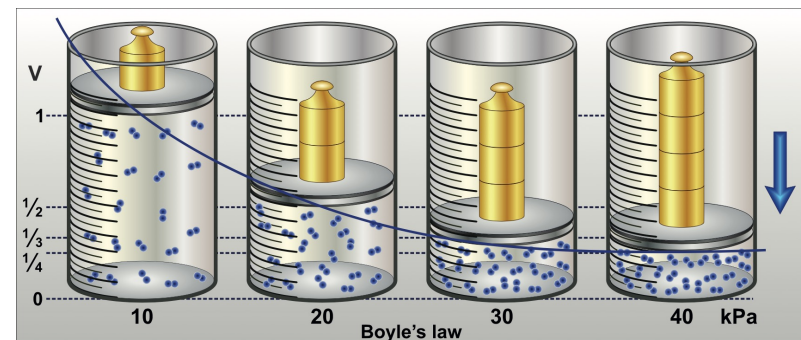
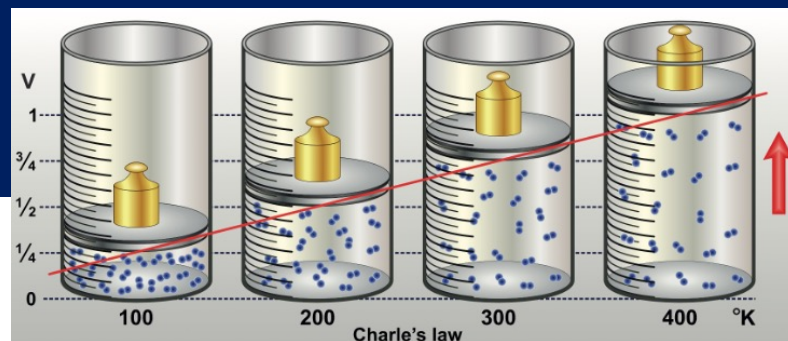


Gas Laws

- Boyle's Law
- Charles' Law
- Gay Lussac's Law
- Combining Gas Laws
- Applications and Practice Questions

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



Preview File

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- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
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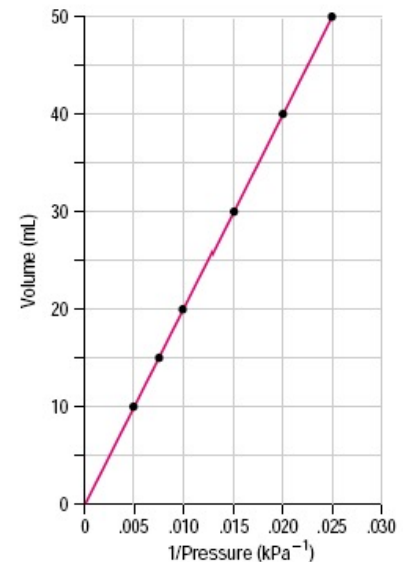
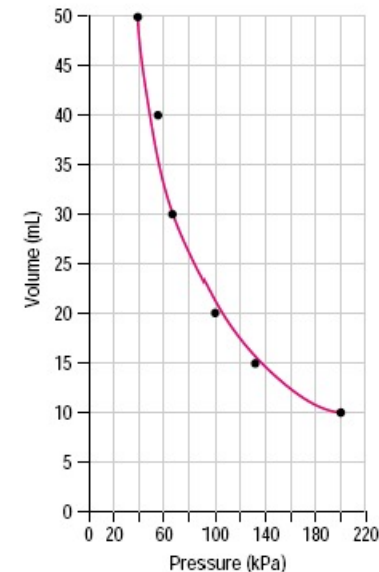
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Boyle's Law



- _____
- The original graph representing the relationship was not a linear relationship
- By taking the inverse of all pressure values ($1/P$), a linear graph appears

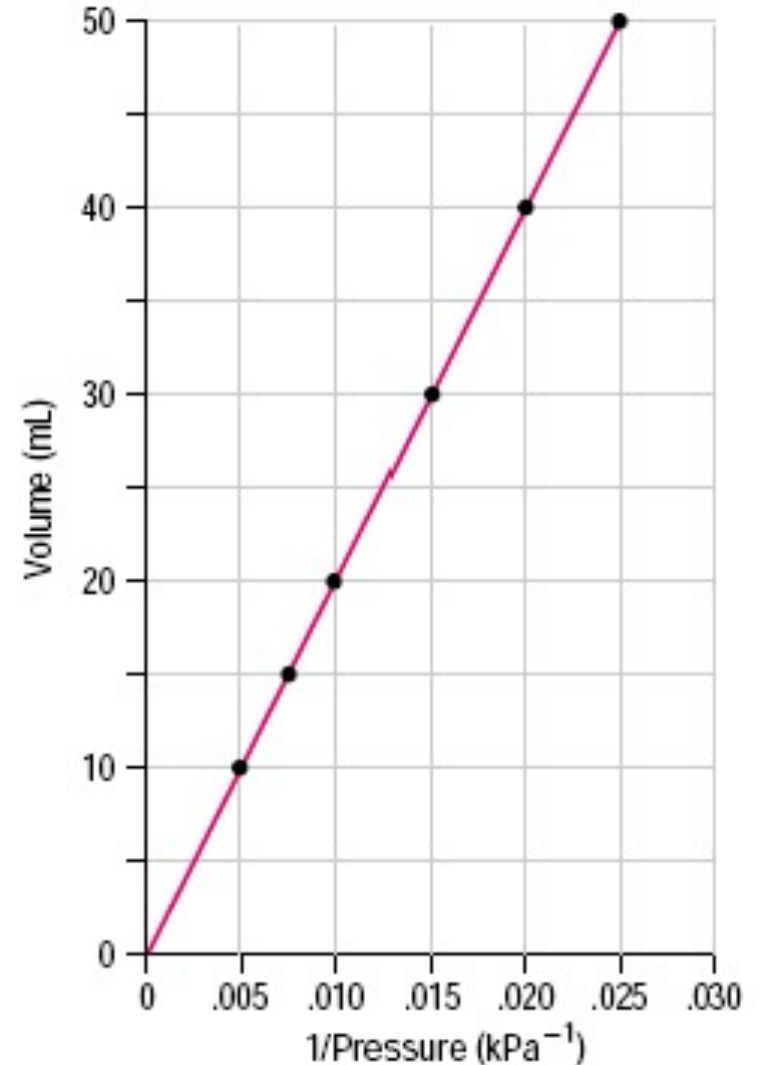


Boyle's Law

- _____

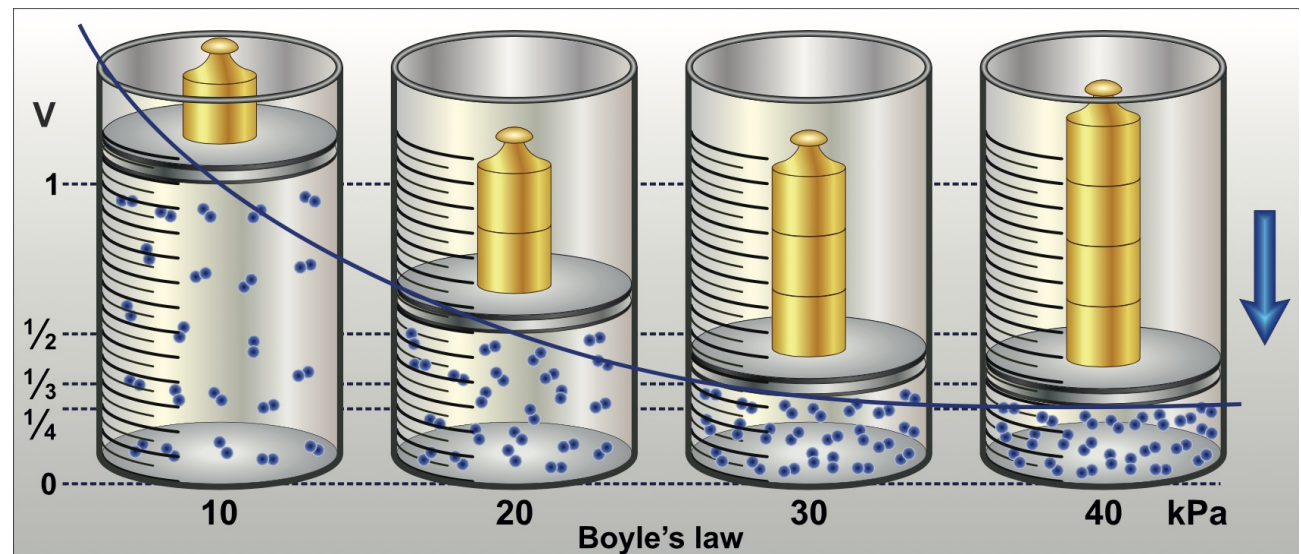
$$P \propto \frac{1}{V} \longrightarrow P = \frac{k}{V}$$
$$PV = k$$

- Note k is an unknown constant (the slope)



Boyle's Law

- $P_1V_1 = k$
- Suppose the same gas is subjected to new conditions → e.g. Increased pressure because the container was made smaller
- $P_2V_2 = k$



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Check Your Understanding

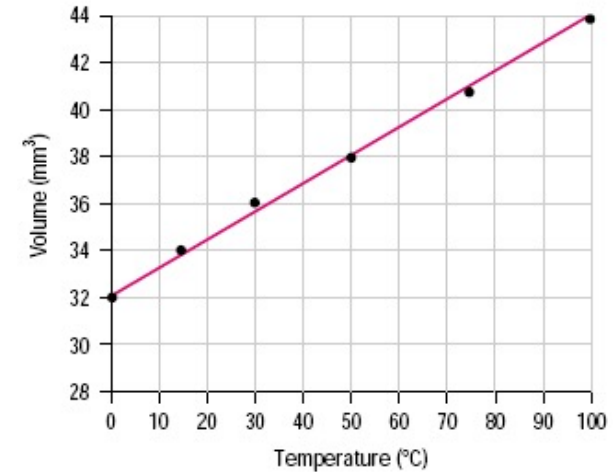
In Vancouver, a balloon with a volume of 5.0 L is filled with air at 101 kPa pressure. The balloon is then taken to Banff, where the atmospheric pressure is only 91 kPa (Banff is 1386 m above sea level). Will the balloon's volume be larger or smaller at Banff? If the temperature is the same in both places, what will the new volume of the balloon be?

Charles' Law

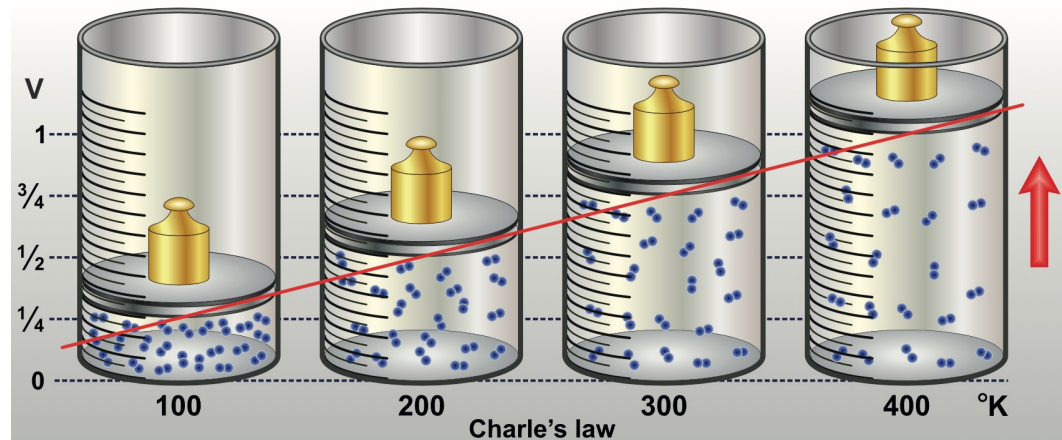


- Relates volume to temperature with a fixed pressure

• _____



$$V = kT, k = \frac{V}{T}$$



Charles' Lab Application – Hot Air Balloons

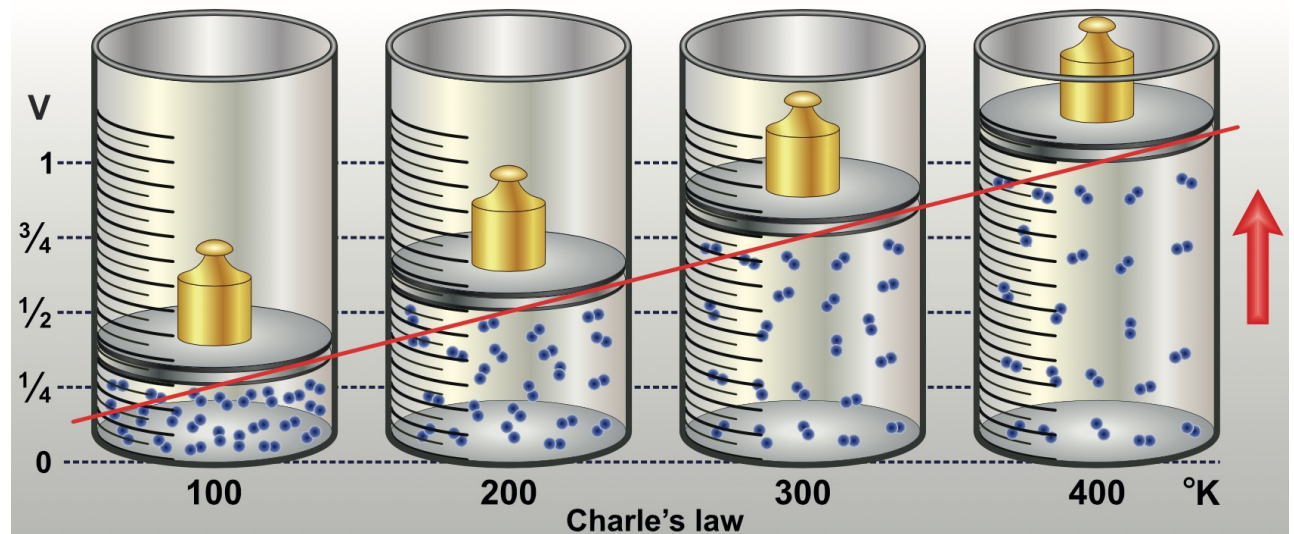
- If a gas is heated, as in a hot air balloon, its volume will increase
- As the volume of gas increases, it fills the balloon
- If the air continues to heat up, it expands and flows out of the hole in the bottom of the balloon
- _____



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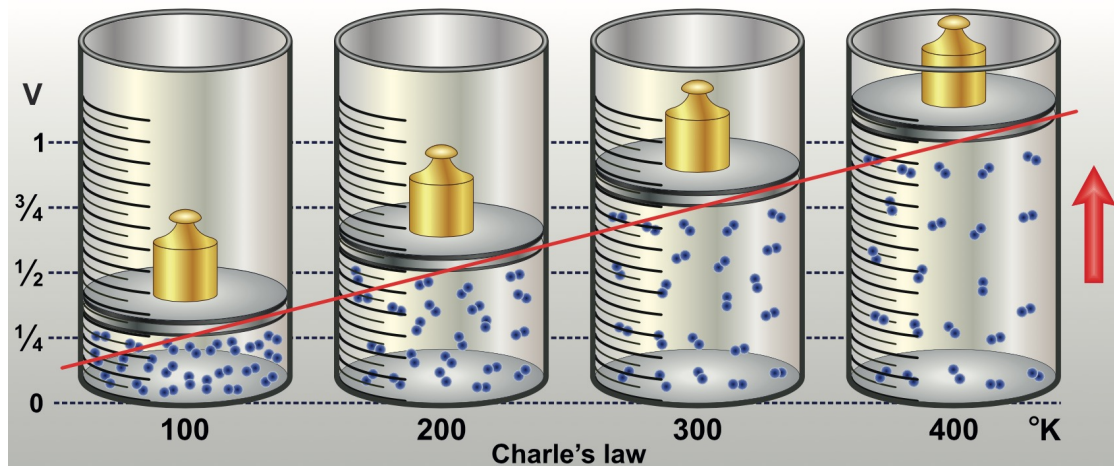
Volume vs. Temperature: Charles' Law

- Notice the linear relationship
- The relationship between temperature and volume describes a “direct relationship”
- _____



Volume vs. Temperature: Charles' Law

- As you lower the temperature of a gas, theoretically enough energy would be drawn from it for its volume to reach zero because its particles would be so close together
- This would occur at -273°C
-



Charles' Law

- _____

- As before, we can equate the k from situation 1 and 2 to give us our working formula:

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Gay Lussac's Law

- _____

$$T \propto T$$

$$\frac{P}{T} = k$$

- If you heat a gas $\rightarrow$ the molecules gain energy $\rightarrow$ move faster $\rightarrow$ more impacts on the walls of the container $\rightarrow$ increase in pressure

$$P = kT$$

- As before, a working formula  would be:

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

Check Your Understanding

At a temperature of 10°C , a container is filled with gas at a pressure of 225 kPa. What will the pressure be if the container is placed in the hot sun to reach a temperature of 42°C ?

Combining Gas Laws

- The three previous laws were discovered by different scientists, at different places, and at different times
- The three laws can be combined, meaning that if 2 of the 3 variables (T, P, V) are known, the other can be determined

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

- What is kept constant is the mass of the gas
- _____

Check Your Understanding

A weather balloon with a volume of 55.0 L

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