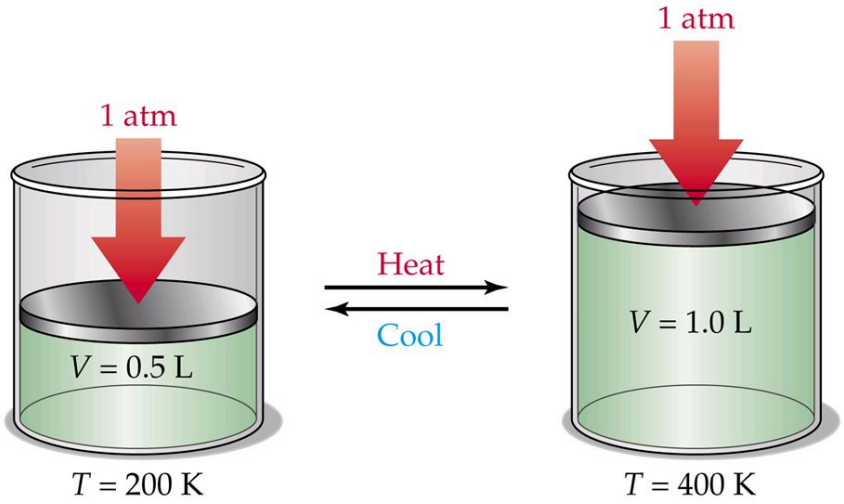
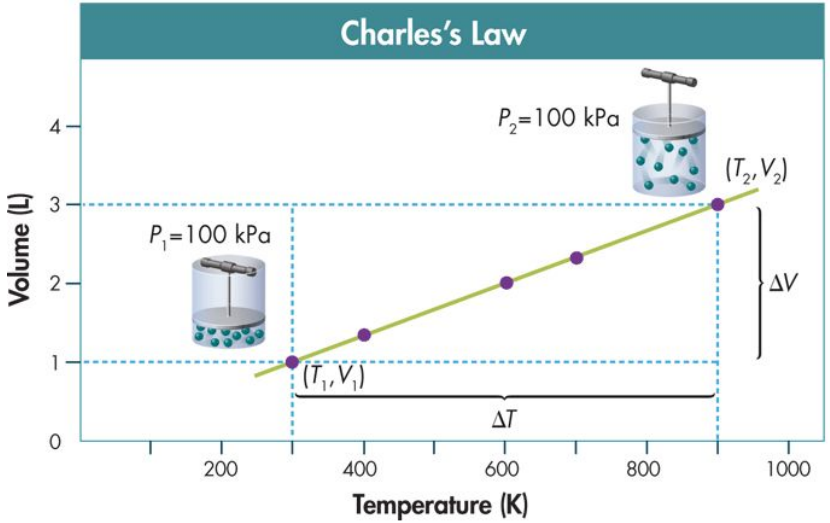
Charles' Law

★ -States that volume occupied by a fixed amount of gas is directly proportional to its temperature, if the pressure remains constant.

★ -In other words, **[Kelvin] temperature and volume have a direct relationship**

★ –This means **as one variable increases, the other also increases**





Charles's Law Equation

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

TEMPERATURE MUST BE KELVIN!

-Why?

Example Problem 1

A balloon inflated in a room at 297 K has a volume of 4.00 L. The balloon is then heated to a temperature of 331 K. What is the new volume if the pressure remains constant?

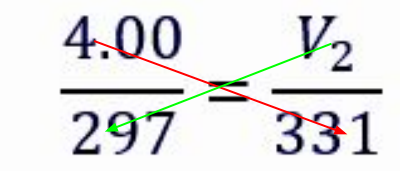
$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Example Problem 1

A balloon inflated in a room at 297 K has a volume of 4.00 L. The balloon is then heated to a temperature of 331 K. What is the new volume if the pressure remains constant?

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

$V_1 = 4.00$ L
$T_1 = 297$ K
$V_2 = ?$
$T_2 = 331$ K



(CROSS MULTIPLY)

$(4.00\text{ L})(331\text{ K}) = (V_2)(297\text{ K})$

$4.46\text{ L} = V_2$

Example Problem 2

200 mL of air at -20°C is heated to 40°C. What is the new volume?

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

K = C + 273.15

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200 mL of air at -20°C is heated to 40°C. What is the new volume?

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

V_1 = 200 ml
T_1 = -20°C
V_2 = ?
T_2 = 40°C

V_1 = 200 ml
T_1 = 253.15 K
V_2 = ?
T_2 = 313.15 K

You must convert all temperatures to Kelvin, before plugging into the equation.

Example Problem 2

200 mL of air at -20°C is heated to 40°C. What is the new volume?

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

V_1 = 200 ml
T_1 = 253.15 K
V_2 = ?
T_2 = 313.15 K

$$\frac{200}{253.15} = \frac{V_2}{313.15}$$ (CROSS MULTIPLY)

$(200)(313.15) = (V_2)(253.15)$

247 mL = V_2

Example Problem 3

What is the temperature of a 2.3 L balloon if it shrinks to a volume of 0.632 L when it is dipped into liquid nitrogen at a temperature of 77 K?

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

Example Problem 3

What is the temperature of a 2.3 L balloon if it shrinks to a volume of 0.632 L when it is dipped into liquid nitrogen at a temperature of 77 K?

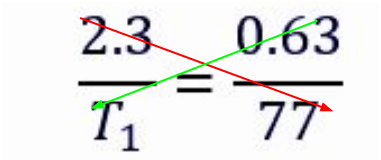
$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

V_1 = 2.3 L

T_1 =

V_2 = 0.632 L

T_2 = 77 K



(CROSS MULTIPLY)

$(2.3)(77) = (0.63)(T_1)$

T_1 = 280 K