Topic 3: Charles Law

Talk about breathing and why breathing is difficult at high elevations

Animation

http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/gaslaw/charles_law.html

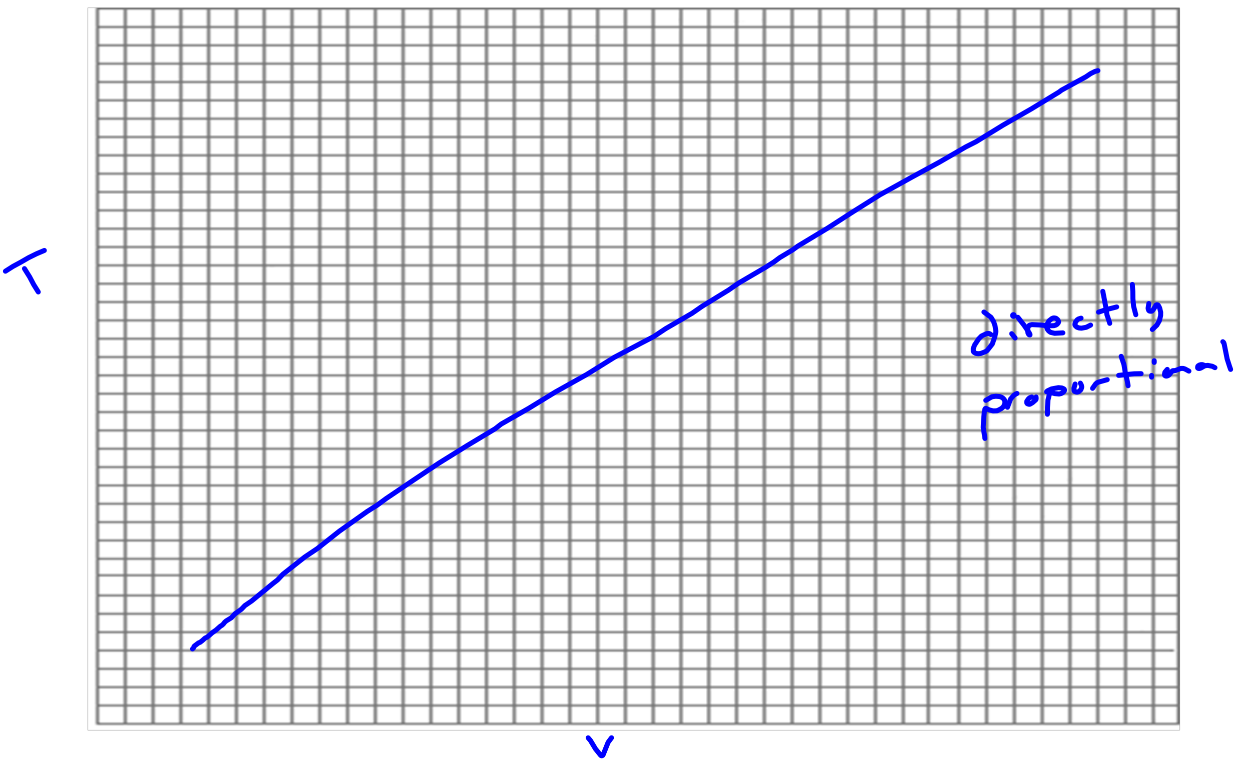
From watching the animation, fill in the blanks below

When the temperature of a gas ____decreases____, the volume of the gas will decrease.

When the temperature of a gas ____increases____, the volume of the gas will increase.

Charles Law states:

- As the temperature of a gas increases, the volume of the gas will increase proportionately when pressure and the amount of gas is kept constant



Charles Law Formula

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

V_1 = initial volume of gas
T_1 = initial temp of gas
V_2 = final volume of gas
T_2 = final temp of gas

in kelvins (k)

Example:
A gas cylinder with a moveable piston is heated to 315°C. The initial temp. was 25.0°C and the initial volume was 0.30L. What will be the final volume of the cylinder?

V_1 = 0.30 L
T_1 = 25°C = 298.0 k
V_2 = ??
T_2 = 315°C = 588 k

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{0.30L}{298k} = \frac{V_2}{588k}$

V_2 = 0.5919... L
= 0.59L

Example:
During a temperature increase from -120.00°C to 250.00°C, a volume of 2300 L is created. What was the original volume?

V_1 = ??
T_1 = -120.00°C = 153k
V_2 = 2300L
T_2 = 250.00°C = 523k

$\frac{V_1}{153k} = \frac{2300L}{523k}$

V_1 = 672.84... L
= 672.8 L

600.0 mL of air is at 20.0 °C. What is the volume at 60.0 °C?

$V_1 = 600.0\text{ mL}$
$T_1 = 20°C = 293K$
$T_2 = 60.0°C = 333K$
$V_2 = ??$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{600.0\text{ mL}}{293K} = \frac{V_2}{333K}$

$V_2 = 681.911... \text{ mL}$

$= 682 \text{ mL}$

A gas occupies 900.0 mL at a temperature of 27.0 °C. What is the volume at 132.0 °C?

300 405

At 210.0 °C a gas has a volume of 8.00 L. What is the volume of this gas at -23.0 °C?

$T_1 = 210.0°C = 483K$
$V_1 = 8.00L$
$V_2 =$
$T_2 = -23.0°C = 250K$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{8.00L}{483K} = \frac{V_2}{250K}$

$V_2 = 4.1404... L$

$= 4.14L$

When 50.0 L of oxygen at 20.0 °C is compressed to 5.00 L, what is the new temperature?

A container expands from 125 L to 300 L when a temperature of 135.00°C is attained. What was its original temperature?

$V_1 = 125L$
$V_2 = 300L$
$T_1 = ??$
$T_2 = 135.00°C = 408K$

$\frac{125L}{T_1} = \frac{300L}{408K}$

$T_1 = 170K$

Using a pressure of 2.20 atm, a gas expands *an extra* 345 L from its original 100 L. If the original temperature was standard calculate the final temperature.

$V_1 = 100L$
$T_1 = 273K$
$V_2 = 445L$
$T_2 =$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{100L}{273K} = \frac{445L}{x}$

$T_2 = 1214.85K$

$= 1.21 \times 10^3 K$

The temperature of a 4.00 L sample of gas is changed from 10.0 °C to 20.0 °C. What will the volume of this gas be at the new temperature if the pressure is held constant?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{4.00L}{283K} = \frac{V_2}{293K}$

$V_2 = 4.14L$