1. Under which conditions of temperature and pressure would helium behave most like an ideal gas?
   (1) 50K and 20 kPa  (2) 50K and 600 kPa
   (3) 750 K and 20 kPa  (4) 750 K and 600 kPa

2. The concept of an ideal gas is used to explain
   (1) the mass of a gas sample  (2) the behavior of a gas sample
   (3) why some gases are monatomic  (4) why some gases are diatomic

3. Which 5.0-milliliter sample of NH₃ will take the shape of and completely fill a closed 100.0-milliliter container?
   (1) NH₃(s)  (2) NH₃(l)
   (3) NH₃(g)  (4) NH₃(aq)

4. An assumption of the kinetic theory of gases is that the particles of a gas have
   (1) little attraction for each other and a significant volume
   (2) little attraction for each other and an insignificant volume
   (3) strong attraction for each other and a significant volume
   (4) strong attraction for each other and an insignificant volume

5. A real gas behaves more like an ideal gas when the gas molecules are
   (1) close and have strong attractive forces between them
   (2) close and have weak attractive forces between them
   (3) far apart and have strong attractive forces between them
   (4) far apart and have weak attractive forces between them

6. Which gas is least likely to obey the ideal gas laws at very high pressures and very low temperatures?
   (1) He  (2) Ne
   (3) Kr  (4) Xe

7. One reason that a real gas deviates from an ideal gas is that the molecules of the real gas have
   (1) a straight-line motion
   (2) no net loss of energy on collision
   (3) a negligible volume
   (4) forces of attraction for each other

8. At the same temperature and pressure, 1.0 liter of CO(g) and 1.0 liter of CO₂(g) have
   (1) equal masses and the same number of molecules
   (2) different masses and a different number of molecules
   (3) equal volumes and the same number of molecules
   (4) different volumes and a different number of molecules

9. The diagrams below represent four 500-milliliter flasks. Each flask contains the gas represented by its symbol. All gas samples are at STP.

   ![Diagrams of Gas Flasks]

   Each flask contains the same number of
   (1) atoms, only  (2) molecules, only
   (3) atoms and molecules

10. As the temperature of a gas increases at constant pressure, the volume of the gas
    (1) decreases    (2) increases
    (3) remains the same

11. A cylinder with a tightly fitted piston is shown in the diagram below.

   ![Diagram of Cylinder with Piston]

   As the piston moves downward, the number of molecules of air in the cylinder
   (1) decreases    (2) increases
   (3) remains the same

12. A gas occupies a volume of 500. milliliters at a pressure of 38.0 kPa and a temperature of 298 K. At what temperature will the gas occupy a volume of 250. milliliters and have a pressure of 76.0 kPa?
    (1) 149 K  (2) 298 K
    (3) 447 K  (4) 596 K

13. The volume of a gas is 4.00 liters at 293 K and constant pressure. For the volume of the gas to become 3.00 liters, the Kelvin temperature must be equal to
    (1) \( \frac{3.00 \times 293}{4.00} \)
    (2) \( \frac{4.00 \times 293}{3.00} \)
    (3) \( \frac{3.00 \times 4.00}{293} \)
    (4) \( \frac{293}{3.00 \times 4.00} \)
14. Which graph best represents the pressure-volume relationship for an ideal gas at constant temperature?

(1) \[ \text{ } \]
(2) \[ \text{ } \]
(3) \[ \text{ } \]
(4) \[ \text{ } \]

15. The graph below represents the relationship between pressure and volume of a given mass of a gas at constant temperature.

The product of pressure and volume is constant. According to the graph, what is the product in atm\text{mm}\text{L}?

(1) 20.
(2) 40.
(3) 60.
(4) 80.

16. If the Kelvin temperature of a gas sample is doubled while the pressure is halved, the volume of the gas will

(1) remain the same
(2) increase 2 times
(3) decrease by half
(4) increase 4 times

17. Under which conditions will the volume of a given sample of a gas decrease?

(1) decreased pressure and decreased temperature
(2) decreased pressure and increased temperature
(3) increased pressure and decreased temperature
(4) increased pressure and increased temperature
18. Base your answers to the question below on your knowledge of chemistry and the graph below:

The graph shows the relationship between volume and absolute temperature for an ideal gas and two real gases, helium and oxygen.

![Graph showing relationship between volume (L) and temperature (K) for ideal gas, helium, and oxygen.]

**KEY**
- Ideal Gas
- Helium
- Oxygen

**a** Describe the relationship for the ideal gas shown in this graph.

**b** According to the graph above, what experimental condition is necessary for real gases to behave like an ideal gas?

**c** At 90 K what happens to oxygen?

**d** Why does helium behave more like an ideal gas than does oxygen?
   a) A direct relationship between the volume of a gas and its absolute temperature.  
   b) High temperatures.  
   c) It changes to a liquid at its boiling point.  
   d) The intermolecular forces between helium molecules is less than those between oxygen molecules.

19. Four identical balloons contain equal volumes of gas at STP:

- Balloon #1 contains H₂ gas
- Balloon #2 contains He gas
- Balloon #3 contains O₂ gas
- Balloon #4 contains N₂ gas

**a** Which balloon, if any, would weigh the most? Explain.

**b** According to the Kinetic Molecular Theory, why would the balloons expand if they were heated?

Base your answers to questions 20 through 23 on the information below.

A weather balloon has a volume of 52.5 liters at a temperature of 295 K. The balloon is released and rises to an altitude where the temperature is 252 K.

20. How does this temperature change affect the gas particle motion?

21. The original pressure at 295 K was 100.8 kPa and the pressure at the higher altitude at 252 K is 45.6 kPa. Assume the balloon does not burst. Show a correct numerical setup for calculating the volume of the balloon at the higher altitude.

22. What Celsius temperature is equal to 252 K?

23. What pressure, in atmospheres (atm), is equal to 45.6 kPa?
24. Base your answer to the following question on the information below.

When cola, a type of soda pop, is manufactured, CO₂(g) is dissolved in it.

A capped bottle of cola contains CO₂(g) under high pressure. When the cap is removed, how does pressure affect the solubility of the dissolved CO₂(g)?

25. Base your answer to the following question on the information and diagrams below.

Cylinder A contains 22.0 grams of CO₂(g) and cylinder B contains N₂(g). The volumes, pressures, and temperatures of the two gases are indicated under each cylinder.

<table>
<thead>
<tr>
<th>Cylinder A</th>
<th>Cylinder B</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂(g)</td>
<td>N₂(g)</td>
</tr>
<tr>
<td>V = 12.3 L</td>
<td>V = 12.3 L</td>
</tr>
<tr>
<td>P = 1.0 atm</td>
<td>P = 1.0 atm</td>
</tr>
<tr>
<td>T = 300. K</td>
<td>T = 300. K</td>
</tr>
</tbody>
</table>

The temperature of the CO₂(g) is increased to 450. K and the volume of cylinder A remains constant. Show a correct numerical setup for calculating the new pressure of the CO₂ (g) in cylinder A.