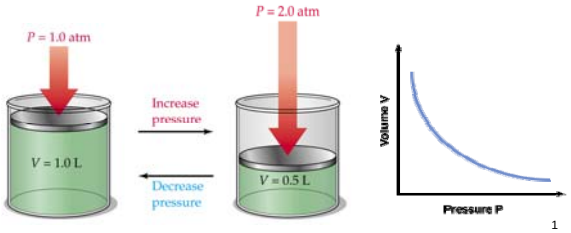
10-3 Boyle's Law

Boyle's Law - Volume varies inversely with pressure

PV = k

V ↓ P ↑ and V ↑ P ↓



1

10-3 Boyle's Law

Boyle's Law

$$\frac{P_1}{V_2} = \frac{P_2}{V_1}$$

or

$$P_1V_1 = P_2V_2$$

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10-3 Boyle's Law

A sample oxygen gas has a volume of 150 mL and pressure of 0.947 atm. What will the volume be at a pressure of 0.987 atm?

Solve for the variable (V_2)

$$P_1V_1 = P_2V_2 \rightarrow \frac{P_1V_1}{P_2} = V_2$$

$$\frac{P_1V_1}{P_2} = \frac{(0.947\ \text{atm})(150\ \text{mL})}{0.987\ \text{atm}} = 144\ \text{mL O}_2$$

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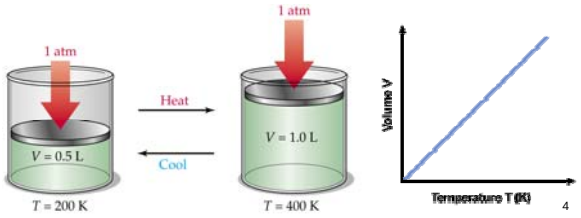
10-3 Charles's Law

Charles's Law - Volume varies directly with absolute temperature (Kelvin)

V = kT

T ↑ V ↑ and T ↓ V ↓



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10-3 Charles's Law

Charles's Law

$$\frac{V_1}{V_2} = \frac{T_1}{T_2} \quad \text{or} \quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Temperature must be in Kelvin!!!

Kelvin Scale – starts at -273.15°C with a value of 0 K.
This is the lowest possible temperature and is called **Absolute Zero**.

To convert °C to K

K = °C + 273.15

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10-3 Charles's Law

A sample of neon gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at 50°C?

Convert Temperatures to Kelvin (T_1 and T_2)

$T_1 = 25° + 273 = 298$ K $\quad T_2 = 50° + 273 = 323$ K

Solve for the variable (V_2)

$$\frac{V_1T_2}{T_1} = V_2 = \frac{(150\ \text{mL})(323\ \cancel{K})}{298\ \cancel{K}} = 815\ \text{mL Ne}$$

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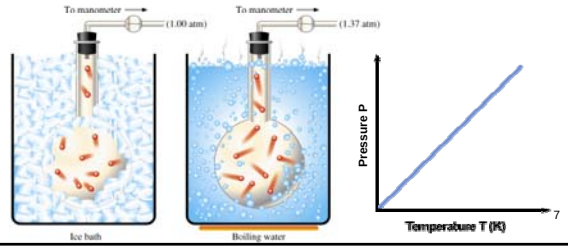
10-3 Gay-Lussac's Law

Gay-Lussac's Law - Pressure varies directly with absolute temperature (Kelvin)

P = kT (Temperature must be in Kelvin!!!)

T ↑ P ↑ and T ↓ P ↓



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10-3 Gay Lussac's Law

Gay-Lussac's Law

$$\frac{P_1}{P_2} = \frac{T_1}{T_2} \quad \text{or} \quad \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Temperature must be in Kelvin!!!

Kelvin Scale – starts at -273.15°C with a value of 0 K.
This is the lowest possible temperature and is called **Absolute Zero**.

To convert °C to K
K = °C + 273.15

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10-3 Gay Lussac's Law

A gas in an aerosol can is at a pressure of 3.00 atm at 25°C. What is the pressure if the can is heated to 52°C?

Convert Temperatures to Kelvin (T_1 and T_2)

$T_1 = 25° + 273 = 298$ K $T_2 = 52° + 273 = 325$ K

Solve for the variable (P_2)

$$\frac{P_1 T_2}{T_1} = P_2 = \frac{(3.00 \text{ atm})(325 \cancel{K})}{298 \cancel{K}} = 3.27 \text{ atm}$$

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10-3 Combined Gas Law

Combined Gas Law - Relationship of pressure, volume, temperature (K)

This one Equation will handle three gas laws!

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Temperature must be in Kelvin!!!

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10-3 Combined Gas Law

Combined Gas Law

A balloon has a volume of 50.0 L at 25°C and 1.08 atm. What is the volume at 0.855 atm and 10°C?

Convert Temperatures to Kelvin (T_1 and T_2)

$T_1 = 25° + 273 = 298$ K $T_2 = 10° + 273 = 283$ K

Solve for the variable (V_2)

$$\frac{P_1 V_1 T_2}{P_2 T_1} = V_2 = \frac{(1.08 \cancel{\text{ atm}})(50.0 \text{ L})(283 \cancel{K})}{(0.855 \cancel{\text{ atm}})(298 \cancel{K})} = 60 \text{ L}$$

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