

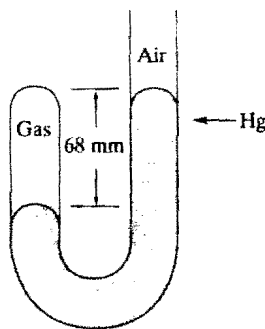
3. The SI unit of pressure is the newton.
4. A pressure of one standard atmosphere can support a column of water with a height of 33.9 ft.
5. As the temperature is raised from 100°C to 200°C, the volume of an ideal gas will double at constant pressure.
6. One mole of an ideal gas occupies 22.4 L at 1 atm and 25°C.
7. The density of a gas is inversely proportional to its molecular mass.
8. The volume of a gas is inversely proportional to its pressure.
9. The partial pressure of a component in a gas mixture is proportional to its mole fraction.
10. In the reaction  $2A(g) + B(g) \rightarrow 2C(g)$ , if 2 L of B react, then 4 L of C will be formed.
11. Consider two gases, A and B. Gas A has a molar mass of 50 g/mol, and gas B has a molar mass of 100 g/mol. At STP, 100 g of A will occupy the same volume as 50 g of B.
12. According to the kinetic molecular theory, all molecules of a certain gas at temperature  $T$  have the same kinetic energy.
13. According to Graham's law,  $CH_4$  will diffuse faster than  $N_2$ .
14. The strength of intermolecular forces between  $CO_2$  molecules is greater than between  $CH_4$  molecules.
15. Deviations from ideal behavior are more pronounced at low pressure than at high pressure.

3-15

True/False

Correct/False**SELF-TEST A**

1. A barometer reads 695 mm Hg. Calculate the pressure in units of
  - a. atm
  - b. torr
  - c. bars
  - d. Pa
  - e. psi
2. What is the pressure of the gas trapped in the apparatus shown below when the atmospheric pressure is 0.950 atm?



3. The pressure of  $H_2$  gas in a 0.50-L cylinder is 1775 psi at  $70^\circ F$ . What volume would the gas occupy at 1 atm and the same temperature?

4. If 30.0 L of oxygen is cooled at constant pressure from  $200^{\circ}\text{C}$  to  $0^{\circ}\text{C}$ , what would be the new volume of oxygen?
5. A balloon has a volume of 1500 L of He at 0.925 atm and  $23^{\circ}\text{C}$ . At an altitude of 20 km the temperature is  $-50^{\circ}\text{C}$  and the pressure is 0.25 bar. What is the volume of this balloon at 20 km?
6. The Martian atmosphere is mostly  $\text{CO}_2$  at a pressure of 5.5 mm Hg at a temperature of  $-31.4^{\circ}\text{C}$ . What is the density of the atmosphere?
7. How many grams of chlorine ( $\text{Cl}_2$ ) occupy a 0.716-L cylinder when the pressure is 10.9 atm at  $30^{\circ}\text{C}$ ?
8. Fill in the blank spaces in the table.

	$P$	$V$	$n$	$T$
a.	7.25 atm	40.0 L	10.5 mol	_____
b.	451 torr	150 mL	$2.50 \times 10^{-3}$ mol	_____
c.	14.2 atm	12.0 L	_____	325 K
d.	152 kPa	120 mL	_____	$25^{\circ}\text{C}$
e.	2.50 atm	_____	12.0 mol	501 K
f.	2280 torr	_____	$2.00 \times 10^2$ mol	$450^{\circ}\text{C}$
g.	_____	22.4 L	1.25 mol	301 K
h.	_____	10.0 mL	0.0625 mol	$25^{\circ}\text{C}$

9. Calculate the volume occupied by 15.2 g of  $\text{CO}_2$  at 0.74 atm and  $24^{\circ}\text{C}$ .
10. What is the density of uranium hexafluoride gas ( $\text{UF}_6$ ) at STP?
11. When 1.48 g of mercuric chloride is vaporized in a 1.00-L bulb at 680 K, the pressure is 225 mm Hg. What are the molar mass and molecular formula of mercuric chloride vapor?
12. Determine the molecular mass of chloroform gas if a sample weighing 0.495 g is collected as a vapor (gas) in a flask of volume 127  $\text{cm}^3$  at  $98^{\circ}\text{C}$ . The pressure of the chloroform vapor at this temperature in the flask was determined to be 754 mm Hg.
13. A 150-mL sample of  $\text{O}_2$  gas is collected over water at  $20^{\circ}\text{C}$  and 758 torr. What volume will the same sample of oxygen occupy at STP when it is dry?
14. A sample of nitrogen gas is bubbled through liquid water at  $25^{\circ}\text{C}$  and then collected in a volume of 750  $\text{cm}^3$ . The total pressure of the gas, which is saturated with water vapor, is found to be 740 mm at  $25^{\circ}\text{C}$ . The vapor pressure of water at this temperature is 24 mm. How many moles of nitrogen are in the sample?
15. The volume of carbon monoxide gas ( $\text{CO}$ ) collected over water at  $25^{\circ}\text{C}$  was 680  $\text{cm}^3$  with a total pressure of 752 mm Hg. The vapor pressure of water at  $25^{\circ}\text{C}$  is 23.8 mm Hg. Determine the partial pressure and mole fraction of  $\text{CO}$  in the container.
16. The partial pressures of  $\text{N}_2$ ,  $\text{O}_2$ , and Ar in dry air are 570, 153, and 6 torr, respectively. What are the mole fractions of these three gases?
17. A mixture of 40.0 g of  $\text{O}_2$  and 40.0 g of He has a total pressure of 0.900 atm. What are the partial pressures of  $\text{O}_2$  and He in the mixture?
18. a. What volume of  $\text{CO}_2$  at 1 atm and  $225^{\circ}\text{C}$  would be produced by the reaction of 12.0 g  $\text{NaHCO}_3$ ?
- $$2\text{NaHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{CO}_2 + 2\text{H}_2\text{O}$$
- b. On cooling to  $20^{\circ}\text{C}$ , what volume would the  $\text{CO}_2$  occupy?

19. How many liters of ammonia at 10 atm and 500°C can be produced by the reaction of 6.0 g of hydrogen with excess N<sub>2</sub>?
20. In the oxidation of ammonia,
- $$4\text{NH}_3(g) + 5\text{O}_2(g) \rightarrow 4\text{NO}(g) + 6\text{H}_2\text{O}(l)$$
- how many liters of O<sub>2</sub>, measured at 18°C and 1.10 atm, must be used to produce 50 L of NO at the same condition?
21. How many liters of oxygen, measured at STP, are required for the complete combustion of 72.0 g of hexane (C<sub>6</sub>H<sub>14</sub>), a component of gasoline?
22. In an effusion experiment it required 45 s for a certain number of moles of an unknown gas to pass through a small orifice into a vacuum. Under the same conditions it required 18 s for the same number of moles of O<sub>2</sub> to effuse. Find the molar mass of the unknown gas.
23. What is the relative rate of effusion of neon atoms compared to the rate of effusion of O<sub>2</sub> molecules?
24. If the average molecular speed of a N<sub>2</sub> molecule is 475 m/s at 25°C, what is the average speed of a He molecule at 25°C?
25. In each of the following pairs, which gas would you expect to deviate more than the value  $PV/nRT = 1$  expected for an ideal gas?  
 a. N<sub>2</sub> or SF<sub>6</sub>      b. He or O<sub>2</sub>      c. CO<sub>2</sub> or SO<sub>2</sub>
26. Calculate the pressure of 200 mol NH<sub>3</sub> in a 10.0-L container at 500°C using  
 (a) the ideal gas law  
 (b) the van der Waals equation

### GENERAL PROBLEMS

27. A 0.356-g sample of XH<sub>2</sub>(s) reacts with water according to the following equation:
- $$\text{XH}_2(s) + 2\text{H}_2\text{O}(l) \rightarrow \text{X}(\text{OH})_2(s) + 2\text{H}_2(g)$$
- The hydrogen evolved is collected over water at 23°C and occupies a volume of 431 mL at 746 mm Hg total pressure. Find the number of moles of H<sub>2</sub> produced and the atomic weight of X ( $VP_{\text{H}_2\text{O}} = 21 \text{ mm Hg}$ ).
28. A H<sub>2</sub> gas thermometer has a volume of 100.0 cm<sup>3</sup> when immersed in an ice-water bath at 0°C. When immersed in boiling liquid Cl<sub>2</sub>, the volume of the H<sub>2</sub> at the same pressure was 87.2 cm<sup>3</sup>. Determine the temperature of the boiling point of Cl<sub>2</sub> in kelvins and degrees Celsius.
29. a. The buoyant force on a balloon is proportional to the mass of air it displaces. What mass of air is displaced by a weather balloon at an altitude where the pressure is 212 mm Hg and the temperature is -35°C? Initially the balloon contained 10 mol He.  
 b. The lift of the balloon is the difference between its mass and that of the displaced air. What is the lift of the above balloon?
30. A certain noble gas compound contains 68.8% Kr and 31.2% F. Its density at STP is 5.44 g/L. What is the molecular formula of the compound?