Modeling a Gas

1. There are certain assumptions we need to make when we model a gas. Describe the impact of the following assumptions for modeling a gas:
   a. The molecules are perfectly elastic

   b. The molecules are spheres

   c. The molecules are identical

   d. There are no intermolecular forces except at collisions

   e. The molecules are very small compared to the volume of the container

2. The absolute temperature of a gas is directly related to the average kinetic energy of the molecules, $KE_{mean} = \frac{3}{2}nRT$ where n is the number of number of moles and R is the molar gas constant (8.314 J mol^{-1} K^{-1}). By what fraction does the kinetic energy change when the temperature of a sample of gas increases from 10 ºC to 20 ºC?

3. Suppose that there are two different ideal gas samples at the same temperature. Each sample has the same number of molecules, but one sample is made of molecules with twice the mass of the molecules of the other. How do the average speeds of the molecules compare?

4. Pressure is the amount of force for each unit of surface area. Explain how a gas can exert pressure on the walls of a container. What factors would influence the amount of pressure in an arrangement?

5. There are various gas laws that relate temperature, pressure, and volume. They can be combined into a single Ideal Gas Law $PV = nRT$. Write the relationships for a single sample (n stays constant) where one quantity is held constant. Explain a situation where this could happen and include what you would observe.
   a. Relate P and V if T is held constant.

   b. Relate V and T if P is held constant.

   c. Relate T and P if V is held constant.

6. Give two examples of how the relationship between pressure, volume, and temperature are used in your daily life.

7. If there are 5.0 moles of an ideal gas within a volume of 0.25 m^3 at 25 ^oC, what is the pressure of the gas?

8. If an ideal gas at 10 kPa is in a 0.3 m^3 container at 5 ^oC, how many moles of gas are there?

9. The pressure in a flexible container is able to regulated by a valve. When the pressure is set to 1 kPa, the volume is 0.5 m^3. If the pressure is increased to 5 kPa, calculate the new volume assuming temperature remains constant.

10. Assume when inflating a balloon, the temperature and pressure remain constant. There are 5 moles of gas when the balloon is fully inflated. How many moles of gas are there to inflate the balloon to half its volume?

11. A pop can has a fixed volume of 3.5×10^{-4} m^3. At 25^oC, the pressure in the can is 250 kPa. If the can bursts at 500 kPa. At what temperature would this occur?