Back

MTV no PTV

Recommended grades level(s) 11-12

Time Duration: - 50 minutes

Objective(s):
The student will know the variables used in the universal gas law with appropriate units.
The student will qualitatively understand how the variables related in Boyle's, Charles, and the Universal Gas Laws.

Materials and/or Resources:
Balloon
Paper bags
Pop can
Hot plate
Copper or plastic pipe
Wood dowel
Tape

Background Information:
This is a high interest introduction to the gas laws. Stressing the interdependent of the three variables; pressure, temperature, and volume.

Procedures:

1. At the beginning of the class, ask the students what are the call letters for their favorite TV station. Hopefully they will say --> MTV <-- . With this, lead them into a discussion of the PRESSURES from their parents to watch less MTV. How many parents get hot under the collar, a raise in body TEMPERATURE that could be measured. At what VOLUME of the TV sound do their parents start telling them "turn down the sound, I can't hear myself think". As you are leading this discussion write down the following words on the black board. PRESSURE, TEMPERATURE, VOLUME

2. Handout a balloon to each student. Have them blow it up and hold the balloon. Now ask the students what affects, conditions or quantities are involved in keeping the balloon as it is. They should note the words that are on the board. As they mention each of the above variables get the students to state a symbol to use for each and get a metric unit for each. To get the units for pressure the students might have to go out to the parking lot and read the metric units off of a car tire.

3. Hand out a tag board card (10 cm x 25 cm) and markers. Have each student place the letters P T V in large letters on the card. Then put a pencil hole through the center of each letter.

4. Show each of the following demo's and have students predict how each variable will change. They will use the card and always place a pencil in the variable that is constant. If the pressure of a gas is constant then the pencil will be placed in the card through the hole in the P. Now if the temperature of the gas goes up the card is pivoted on the pencil so that the temperature goes up. One then sees that the volume of the gas goes up.

    a. Potato Gun (Boyle's Law) ------- T cnst, V up, P down

    b. A potato gun is made from a copper or plastic pipe 9/16-inch inner diameter and 36 to 40 inches long that have had one end flared. For the copper pipe uses a metal flaring tool, for the plastic pipe file the inside of one end with a rat-tail file. A ramrod is made from a 1/2 inch wood dowel that is about 6 inches longer that the pipe. Tape the dowel thickly about 4 inches from the end. The tape acts as a hand guard.

    c. To use the gun push the flared end of the pipe through a potato. Now take the push rod and push the potato plug to the other end of the pipe. Push the flared end of the pipe back into the potato so that you have two plugs one on each end of the pipe. Using the ramrod push the second plug towards the first plug.

    d. The first plug will shoot out the end. (DO NOT AIM AT A STUDENT) Ask the students which variable is held constant. -- temperature -- Have students place the pencil in the temperature hole. Now ask which of the other two variables you are changing. -- volume of the gas -- The students will then take the card and move the volume down showing that the volume is decreasing. The pressure of the gas is then going up!

5. Collapsing Pop Can ---------- V cnst, T down, P down
    a. Place a pop can one a hot plate with a small amount of water in the can. When there is steam coming out of the can using gloves invert the can into a pan of cool water. The can will collapse.
    b. Ask the students which variable is held constant. -- volume --- Have students place the pencil in the volume hole. Now ask which of the other two variables you are changing. -- temperature of the gas -- The students will then take the card and move the temperature down showing that the pressure of the gas inside of the can is decreasing.
6. Inverted Paper Bag Balance (Charles' Law) ---------P cnst, T up, V up
    a. A balance is made where the balance pans are inverted paper bags. A lit candle is placed below one of the bags. Ask students which variable is held constant. -- pressure -- Have students place the pencil in the pressure hole. Now ask which of the other two variables you are changing. -- temperature of the gas -- The students will then use the card to find that the volume of the heated gas is increasing.

7. There are many gas demos' that use can use the more that you can have students do the better. Some are - exploding soap bubble, Cartesian diver, hand boiler, determination of absolute zero, and open-end thermometer.

Reproducible Materials:
Homework: Have students find two examples of changing gases and using the PTV card find the variable that is constant and determine the variables that will change.

Development Resources:
http://askeric.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Chemistry/CHM0030.html

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