_2H_5$)

79. The mole fraction of oxygen molecules in dry air is 0.2095.   What volume of dry air at 1.00 atm and 25°C is required for burning 1.00 L of hexane (C_6H_{14}, density = 0.660 g/mL) completely, yielding carbon dioxide and water?
   A)   187 L   B)   712 L   C)   1780 L   D)   894 L   E)   8490

81. A block of dry ice (solid CO_2, density = 1.56 g/mL) of dimensions 25.0 cm × 25.0 cm × 25.0 cm is left to sublime (i.e. to pass from the solid phase to the gas phase) in a closed chamber of dimensions 4.00 m × 5.00 m × 3.00 m.   The partial pressure of carbon dioxide in this chamber at 25°C will be
   A)   171 mmHg.   D)   0.171 mmHg.
   B)   107 mmHg.   E)   14.4 mmHg.
   C)   0.225 mmHg.