

## unit 4 test - Gas Laws

### Matching

Match each item with the correct statement below.

- |                  |                     |
|------------------|---------------------|
| a. Boyle's law   | d. Graham's law     |
| b. Charles's law | e. Gay-Lussac's law |
| c. Dalton's law  | f. ideal gas law    |

- \_\_\_\_\_ 1. For a given mass of gas at constant temperature, the volume of the gas varies inversely with pressure.
- \_\_\_\_\_ 2. The volume of a fixed mass of gas is directly proportional to its Kelvin temperature, if the pressure is kept constant.
- \_\_\_\_\_ 3. The pressure of a gas is directly proportional to its Kelvin temperature if the volume is kept constant.
- \_\_\_\_\_ 4.  $P \propto V = n \propto R \propto T$
- \_\_\_\_\_ 5. At constant volume and temperature, the total pressure exerted by a mixture of gases is equal to the sum of the partial pressures of the component gases.
- \_\_\_\_\_ 6. The rate at which a gas will effuse is inversely proportional to the square root of the gas's molar mass.

Match each item with the correct statement below.

- |                    |                     |
|--------------------|---------------------|
| a. effusion        | c. diffusion        |
| b. compressibility | d. partial pressure |

- \_\_\_\_\_ 7. a measure of how much the volume of matter decreases under pressure
- \_\_\_\_\_ 8. the pressure exerted by a gas in a mixture
- \_\_\_\_\_ 9. the escape of gas through a small hole in a container
- \_\_\_\_\_ 10. tendency of molecules to move to regions of lower concentration

### Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- \_\_\_\_\_ 11. Why is a gas easier to compress than a liquid or a solid?
- Its volume increases more under pressure than an equal volume of liquid does.
  - Its volume increases more under pressure than an equal volume of solid does.
  - The space between gas particles is much less than the space between liquid or solid particles.
  - The volume of a gas's particles is small compared to the overall volume of the gas.
- \_\_\_\_\_ 12. Why does the pressure inside a container of gas increase if more gas is added to the container?
- There is an increase in the number of collisions between particles and the walls of the container.
  - There is an increase in the temperature of the gas.
  - There is a decrease in the volume of the gas.
  - There is an increase in the force of the collisions between the particles and the

walls of the container.

- \_\_\_\_\_ 13. How does the gas propellant move when an aerosol can is used?
- from a region of high pressure to a region of lower pressure
  - from a region of high pressure to a region of equally high pressure
  - from a region of low pressure to a region of higher pressure
  - from a region of low pressure to a region of equally low pressure
- \_\_\_\_\_ 14. If the volume of a container of gas is reduced, what will happen to the pressure inside the container?
- The pressure will increase.
  - The pressure will not change.
  - The pressure will decrease.
  - The pressure depends on the type of gas.
- \_\_\_\_\_ 15. If a balloon is squeezed, what happens to the pressure of the gas inside the balloon?
- It increases.
  - It stays the same.
  - It decreases.
  - The pressure depends on the type of gas in the balloon.
- \_\_\_\_\_ 16. What happens to the temperature of a gas when it is compressed?
- The temperature increases.
  - The temperature does not change.
  - The temperature decreases.
  - The temperature becomes unpredictable.
- \_\_\_\_\_ 17. As the temperature of the gas in a balloon decreases, which of the following occurs?
- The volume of the balloon increases.
  - The average kinetic energy of the gas decreases.
  - The gas pressure inside the balloon increases.
  - all of the above
- \_\_\_\_\_ 18. What happens to the pressure of a gas inside a container if the temperature of the gas decreases?
- The pressure increases.
  - The pressure does not change.
  - The pressure decreases.
  - The pressure cannot be predicted.
- \_\_\_\_\_ 19. If 4 moles of gas are added to a container that already holds 1 mole of gas, how will the pressure change inside the container?
- The pressure will be five times higher.
  - The pressure will double.
  - The pressure will be four times higher.
  - The pressure will not change.
- \_\_\_\_\_ 20. Why does air escape from a tire when the tire valve is opened?
- The pressure outside the tire is lower than the pressure inside the tire.
  - The pressure outside the tire is greater than the pressure inside the tire.
  - The temperature is higher outside the tire than inside the tire.
  - There are more particles of air outside the tire than inside the tire.
- \_\_\_\_\_ 21. Which of these changes would NOT cause an increase in the pressure of a contained gas?
- The volume of the container is increased.
  - More of the gas is added to the container.
  - The temperature is increased.



- b. It stays the same. d. The change cannot be predicted.
- \_\_\_ 31. When the volume and number of particles of a gas are constant, which of the following is also constant?
- the sum of the pressure and temperature in kelvins
  - the difference of the pressure and temperature in kelvins
  - the product of the pressure and temperature in kelvins
  - the ratio of the pressure and temperature in kelvins
- \_\_\_ 32. As the temperature of a fixed volume of a gas increases, the pressure will \_\_\_\_.
- vary inversely
  - decrease
  - not change
  - increase
- \_\_\_ 33. If a sealed syringe is plunged into cold water, in which direction will the syringe piston slide?
- in
  - out
  - No movement will occur.
  - The direction cannot be predicted.
- \_\_\_ 34. What happens when a piston is used to decrease the volume of a contained gas?
- Fewer gas particles exert a force on the piston.
  - The piston's pressure on the gas becomes greater than the pressure exerted by the gas on the piston.
  - Gas particles become compressed.
  - Gas particles leak out of the container.
- \_\_\_ 35. A gas occupies a volume of 2.4 L at 14.1 kPa. What volume will the gas occupy at 84.6 kPa?
- 497 L
  - 2.5 L
  - 14 L
  - 0.40 L
- \_\_\_ 36. If a sealed syringe is heated, in which direction will the syringe plunger move?
- out
  - in
  - The plunger will not move.
  - The direction cannot be predicted.
- \_\_\_ 37. A sample of gas occupies 17 mL at  $-112^{\circ}\text{C}$ . What volume does the sample occupy at  $70^{\circ}\text{C}$ ?
- 10.6 mL
  - 27 mL
  - 36 mL
  - 8.0 mL
- \_\_\_ 38. In general, for a gas at a constant volume, \_\_\_\_.
- the pressure of the gas is inversely proportional to its temperature in kelvins
  - the volume of the gas is inversely proportional to its temperature in kelvins
  - the volume of the gas is directly proportional to its temperature in kelvins
  - the pressure of the gas is directly proportional to its temperature in kelvins
- \_\_\_ 39. The combined gas law relates which of the following?
- pressure and volume only
  - temperature and pressure only
  - volume and temperature only
  - temperature, pressure, and volume
- \_\_\_ 40. If a balloon containing 3000 L of gas at  $39^{\circ}\text{C}$  and 99 kPa rises to an altitude where the pressure is 45.5 kPa and the temperature is  $16^{\circ}\text{C}$ , the volume of the balloon under these new conditions would be calculated using the following conversion factor ratios: \_\_\_\_.
- $3000 \text{ L} \times \frac{99}{45.5} \times \frac{16}{39}$
  - $3000 \text{ L} \times \frac{312}{289} \times \frac{45.5}{99}$
  - $3000 \text{ L} \times \frac{289}{312} \times \frac{99}{45.5}$
  - $3000 \text{ L} \times \frac{39}{16} \times \frac{45.5}{99}$
- \_\_\_ 41. What does the ideal gas law allow a scientist to calculate that the other gas laws do not?

- a. number of moles  
b. pressure  
c. volume  
d. temperature
- \_\_\_ 42. At a certain temperature and pressure, 0.20 mol of carbon dioxide has a volume of 3.1 L. A 3.1-L sample of hydrogen at the same temperature and pressure \_\_\_\_.
- a. has the same mass  
b. contains the same number of atoms  
c. has a higher density  
d. contains the same number of molecules
- \_\_\_ 43. How is the ideal gas law usually written?
- a.  $\frac{PV}{nT} = R$   
b.  $\frac{PV}{T} = nR$   
c.  $PV = nRT$   
d.  $P = \frac{nRT}{V}$
- \_\_\_ 44. Which law can be used to calculate the number of moles of a contained gas?
- a. Boyle's law  
b. combined gas law  
c. ideal gas law  
d. Charles's law
- \_\_\_ 45. Which of the following is constant for 1 mole of any ideal gas?
- a.  $PVT$   
b.  $\frac{PV}{T}$   
c.  $\frac{PT}{V}$   
d.  $\frac{VT}{P}$
- \_\_\_ 46. At high pressures, how does the volume of a real gas compare with the volume of an ideal gas under the same conditions?
- a. It is much greater.  
b. It is much less.  
c. There is no difference.  
d. It depends on the type of gas.
- \_\_\_ 47. At low temperatures and pressures, how does the volume of a real gas compare with the volume of an ideal gas under the same conditions?
- a. It is greater.  
b. It is less.  
c. There is no difference.  
d. It depends on the type of gas.
- \_\_\_ 48. An ideal gas CANNOT be \_\_\_\_.
- a. condensed  
b. cooled  
c. heated  
d. compressed
- \_\_\_ 49. Under what conditions of temperature and pressure is the behavior of real gases most like that of ideal gases?
- a. low temperature and low pressure  
b. low temperature and high pressure  
c. high temperature and low pressure  
d. high temperature and high pressure
- \_\_\_ 50. If the atmospheric pressure on Mt. Everest is one-third the atmospheric pressure at sea level, the partial pressure of oxygen on Everest is \_\_\_\_.
- a. one-sixth its pressure at sea level  
b. one-third its pressure at sea level  
c. one-half its pressure at sea level  
d. equal to its pressure at sea level
- \_\_\_ 51. What happens to the partial pressure of oxygen in a sample of air if the temperature is increased?
- a. It increases.  
b. It stays the same.  
c. It decreases.  
d. The change cannot be determined.

- \_\_\_ 52. If oxygen is removed from a sample of air as iron rusts, what happens to the partial pressure of oxygen in the air?
- It increases.
  - It stays the same.
  - It decreases.
  - The change cannot be determined.
- \_\_\_ 53. If oxygen is removed from a sample of air as iron rusts, what happens to the total pressure of the air?
- It increases.
  - It stays the same.
  - It decreases.
  - The change cannot be determined.
- \_\_\_ 54. A breathing mixture used by deep-sea divers contains helium, oxygen, and carbon dioxide. What is the partial pressure of oxygen at 101.4 kPa if  $P_{\text{He}} = 82.5$  kPa and  $P_{\text{CO}_2} = 0.4$  kPa?
- 82.9 kPa
  - 19.3 kPa
  - 18.5 kPa
  - 101.0 kPa
- \_\_\_ 55. When a container is filled with 3.00 moles of  $\text{H}_2$ , 2.00 moles of  $\text{O}_2$ , and 1.00 mole of  $\text{N}_2$ , the pressure in the container is 768 kPa. What is the partial pressure of  $\text{O}_2$ ?
- 256 kPa
  - 128 kPa
  - 128 kPa
  - 192 kPa
- \_\_\_ 56. A box with a volume of 22.4 L contains 1.0 mol of nitrogen and 2.0 mol of hydrogen at  $0^\circ\text{C}$ . Which of the following statements is true?
- The total pressure in the box is 101 kPa.
  - The partial pressures of  $\text{N}_2$  and  $\text{H}_2$  are equal.
  - The total pressure is 202 kPa
  - The partial pressure of  $\text{N}_2$  is 101 kPa.
- \_\_\_ 57. If the volume of a container of air is reduced by one-half, what happens to the partial pressure of oxygen within the container?
- It is reduced by one-half.
  - It does not change.
  - It is doubled.
  - It is reduced by one-fourth.
- \_\_\_ 58. The tendency of molecules to move toward areas of lower concentration is called \_\_\_\_.
- suffusion
  - suspension
  - effusion
  - diffusion
- \_\_\_ 59. Which of the following gases will effuse the most rapidly?
- bromine
  - chlorine
  - ammonia
  - hydrogen
- \_\_\_ 60. Which of the following atoms would have the greatest velocity if each atom had the same kinetic energy?
- bromine
  - chlorine
  - ammonia
  - hydrogen
- \_\_\_ 61. Which of the following gases is the best choice for inflating a balloon that must remain inflated for a long period of time?
- argon
  - oxygen
  - hydrogen
  - neon

### Short Answer

62. The volume of a gas is 250 mL at 340.0 kPa pressure. What will the volume be when the pressure is reduced to 50.0 kPa, assuming the temperature remains constant?
63. A balloon filled with helium has a volume of 30.0 L at a pressure of 100 kPa and a temperature of 15.0°C. What will the volume of the balloon be if the temperature is increased to 80.0°C and the pressure remains constant?
64. A gas has a volume of 590 mL at a temperature of -55.0°C. What volume will the gas occupy at 30.0°C?
65. A rigid container of O<sub>2</sub> has a pressure of 340 kPa at a temperature of 713 K. What is the pressure at 273 K?
66. A 10-g mass of krypton occupies 15.0 L at a pressure of 210 kPa. Find the volume of the krypton when the pressure is increased to 790 kPa.
67. A gas has a pressure of 710 kPa at 227°C. What will its pressure be at 27°C, if the volume does not change?
68. A gas occupies a volume of 140 mL at 35.0°C and 97 kPa. What is the volume of the gas at STP?
69. A gas storage tank has a volume of  $3.5 \times 10^5 \text{ m}^3$  when the temperature is 27°C and the pressure is 101 kPa. What is the new volume of the tank if the temperature drops to -10°C and the pressure drops to 95 kPa?
70. How many moles of N<sub>2</sub> are in a flask with a volume of 250 mL at a pressure of 300.0 kPa and a temperature of 300.0 K?
71. The gaseous product of a reaction is collected in a 25.0-L container at 27°C. The pressure in the container is 300.0 kPa and the gas has a mass of 96.0 g. How many moles of the gas are in the container?
72. What is the pressure exerted by 32 g of O<sub>2</sub> in a 22.0-L container at 30.0°C?
73. A mixture of gases at a total pressure of 95 kPa contains N<sub>2</sub>, CO<sub>2</sub>, and O<sub>2</sub>. The partial pressure of the CO<sub>2</sub> is 24 kPa and the partial pressure of the N<sub>2</sub> is 48 kPa. What is the partial pressure of the O<sub>2</sub>?
74. Use Graham's law to calculate how much faster fluorine gas, F<sub>2</sub>, will effuse than chlorine gas, Cl<sub>2</sub>, will. The molar mass of F<sub>2</sub> = 38.0; the molar mass of Cl<sub>2</sub> = 70.9.

## Essay

75. How does the air pressure in a balloon change when the balloon is squeezed? Explain why this change occurs.
76. How does the pressure of an enclosed gas in a rigid container change when the gas is heated? Explain why this change occurs.
77. Explain how pumping air into a bicycle tire increases the pressure within the tire.

78. What are some of the differences between a real gas and an ideal gas?
79. What is Dalton's law of partial pressures? Explain how this law relates to the fact that mountain climbers must carry tanks of oxygen when scaling high peaks.
80. Explain why the rates of diffusion and effusion, for any particular gas at constant temperature, are proportional to the square root of the molar mass of the gas.

L3

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