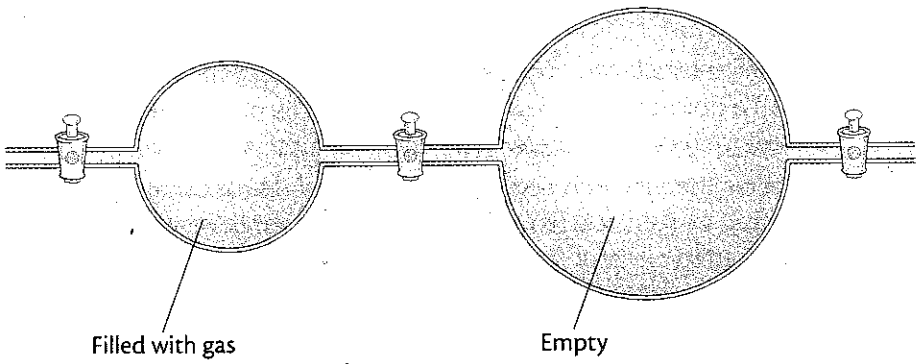
Activity - Comparing Pressure, Temperature and Volume

Part 1: Pressure - Volume Relationships

1) Explain each statement:
a) Even if they have an ample supply of oxygen gas, airplane passengers experience discomfort if the cabin undergoes a drop in air pressure.
b) Carbonated soft drink cans "pop" when the container is opened.
c) Tennis balls are sold in pressurized containers.
d) When you climb a mountain or ride an elevator to the top of a tall building, your ears may "pop".

2) You can but helium gas in small pressurized cans to inflate party balloons. Assume the container label indicates that the can delivers 7100 mL of helium at 100 kPa pressure. The volume of the can is 492 mL.
a) Do you expect the pressure inside the can to be greater or less than 100 kPa? Explain.
b) Calculate the gas pressure inside the can.



3) Two gas bulbs are separated by a valve as shown in the figure above. The 0.50 L bulb on the left contains a gas sample at a pressure of 6.0 atm. The 1.7 L bulb on the right is evacuated - it does not contain any gas.
a) What will happen to the total volume of the gas sample when the middle valve is opened?
b) What will happen to the total pressure of the gas sample when the middle valve is opened?
c) Calculate the pressure of the gas sample after the valve is opened.
d) Draw a molecular model of the gas molecules before and after the valve is opened.

Part 2: Temperature - Volume Relationships

4) What would happen to the volume of a balloon originally at 20 ^{o}C if you took it outside to a temperature of -20 ^{o}C?

5) In planning to administer an anesthetic gas to a patient, why must an anesthesiologist take into account the fact that during the surgery the gas is used both at room temperature (18 ^{o}C) and at the patient's body temperature (37 ^{o}C)?

6) An air bubble trapped in bread dough at room temperature (291 K) has a volume of 1.0 mL. The bread bakes at 415 K.
a) Do you expect the volume of the gas in the oven to be larger or smaller than 1.0 mL? Explain.
b) Calculate the volume of the air bubble.

7) You buy a 3 L balloon in a mall and put it in a car. The temperature in the mall is 22 ^{o}C and the temperature in the car is -5 ^{o}C.
a) What will you observe as the balloon sits in the car?
b) What would be the new volume of the balloon?
c) What will happen to the balloon if you return to the mall?
d) Sketch an illustration that depicts the helium atoms when the balloon was in the mall and when the balloon was in the car.

Part 3: Pressure, Volume and Temperature Relationships

8) If the Kelvin temperature of a gas sample in a steel tank increases to three times its original value, what will happen to the pressure of the gas?

9) If a sample of gas is cooled at a constant pressure until it shrinks to 1/4 of its initial volume, what change in Kelvin temperature has occurred?

10) Explain why car owners in severe northern climates often add air to their tires in winter and release some air from the tires is summer.

11a) When the volume of a gas sample is measured, its pressure and temperature must also be specified. Why?
b) This practice is normally not necessary for liquids and solids. Why?

12) Use kinetic model theory and gas laws to explain why a weather balloon steadily expands as it rises.

13) Why does the warning label on an aerosol can indicate not to dispose of the can in a fire?

14) Experts recommend measuring automobile tire pressure when the tires are cold. Why is this better than measuring the tire pressure after driving for several hours?