

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Charles' Law Worksheet

- 1) The temperature inside my refrigerator is about 4° Celsius. If I place a balloon in my fridge that initially has a temperature of 22° C and a volume of 0.5 liters, what will be the volume of the balloon when it is fully cooled by my refrigerator?

$$T_1 = 4^{\circ} = 277\text{K} \quad T_2 = 22^{\circ} = 295\text{K} \quad V_1 = 0.5\text{L} \quad V_2 = ?$$

$$V_1 = \underline{0.471\text{L}}$$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{0.5\text{L} \times 277\text{K}}{295\text{K}} = \underline{0.471\text{L}}$$

- 2) A man heats a balloon in the oven. If the balloon initially has a volume of 0.4 liters and a temperature of 20° C, what will the volume of the balloon be after he heats it to a temperature of 250° C?

$$V_1 = 0.4\text{L} \quad V_2 = ?$$

$$T_1 = 20^{\circ} = 293\text{K} \quad T_2 = 250^{\circ} = 523\text{K}$$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{0.4\text{L} \times 523\text{K}}{293\text{K}} = \underline{0.71\text{L}}$$

- 3) On hot days, you may have noticed that potato chip bags seem to "inflate", even though they have not been opened. If I have a 250 mL bag at a temperature of 19° C, and I leave it in my car which has a temperature of 60° C, what will the new volume of the bag be?

$$V_1 = 0.25\text{L} \quad V_2 = ?$$

$$T_1 = 19^{\circ} = 292\text{K} \quad T_2 = 60^{\circ} = 333\text{K}$$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{0.25\text{L} \times 333\text{K}}{292\text{K}} = \underline{0.285\text{L}}$$

- 4) A soda bottle is flexible enough that the volume of the bottle can change even without opening it. If you have an empty soda bottle (volume of 2 L) at room temperature (25° C), what will the new volume be if you put it in your freezer (-4° C)?

$$V_1 = 2\text{L} \quad V_2 = ?$$

$$T_1 = 25^{\circ} = 298\text{K} \quad T_2 = -4^{\circ} = 269\text{K}$$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{2\text{L} \times 269\text{K}}{298\text{K}} = \underline{1.81\text{L}}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

- 5) Some students believe that teachers are full of hot air. If I inhale 2.2 liters of gas at a temperature of 18°C and it heats to a temperature of 38°C in my lungs, what is the new volume of the gas?

$$V_1 = 2.2 \text{ L}$$

$$V_2$$

$$V_2 = \frac{V_1 T_2}{T_1}$$

$$T_1 = 18^\circ\text{C} = 291 \text{ K}$$

$$T_2 = 38^\circ\text{C} = 311 \text{ K}$$

$$= \frac{2.2 \text{ L} \times 311 \text{ K}}{291 \text{ K}} = \underline{\underline{2.35 \text{ L}}}$$

- 6) How hot will a 2.3 L balloon have to get to expand to a volume of 400 L? Assume that the initial temperature of the balloon is 25°C.

$$V_1 = 2.3 \text{ L}$$

$$V_2 = 400 \text{ L}$$

$$T_2 = \frac{V_2 T_1}{V_1}$$

$$T_2 = 25^\circ\text{C} = 298 \text{ K}$$

$$\frac{400 \text{ L} \times 298 \text{ K}}{2.3 \text{ L}} = 51826 \text{ K}$$

- 7) I have made a thermometer which measures temperature by the compressing and expanding of gas in a piston. I have measured that at 100°C the volume of the piston is 20 L. What is the temperature outside if the piston has a volume of 15 L? What would be appropriate clothing for the weather?

$$V_1 = 20 \text{ L}$$

$$V_2 = 15 \text{ L}$$

$$T_1 = 100^\circ\text{C} = 373 \text{ K} \quad T_2 = ?$$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{15 \text{ L} \times 373 \text{ K}}{20 \text{ L}} = 279.75$$

$$- 273 \text{ K}$$

$$\underline{\underline{6.75^\circ\text{C}}}$$

Jacket, sweater