Combining Charles and Boyle Name_____

We have used Boyle's law to see how the volume of a gas can change with changing pressures. And we have used Charles' Law to see how the volume of a gas changes with changing temperature. In many lab circumstances both temperature and pressure change. This sheet will help you to see how to combine these steps into one calculation.

Given the following problem, solve it in two steps using Boyle's and Charles' Law separately. You blow a methane bubble with a volume of 200.0mL at a pressure of 1.00 atm and a temperature of 20.0°C. Because methane is lighter than air, the bubble floats upward until it reaches and an altitude where the pressure is 0.600 atm and a temperature of -10.0°C.

1) First solve Bolye's Law for V_2 (rearrange Boyle's Law so that V_2 is by itself) . Then find the change in volume of the bubble due to the just the pressure change.

2) The bubble should have grown larger under the lower pressure conditions. However, this larger bubble is now cooled. Using the new larger volume calculated in question #1 as your starting volume, solve Charles' Law for V_2 and then calculate the actual volume of the bubble after the new larger bubble is cooled to the new colder temperature. (Assume for the initial circumstances that the bubble begins at the volume of the volume calculated above, but has not yet cooled giving it the original temperature that it started with.)

3) Notice that the V_2 from question #1 becomes the V_1 for question #2. Can you figure out a way to combine these calculations into one equation? What is the combined gas law equation?

Combined Gas Laws - Charles and Boyle Together

1. A balloon is filled with helium to a volume of 4.0 liters when the pressure is 1.0 atm. and the temperature is 27.0°C. It escapes and rises until the pressure is .25 atm. and the temperature is -23.0°C. What is the new volume?

2. When a bubble escapes form a sunken ship, it has a volume of 12.0cm^3 at a pressure of 400.0 atm. and a temp.. of -3.00°C. It reaches the surface where the pressure is 1.10 atm. and the temperature is 27.0°C. What is its new volume?

3. A CO_2 bubble in some bread dough had an original volume of 0.30ml. when it formed at 27.0°C and 750 mmmHg of pressure. While baking, its temperature rose to 177.0°C and a thunderstorm moved dropping the pressure to 725 mmHg. What is the new volume of the bubble?

4. If a hot air balloon holds 3000 liters (3.00×10^3 L) of air at 17.0°C and standard pressure, how much air will escape as the balloon is heated to 67.0°C and rises to where the pressure is 13.5 lbs/in^2 ?

5. A SCUBA diver's tank holds 200.0 liters of air at 27.0°C and 150.0 atm. How many 1.50 liter breaths can the diver take where the pressure is 4.00 atm and the temperature is 7.00 °C?

6. You drive to school in a hurricane where the pressure is abnormally low - 720.0 mmHg. However when you get out of your car you notice that the volume of your tires seems normal - 5.00L. During the day a high pressure, bright sunshine system moves overhead changing the pressure to 780.0 mmHg. When you come back outside you notice your tires seem a little flat. What is the new volume of your tires?

7. During the day at 25.0°C a cylinder with a sliding top contains 20.0 liters of air. At night it only holds 18.0 liters of air. None of the air leaked out. What is the temperature at night? Give the answer in Kelvins and in °C. (Assume pressure doesn't change significantly over the entire day.)

Answers: 1) 13 L	2) 4850 cm^3	3) 0.47 ml	4) 827 L
5) 467 breaths	6) 4.62 L	7) 268 K or -5.00°C	