Boyle's Law

 $P_1V_1 = P_2V_2$

P = pressureV = volume

subscript meanings: 1 is before, 2 is after. So P_1 is starting pressure, P_2 is ending pressure.

P, V Inverse Relationship

- In the $P_1V_1 = P_2V_2$ equation, P and V are **inversely proportional**.
- This means that when one of the variables goes up, the other has to go down.
- They move in opposite directions.
- Inverse is the opposite of a *direct relationship* (found in V, T and P, T relationships)

Boyle's Law Example:

Starting conditions of a gas are as follows:

 $P_1 = 4 \text{ atm}$ $V_1 = 5 \text{ L}.$

If the gas pressure goes down to 2 atm, what is the final volume?

 $P_2 = 2 \text{ atm} V_2 = ???$

Solution:

- 1) Write out equation: $P_1V_1 = P_2V_2$
- 2) Substitute known values in: $(4 \text{ atm})(5 \text{ L}) = (2 \text{ atm})V_2$

Algebra work: cancel out "atm" units on both sides	(4) (5 L)	$= 2 V_2$
Algebra: multiply 4x5	20 L	$= 2 V_2$
Algebra: divide both sides by 2	10 L	$= V_2$

3) List answer with units: $V_2 = 10 L$ (final answer is in "L" units, because it is the only unit left after "atm" canceled out)

Notice that if you plug the answer into the starting equation, both sides equal 20:

 $P_1V_1 = P_2V_2$ (4 atm)(5 L) = (2 atm)(10 L)

The pressure went **down** (from 4 atm to 2 atm) while the volume went **up** (from 5 L to 10 L).

When the variables go in opposite directions like that, you have an inverse relationship.

Mathematically, inverse relationships happen when the variables are multiplied together on one side of the equation, just as P and V are multiplied.