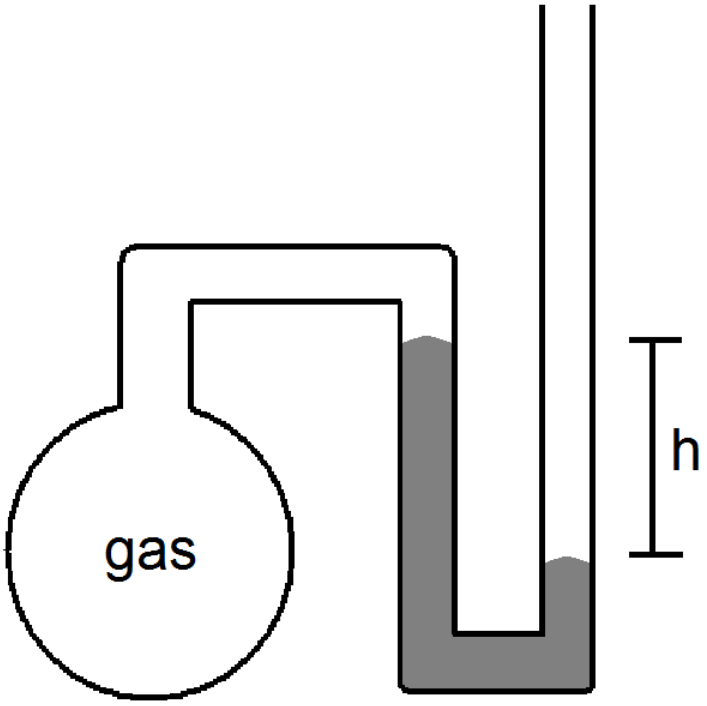
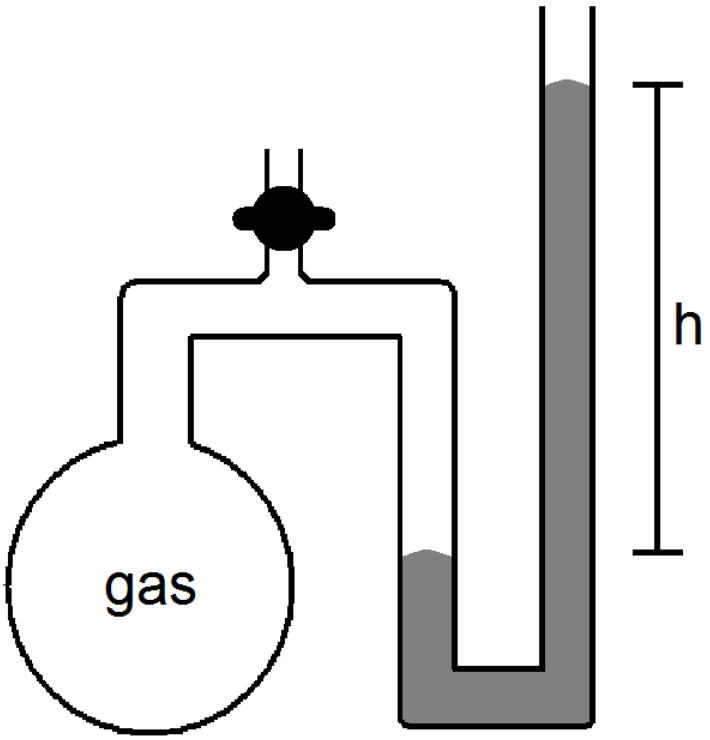
Chapter 5: Gases

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?



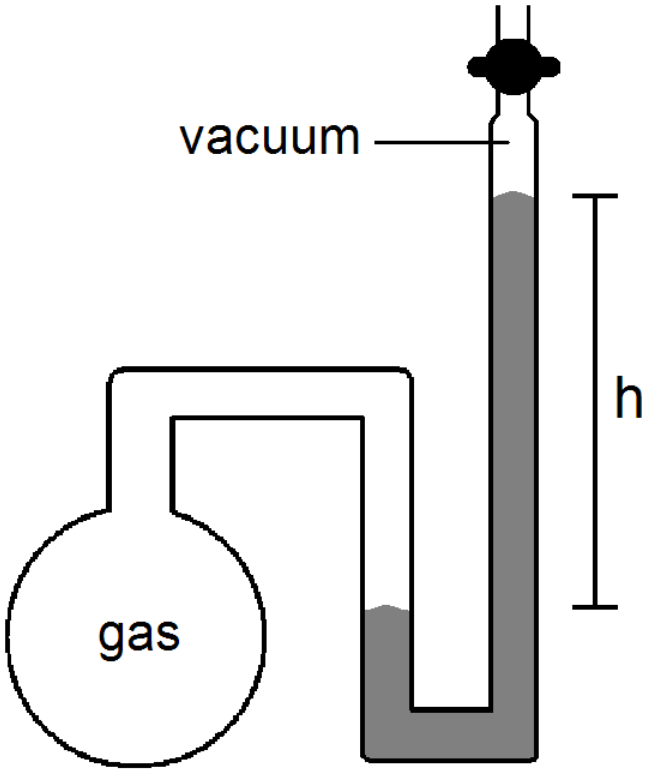
A) 92 mmHg B) 644 mmHg C) 736 mmHg D) 828 mmHg
Ans: B Category: Medium Section: 5.2

2. What will happen to the height (h) of the column of mercury in the manometer shown below if the stopcock is opened?



A) h will decrease
B) h will not change
C) h will increase
D) not enough information given to answer the question
Ans: A Category: Medium Section: 5.2

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
Ans: A Category: Medium Section: 5.2

4. A pressure that will support a column of Hg to a height of 256 mm would support a column of water to what height? The density of mercury is 13.6 g/cm^3; the density of water is 1.00 g/cm^3.
A) 1.00×10^2 ft B) 18.8 mm C) 33.8 ft D) 76.0 cm E) 348 cm
Ans: E Category: Medium Section: 5.2

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
B) 118 kPa
C) 6.63×10^4 kPa
D) 8.72×10^4 kPa
E) 8.72×10^7 kPa
Ans: A Category: Medium Section: 5.2

6. The pressure of a gas sample was measured to be 489 mmHg. Which of the following is *not* an equivalent statement of that pressure? (1 atm = 1.01325×10^5 Pa)
   A) 65.2 kPa B) 6.52×10^4 Pa C) 489 torr D) 0.811 atm
   Ans: D Category: Medium Section: 5.2

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.
   Ans: E Category: Easy Section: 5.1

8. A sample of a gas occupies 1.40×10^3 mL at 25°C and 760 mmHg. What volume will it occupy at the same temperature and 380 mmHg?
   A) 2,800 mL B) 2,100 mL C) 1,400 mL D) 1,050 mL E) 700 mL
   Ans: A Category: Medium Section: 5.3

9. A sample of nitrogen gas has a volume of 32.4 L at 20°C. The gas is heated to 220ºC 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
   Ans: D Category: Medium Section: 5.3

10. If 30.0 L of oxygen are cooled from 200ºC to 1°C at constant pressure, what is the new volume of oxygen?
    A) 0.150 L B) 17.4 L C) 23.0 L D) 51.8 L E) 6.00×10^3 L
    Ans: B Category: Medium Section: 5.3

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
    Ans: D Category: Medium Section: 5.3

12. The gas pressure in an aerosol can is 1.8 atm at 25°C. If the gas is an ideal gas, what pressure would develop in the can if it were heated to 475°C?
    A) 0.095 atm B) 0.717 atm C) 3.26 atm D) 4.52 atm E) 34.2 atm
    Ans: D Category: Medium Section: 5.3

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
    Ans: C Category: Medium Section: 5.4

14. If the pressure on a gas sample is tripled and the absolute temperature is quadrupled, by what factor will the volume of the sample change?
A) 12 B) 4/3 C) 3/4 D) 1/3 E) 4
Ans: B Category: Medium Section: 5.4

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
Ans: E Category: Medium Section: 5.4

16. The temperature of an ideal gas in a 5.00 L container originally at 1 atm pressure and 25°C is lowered to 220 K. Calculate the new pressure of the gas.
A) 1.0 atm B) 1.35 atm C) 8.8 atm D) 0.738 atm E) 0.114 atm
Ans: D Category: Medium Section: 5.3

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
Ans: C Category: Medium Section: 5.3

18. At what temperature will a fixed amount of gas with a volume of 175 L at 15°C and 760 mmHg occupy a volume of 198 L at a pressure of 640 mm Hg?
A) 274°C B) 214°C C) 114°C D) 1°C E) –59°C
Ans: D Category: Medium Section: 5.4

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
Ans: A Category: Medium Section: 5.4

20. Calculate the number of moles of gas contained in a 10.0 L tank at 22°C and 105 atm. (R = 0.08206 L·atm/K·mol)
A) 1.71×10^{-3} mol B) 0.0231 mol C) 1.03 mol D) 43.4 mol E) 582 mol
Ans: D Category: Medium Section: 5.4

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
Ans: E Category: Medium Section: 5.4

22. Calculate the volume occupied by 25.2 g of CO_2 at 0.84 atm and 25°C. R = 0.08206 L·atm/K·mol.
A) 0.060 L B) 1.34 L C) 16.9 L D) 24.2 L E) 734 L
Ans: C Category: Medium Section: 5.4

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
Ans: A Category: Medium Section: 5.4

24. How many molecules of N_2 gas can be present in a 2.5 L flask at 50°C and 650 mmHg?
A) 2.1×10^{-23} molecules
B) 4.9×10^{22} molecules
C) 3.1×10^{23} molecules
D) 3.6×10^{25} molecules
E) 0.081 molecules
Ans: B Category: Medium Section: 5.4

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
Ans: C Category: Medium Section: 5.4

26. A 1.2 L flask contains 0.500 mole of ammonia (NH_3) at 150°C. Calculate the pressure of the ammonia inside the flask.
A) 6.91×10^{-2} atm B) 5.13 atm C) 12.2 atm D) 14.5 atm E) 22.4 atm
Ans: D Category: Easy Section: 5.4

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
Ans: C Category: Medium Section: 5.4

28. Calculate the density, in g/L, of CO_2 gas at 27°C and 0.50 atm pressure.
A) 0.89 g/L B) 1.12 g/L C) 9.93 g/L D) 46.0 g/L E) 2.17 kg/L
Ans: A Category: Medium Section: 5.4

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
Ans: E Category: Medium Section: 5.4

30. Calculate the density of $Br_2(g)$ at 59.0°C and 1.00 atm pressure.
A) 27.2 g/L B) 5.83 g/L C) 769 g/L D) 22.4 g/L E) 3.45 g/L
Ans: B Category: Medium Section: 5.4

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
Ans: B Category: Medium Section: 5.4

32. Calculate the density, in g/L, of chlorine (Cl_2) gas at STP.
A) 2.13×10^{-2} g/L B) 46.9 g/L C) 1.58 g/L D) 3.16 g/L E) 0.316 kg/L
Ans: D Category: Medium Section: 5.4

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
Ans: B Category: Medium Section: 5.4

34. Which of these gases will have the greatest density at the same specified temperature and pressure?
A) H_2 B) $CClF_3$ C) CO_2 D) C_2H_6 E) CF_4
Ans: B Category: Medium Section: 5.4

35. Which one of these gases is "lighter-than-air"?
A) Cl_2 B) SO_2 C) PH_3 D) NO_2 E) Ne
Ans: E Category: Medium Section: 5.4

36. Two moles of chlorine gas at 20.0°C are heated to 350°C while the volume is kept constant. The density of the gas
A) increases.
B) decreases.
C) remains the same.
D) Not enough information is given to correctly answer the question.
Ans: C Category: Medium Section: 5.4

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
B) 121 g/mol
C) 112 g/mol
D) 31.6 g/mol
E) 8.28×10^{-3} g/mol
Ans: B Category: Medium Section: 5.4

38. What is the molar mass of Freon-11 gas if its density is 6.13 g/L at STP?
A) 0.274 g/mol B) 3.64 g/mol C) 78.2 g/mol D) 137 g/mol E) 365 g/mol
Ans: D Category: Medium Section: 5.4

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
Ans: D Category: Medium Section: 5.4

40. 1.018 g of Freon-113 gas is trapped in a 145 mL container at 760. mmHg and 50.0°C. What is the molar mass of Freon-113?
A) 21.7 g/mol B) 28.8 g/mol C) 46.1 g/mol D) 186 g/mol E) 245 g/mol
Ans: D Category: Medium Section: 5.4

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}
Ans: B Category: Medium Section: 5.4

42. A 1.17 g sample of an alkane hydrocarbon gas occupies a volume of 674 mL at 28°C and 741 mmHg. Alkanes are known to have the general formula CnH2n+2. What is the molecular formula of the gas in this sample? (R = 0.08206 L·atm/K·mol)
A) CH_4 B) C_2H_6 C) C_3H_8 D) C_4H_{10} E) C_5H_{12}
Ans: C Category: Medium Section: 5.4

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
Ans: D Category: Medium Section: 5.4

44. A gaseous compound is 30.4% nitrogen and 69.6% oxygen by mass. A 5.25-g sample of the gas occupies a volume of 1.00 L and exerts a pressure of 1.26 atm at –4.0°C. Which of these choices is its molecular formula?
A) NO B) NO_2 C) N_3O_6 D) N_2O_4 E) N_2O_5
Ans: D Category: Medium

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
B) 301 mmHg
C) 356 mmHg
D) 5,345 mmHg
E) 8,020 mmHg
Ans: C Category: Medium Section: 5.6

46. A sample of hydrogen gas was collected over water at 21°C and 685 mmHg. The volume of the container was 7.80 L. Calculate the mass of $H_2(g)$ collected. (Vapor pressure of water = 18.6 mmHg at 21°C.)
A) 0.283 g B) 0.572 g C) 0.589 g D) 7.14 g E) 435 g
Ans: B Category: Medium Section: 5.6

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}
Ans: A Category: Medium Section: 5.6

48. Air contains 78% N_2, 21% O_2, and 1% Ar, by volume. What is the density of air at 1,000. torr and –10°C?
A) 1.0 g/L B) 6.1 g/L C) 1.3 g/L D) 1.8 g/L E) 0.56 g/L
Ans: D Category: Difficult Section: 5.6

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
Ans: A Category: Medium Section: 5.5

50. 2.0 L of gas A at 1.0 atm and 1.0 L of gas B at 1.0 atm are combined in a 3 L flask. The flask is sealed and over time they react to completely 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 pressure 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
Ans: A Category: Medium Section: 5.6

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
Ans: E Category: Difficult Section: 5.6

52. What volume of CO_2 gas at 645 torr and 800 K could be produced by the reaction of 45 g of $CaCO_3$ according to the equation?
$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
A) 0.449 L B) 22.4 L C) 25.0 L D) 34.8 L E) 45.7 mL
Ans: D Category: Medium Section: 5.5

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
Ans: E Category: Medium Section: 5.5

54. How many liters of oxygen gas at 153°C and 0.820 atm can be produced by the decomposition of 22.4 g of solid $KClO_3$? (The other decomposition product is solid potassium chloride.)
A) 3.0 L B) 0.085 L C) 4.20 L D) 7.79 L E) 11.7 L
Ans: E Category: Difficult Section: 5.5

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
Ans: C Category: Difficult Section: 5.5

56. Calculate the volume of $H_2(g)$ at 273 K and 2.00 atm that will be formed when 275 mL of 0.725 M HCl solution reacts with excess Mg to give hydrogen gas and aqueous magnesium chloride.
A) 0.56 L B) 1.12 L C) 2.23 L D) 4.47 L E) 3.54 L
Ans: B Category: Difficult Section: 5.5

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
Ans: C Category: Difficult Section: 5.5

58. Liquid nitrogen has a density of 0.807 g/mL at –195.8 °C. If 1.00 L of $N_2(l)$ is allowed to warm to 25°C at a pressure of 1.0 atm, what volume will the gas occupy? (R = 0.08206 L·atm/K·mol)
A) 59.1 L B) 182 L C) 705 L D) 1.41×10^3 L E) 1.97×10^4 L
Ans: C Category: Medium Section: 5.5

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.
Ans: C Category: Medium Section: 5.7

60. The molecules of different samples of an ideal gas have the same average kinetic energies, at the same
A) pressure. B) temperature. C) volume. D) density.
Ans: B Category: Easy Section: 5.7

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.
    Ans: A Category: Medium Section: 5.4

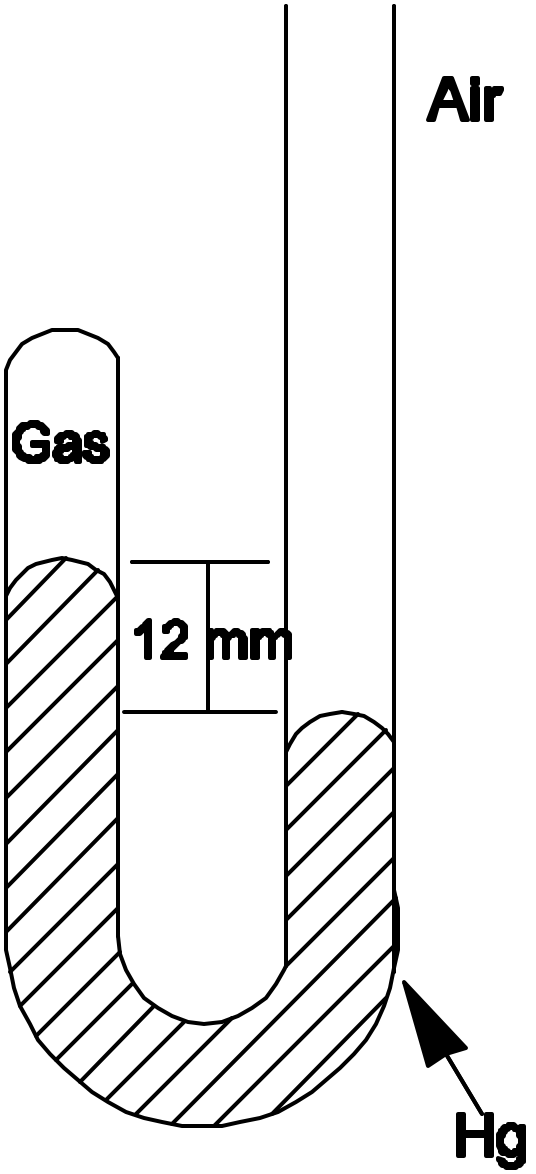
62. Which gas has molecules with the *greatest average molecular speed* at 25°C?
    A) CH_4 B) Kr C) N_2 D) CO_2 E) Ar
    Ans: A Category: Easy Section: 5.7

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.
    Ans: E Category: Easy Section: 5.7

64. 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 high pressures.
    D) high temperatures and low pressures.
    Ans: B Category: Medium Section: 5.8

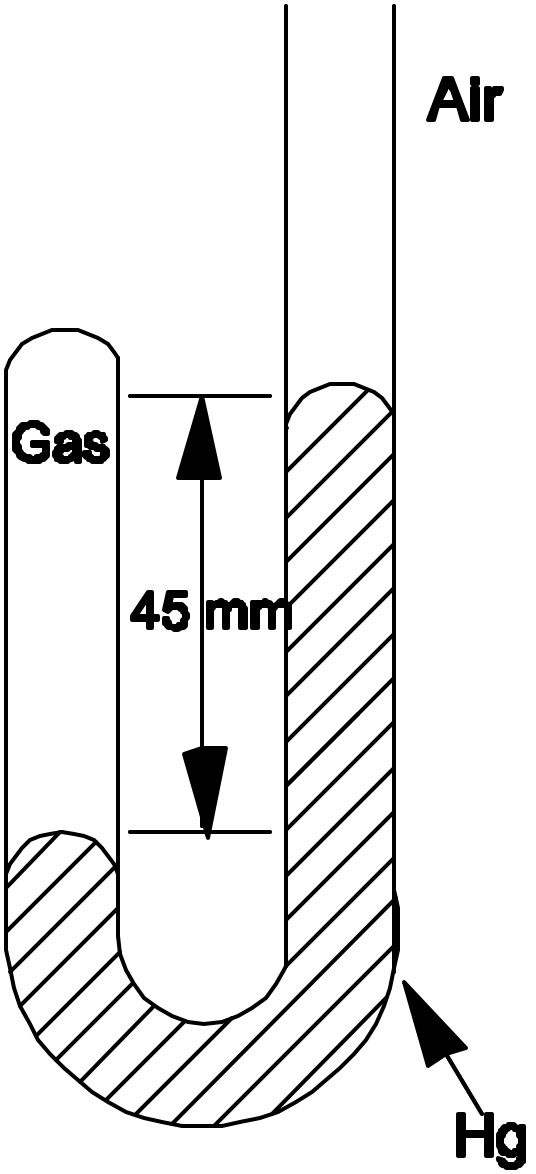
65. For a substance that remains a gas under the conditions listed, deviation from the ideal gas law would be most pronounced at
    A) 100°C and 2.0 atm.
    B) 0°C and 2.0 atm.
    C) –100°C and 2.0 atm.
    D) –100°C and 4.0 atm.
    E) 100°C and 4.0 atm.
    Ans: D Category: Medium Section: 5.8

66. What is the pressure of the gas trapped in the apparatus shown below when the atmospheric pressure is 720 mmHg?



A) 12 mmHg B) 708 mmHg C) 720 mmHg D) 732 mmHg E) 760 mmHg
Ans: B Category: Medium Section: 5.2

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
Ans: D Category: Medium Section: 5.2

68. 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 gas pressure inside the vessel at 23ºC?
A) 1.79 atm B) 6.48 atm C) 3.50 atm D) 0.285 atm E) 3.67 atm
Ans: E Category: Difficult Section: 5.6

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 35ºC, 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
Ans: A Category: Difficult Section: 5.6

70. 9.45 g of liquid hexane (C_6H_{14}) is introduced into a 10.0 L vessel containing 13.15 atm of oxygen gas at 21ºC and ignited, yielding carbon dioxide and water. If the vessel is then cooled to –10ºC, what will be the gas pressure inside the vessel?
A) 3.09 atm B) 13.15 atm C) 1.42 atm D) 10.9 atm E) 12.6 atm
Ans: D Category: Difficult Section: 5.6

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 23ºC?
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
Ans: B Category: Difficult Section: 5.6

72. A method of removing CO_2 from a spacecraft is to allow the CO_2 to react with sodium hydroxide. (The products of the reaction are sodium carbonate and water.) What volume of carbon dioxide at 25°C and 749 mmHg can be removed per kilogram of sodium hydroxide that reacts?
A) 301 L B) 284 L C) 276 L D) 310 L E) 620 L
Ans: D Category: Difficult Section: 5.5

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.
Ans: C Category: Medium Section: 5.7

74. A spacecraft is filled with 0.500 atm of O_2 and 0.500 atm of He. If there is a very small hole in the side of this craft such that gas is lost slowly into outer space,
A) He is lost 2.8 times faster than O_2 is lost.
B) He is lost 8 times faster than O_2 is lost.
C) He is lost twice as fast as O_2 is lost.
D) O_2 is lost 2.8 times faster than He is lost.
E) O_2 is lost 8 times faster than He is lost.
Ans: A Category: Medium Section: 5.7

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
Ans: D Category: Medium Section: 5.7

76. 1.000 atm of oxygen gas, placed in a container having a pinhole opening in its side, leaks from the container 2.14 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) Cl_2 B) SF_6 C) Kr D) UF_6 E) Xe
Ans: B Category: Medium Section: 5.7

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 ($CH_3COOC_2H_5$)
B) camphor ($C_{10}H_{16}O$)
C) diethyl ether ($C_2H_5OC_2H_5$)
D) naphthalene ($C_{10}H_8$)
E) pentanethiol ($C_5H_{11}SH$)
Ans: C Category: Medium Section: 5.7

78. A sample of mercury(II) oxide is placed in a 5.00 L evacuated container and heated until it decomposes entirely to mercury metal and oxygen gas. The container is then cooled to 25°C. One now finds that the gas pressure inside the container is 1.73 atm. What mass of mercury(II) oxide was originally placed into the container?
A) 913 g B) 76.6 g C) 1.51 g D) 45.6 g E) 153 g
Ans: E Category: Difficult Section: 5.5

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
Ans: E Category: Difficult Section: 5.5

80. 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 octane (C_8H_{18}, density = 0.7025 g/mL) completely, yielding carbon dioxide and water?
A) 718 L B) 367 L C) 8980 L D) 1880 L E) 150 L
Ans: C Category: Difficult Section: 5.5

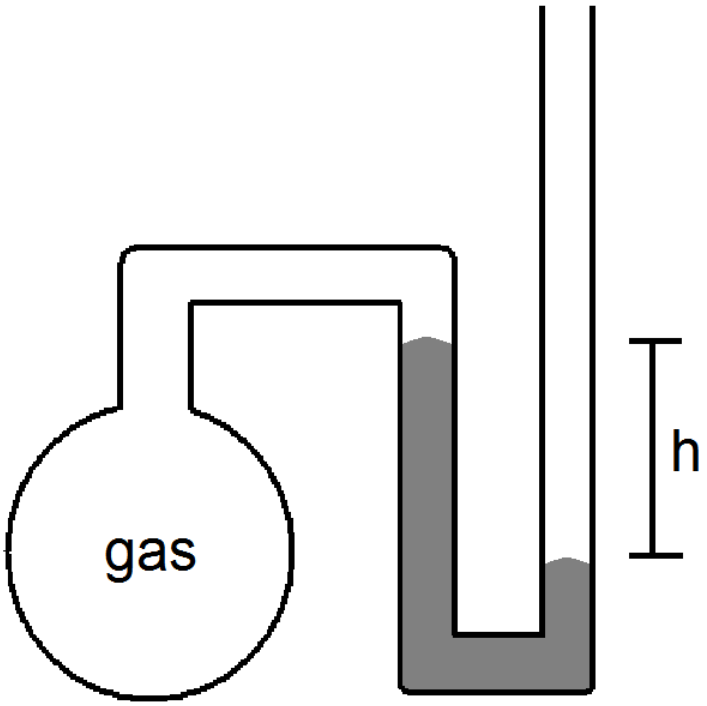
81. A block of dry ice (solid CO_2, density = 1.56 g/mL) of dimensions 25.0 cm × 25.0 cm × 25.0 cm is left to sublime (i.e. to pass from the solid phase to the gas phase) in a closed chamber of dimensions 4.00 m × 5.00 m × 3.00 m. The partial pressure of carbon dioxide in this chamber at 25°C will be
    A) 171 mmHg
    B) 107 mmHg
    C) 0.225 mmHg
    D) 0.171 mmHg
    E) 14.4 mmHg
    Ans: A Category: Medium Section: 5.5

82. A 2.50-L flask contains a mixture of methane (CH_4) and propane (C_3H_8) at a pressure of 1.45 atm and 20°C. When this gas mixture is then burned in excess oxygen, 8.60 g of carbon dioxide is formed. (The other product is water.) What is the mole fraction of methane in the original gas mixture?
    A) 0.341 B) 1.00 C) 0.659 D) 0.855 E) 0.145
    Ans: D Category: Difficult Section: 5.7

83. What is the definition of a "gas"?
    Ans: A "gas" is a substance in which the molecules are separated on the average by distances that are large compared with the sizes of the molecules.
    Category: Easy Section: 5.1

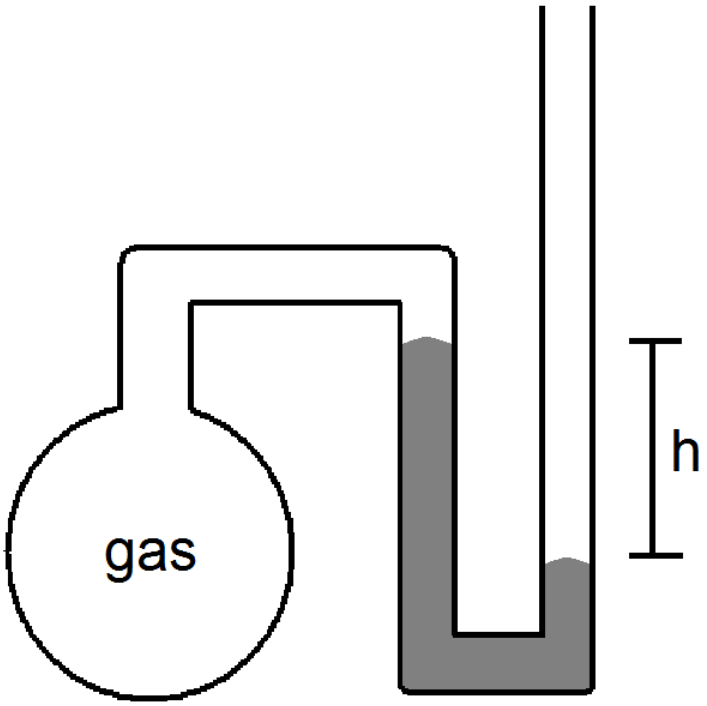
84. What is standard temperature and standard pressure?
    Ans: 0°C and 1 atm pressure
    Category: Easy Section: 5.2

85. What is the pressure of the sample of gas trapped in the open-tube mercury manometer shown below if atmospheric pressure is 742 mmHg and h = 16.7 cm?



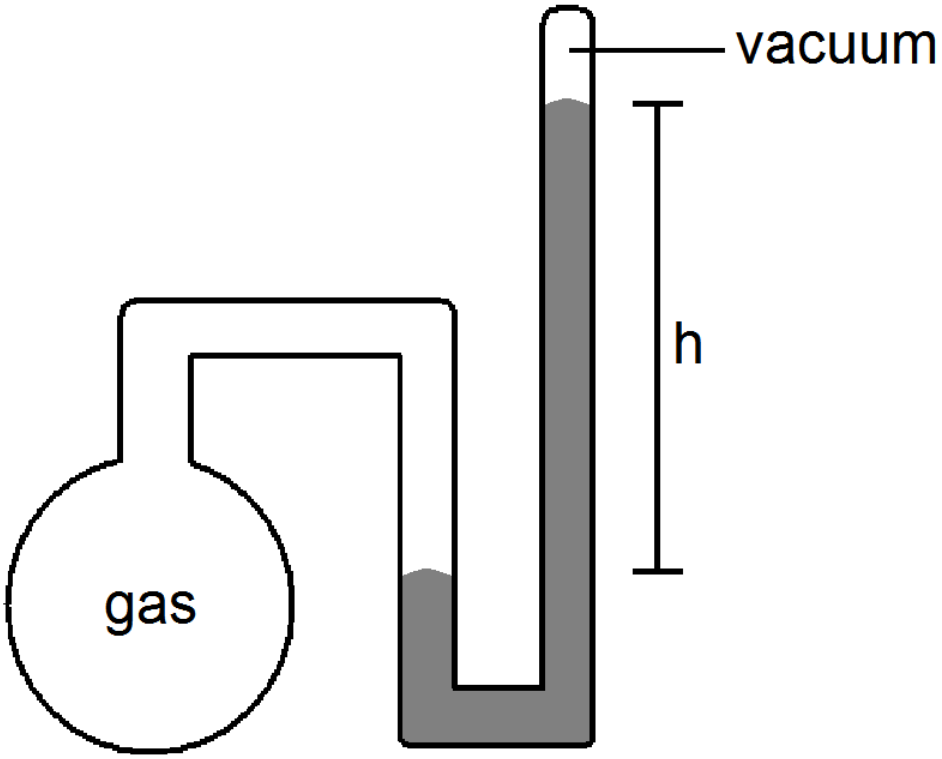
Ans: 575 mmHg
Category: Easy Section: 5.2

86. What is the pressure (in atmospheres) of the sample of gas trapped in the open-tube mercury manometer shown below if atmospheric pressure is 735 mmHg and h = 8.3 cm?



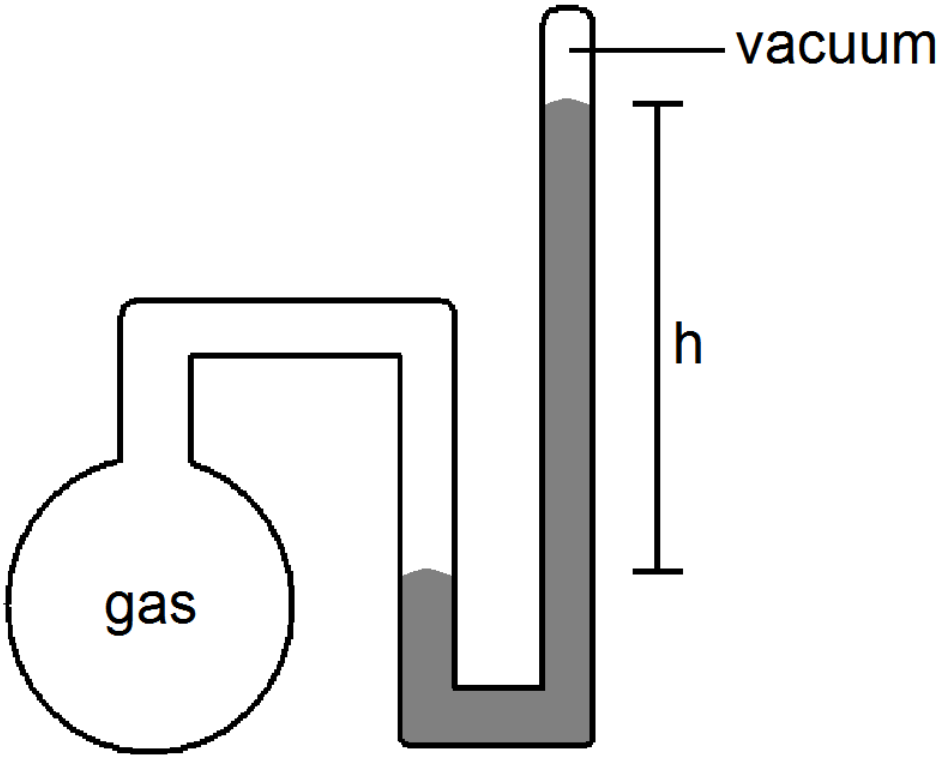
Ans: 0.858 atm
Category: Easy Section: 5.2

87. What is the pressure (in atmospheres) of the sample of gas trapped in the closed-tube mercury manometer shown below if h = 23.6 cm?



Ans: 0.311 atm
Category: Easy Section: 5.2

88. What is the pressure of the sample of gas trapped in the closed-tube mercury manometer shown below if atmospheric pressure is 751 mmHg and h = 17.3 cm?



Ans: 173 mmHg (or 0.228 atm)
Category: Easy Section: 5.2

89. What is the significance of the magnitude of the van der Waals "a" constant?
Ans: The magnitude of the van der Waals "a" constant reflects the strength of the attractions between molecules of a given type of gas.
Category: Easy Section: 5.8

90. How many grams of N_2O, nitrous oxide, are contained in 500. mL of the gas at STP?
Ans: 0.982 g
Category: Easy Section: 5.2

91. Calculate the density of N_2O gas, in grams per liter, at 110°C and 12 atm.
Ans: 16.8 g/L
Category: Medium Section: 5.4

92. Calculate the molar mass of a gaseous substance if 0.125 g of the gas occupies 93.3 mL at STP.
Ans: 30.0 g/mol
Category: Medium Section: 5.4

93. An aerosol can with a volume of 0.50 L has a bursting point of 2.6 atm. If the can contains 1.0 g CO_2 and is heated to 400°C, will it burst?
Ans: No
Category: Medium Section: 5.4

94. Phosgene, a chemical warfare agent used in World War I, consists of 12.41% C, 16.17% O, and 71.69% Cl. 1.00 L of this gas at STP has a mass of 4.42 g. What is the molecular formula of phosgene?
Ans: $COCl_2$
Category: Medium Section: 5.4

95. The van der Waals equation is a modification of the ideal gas equation. For what two facts does this equation account?
Ans: (1) Real gas molecules exert forces on each other. (2) Gas molecules have volume.
Category: Easy Section: 5.8

96. On a spring morning (20°C) you fill your tires to a pressure of 2.25 atmospheres. As you ride along, the tire heats up to 45°C from the friction on the road. What is the pressure in your tires now?
Ans: 2.44 atmospheres
Category: Medium Section: 5.4

97. A gas-filled balloon with a volume of 12.5 L at 0.90 atm and 21°C is allowed to rise to the stratosphere where the temperature is –5°C and the pressure is 1.0 millibar. What is the final volume of the balloon? 1.000 atm = 1.013 bar.
Ans: 1.0×10^4 L
Category: Medium Section: 5.4

98. What volume of H_2 is formed at STP when 6.0 g of Al is treated with excess NaOH?
$2NaOH + 2Al + 6H_2O \rightarrow 2NaAl(OH)_4 + 3H_2(g)$
Ans: 7.5 L
Category: Medium Section: 5.5

99. A convenient way to produce very high purity oxygen in the laboratory is to decompose $KMnO_4(s)$ at high temperature according to the following chemical equation:
$2KMnO_4(s) \rightarrow K_2MnO_4(s) + MnO_2(s) + O_2(g)$
If 2.50 L of $O_2(g)$ is needed at 1.00 atm and 20°C, what mass of $KMnO_4(s)$ should be decomposed? Assume the decomposition of $KMnO_4(s)$ goes to completion.
Ans: 32.8 g
Category: Medium Section: 5.5

100. What is *V* in the table below?

	P	V	T
initial:	1,420 torr	75 mL	200. K
final:	760 torr	*V*	360. K

Ans: 250 mL
Category: Medium Section: 5.4

101. What is *P* in the table below?

	P	V
initial:	14 atm	1.0 L
final:	*P*	50. L

Ans: 0.28 L
Category: Medium Section: 5.3

102. What is *T* in the table below?

	V	T
initial:	91.8 mL	365 K
final:	45.8 mL	*T*

Ans: 182 K *or* –91.0°C
Category: Medium Section: 5.3

103. What is *P* in the table below?

	V	P
initial:	91.8 mL	1 atm
final:	45.8 mL	*P*

Ans: 2 atm
Category: Medium Section: 5.3

104. Today is a beautiful day for a picnic in the mountains, so we seal our peanut butter sandwich in a plastic sandwich bag at the base of the mountain. The approximate volume of the sandwich bag not occupied by the sandwich is 200. mL. The pressure at the base of the mountain is 1.0 atm. If the pressure at the top of the mountain is 0.80 atm, what is the final volume of gas in our sandwich bag?
Ans: 250 mL
Category: Medium Section: 5.3

105. Give five examples of elements that occur as gases at room temperature and pressure?
Ans: (Answers will vary.) Oxygen, nitrogen, helium, hydrogen, argon, chlorine
Category: Easy Section: 5.1

106. Give five examples of compounds that exist as gases at room temperature and pressure.
Ans: (Answers will vary.) Ammonia, carbon dioxide, sulfur dioxide, nitrogen dioxide, methane
Category: Easy Section: 5.1

107. At constant pressure, the density of a gas depends on temperature. Does the density increase or decrease as the temperature increases?
Ans: decrease
Category: Medium Section: 5.3

108. In a weather forecast on a Seattle radio station the barometric pressure was reported to be 29.4 inches. What is this pressure in SI units? (1 inch = 25.4 mm, 1 atm = 760 mmHg)
Ans: 0.983 atm
Category: Easy Section: 5.2

109. At STP, 1 mole of gas has a molar volume of 22.4 L. What is the density of oxygen at STP?
Ans: 1.43 g/L
Category: Medium Section: 5.4

110. Ammonium nitrite undergoes decomposition to produce only gases as shown below.
$NH_4NO_2(s) \rightarrow N_2(g) + 2H_2O(g)$
How many liters of gas will be produced by the decomposition of 32.0 g of NH_4NO_2 at 525°C and 1.5 atm?
Ans: 65 L
Category: Medium Section: 5.5

111. In an effort to address concerns about global warming, a power plant in Portland Oregon is designed to take all of its exhaust gases from its boilers and recycle the CO_2 using the Solvay process to make sodium hydrogen carbonate. The reaction is shown below.
$NH_3(g) + H_2O(l) + CO_2(g) + NaCl(aq) \rightarrow NaHCO_3(aq) + NH_4Cl(aq)$
How many liters each of NH_3 and CO_2 (both at STP) would be consumed to produce 3.00 kg of sodium bicarbonate?
Ans: The volume of both NH_3 and CO_2 would be 800. liters.
Category: Medium Section: 5.5

112. Baking powder is made up of sodium hydrogen carbonate and calcium hydrogen phosphate. When baking powder is wet, these components react to produce carbon dioxide. The equation for this reaction is given below.
$NaHCO_3(aq) + CaHPO_4(aq) \rightarrow NaCaPO_4(aq) + CO_2(g) + H_2O(l)$
Assuming all of the carbon dioxide was released as a gas, how many liters of $CO_2(g)$ would be formed at room temperature from 4.00 g of $NaHCO_3$ and excess $CaHPO_4$?
Ans: Approximately 1.16 liters
Category: Medium Section: 5.5

113. Packaged cake mixes usually contain baking powder, a mixture of sodium hydrogen carbonate and calcium hydrogen phosphate that react to produce carbon dioxide gas when they are heated in water. The $CO_2(g)$ formed allows the cake to "rise." When such cake mixes are used at high altitudes, often the cake will rise too much and collapse, unless special instructions are followed. Why does this happen?
Ans: Due to the reduced atmospheric pressure, a greater volume of carbon dioxide is created.
Category: Medium Section: 5.4

114. Many automobiles produce about 5 grams of NO for each mile they are driven. How many liters of NO gas at STP would be produced on a 100-mile trip?
Ans: 400 liters of NO
Category: Medium Section: 5.5

115. A particular coal sample contains 2.32% S. When the coal is burned, the sulfur is converted to sulfur dioxide gas. What volume of $SO_2(g)$, measured at 25°C and 749 mmHg, is produced by burning 2.0×10^6 lb of this coal? (1 lb = 454 g)
Ans: 1.6×10^7 liters
Category: Medium Section: 5.5

116. At standard temperature and pressure, a given sample of water vapor occupies a volume of 2.80 L. How many moles of water vapor are present?
Ans: 0.125 mol
Category: Easy Section: 5.4

117. Gasoline (which can be considered to be octane, C_8H_{18}) burns in oxygen to produce carbon dioxide and water. What volume of oxygen at STP is necessary to react with 1.0 gal of gasoline?
(The density of gasoline is 0.81 g/mL. 1 gal = 3.78 L)
Ans: 7,500 L
Category: Difficult Section: 5.5

118. Gasoline (which can be considered to be octane, C_8H_{18}) burns in oxygen to produce carbon dioxide and water. What volume of carbon dioxide at STP is generated as a result of the combustion of 1.0 gal of gasoline?
(The density of gasoline is 0.81 g/mL. 1 gal = 3.78 L)
Ans: 4800 L
Category: Difficult Section: 5.5