Pressure in Motion

Read, compare, and graph ideal gas states

HS-PSII-2.4 "Develop graphical and mathematical representations that describe the relationship among the volume, temperature, and number of molecules of an ideal gas in a closed system and the pressure exerted by the system and apply those..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle the one value among volume, temperature, and molecule count that changes in each table row after the first, comparing each row with the first. Underline the equation that links all four quantities.

What Changes Inside a Sealed Cylinder?

1. A bicycle pump warms when you compress the air inside it. Now picture a sealed cylinder: no molecules enter or leave as its piston moves. When temperature rises, molecules move faster and strike the walls harder. Giving the molecules less space also increases how often they strike the walls. Pressure measures the force of those collisions per unit area.

2. The table compares ideal gas samples. N stands for one reference number of molecules; 2N means twice that number. Each row describes a sealed sample. Rows with the same molecule count could also show different states of one sealed sample. Compare each row with the first row to see what happens when only one of volume, temperature, or molecule count changes.

FOUR SEALED GAS STATES

Volume (L)	Temperature (K)	Molecule count	Pressure (kPa)
3.0	300	N	100
6.0	300	N	50
3.0	450	N	150
3.0	300	2N	200

3. For ideal gases, PV = NkT, where P is absolute pressure, V is volume, N is molecule count, T is kelvin temperature, and k is a constant. At fixed N and T, pressure falls as volume grows. At fixed N and V, pressure rises in proportion to kelvin temperature. A pressure-versus-volume graph at fixed temperature forms a downward curve.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare the first two rows. How does doubling the volume affect pressure when temperature and molecule count stay fixed?

2. Compare the first and third rows. By what factor does temperature change, and by what factor does pressure change?

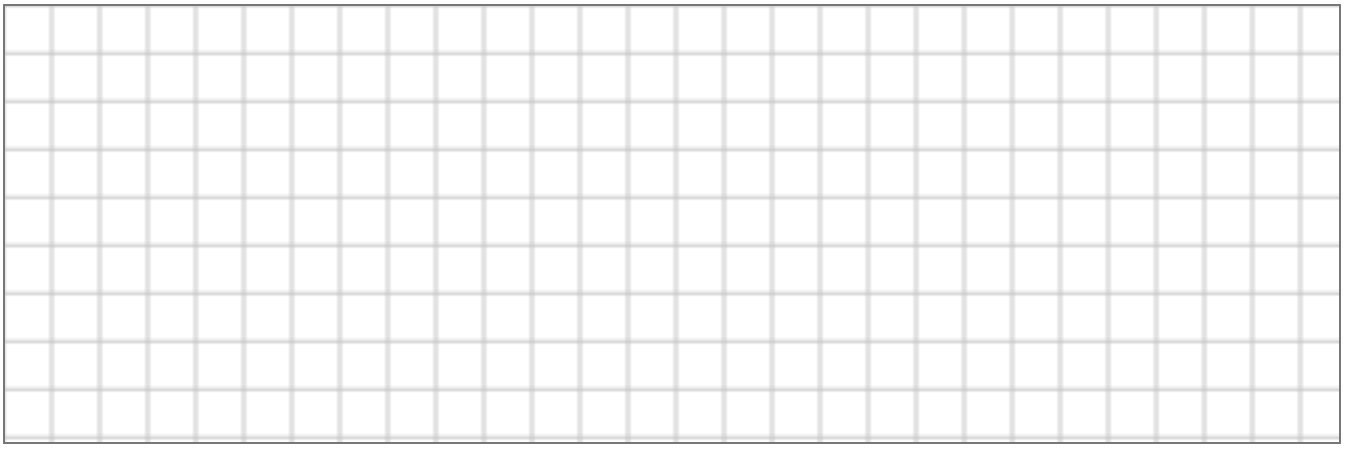
3. Compare the first and fourth rows. What happens to pressure when the molecule count doubles at the same volume and temperature? Could those rows describe one sealed sample?

4. A sealed sample starts in the first-row state. If its volume shrinks to 1.5 L while its temperature stays at 300 K, what pressure does the equation predict? Show your calculation.

3 YOUR TURN

Your own words

A sealed gas sample with N molecules starts at 3.0 L, 300 K, and 100 kPa; heat it to 450 K while holding its volume at 3.0 L, then keep it at 450 K as its volume changes to 4.5 L and 6.0 L. On the grid, plot pressure against volume for all three volumes, label both axes, and write one sentence explaining the graph.



ANSWER KEY

Pressure in Motion

HIGH SCHOOL · HS-PSII-2.4

PART 1 · READ AND MARK

Circle the one value among volume, temperature, and molecule count that changes in each table row after the first, comparing each row with the first. Underline the equation that links all four quantities. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare the first two rows. How does doubling the volume affect pressure when temperature and molecule count stay fixed?	**Pressure falls from 100 kPa to 50 kPa, so it is halved.**
2	Compare the first and third rows. By what factor does temperature change, and by what factor does pressure change?	**Temperature changes by a factor of 1.5, from 300 K to 450 K. Pressure also changes by a factor of 1.5, from 100 kPa to 150 kPa.**
3	Compare the first and fourth rows. What happens to pressure when the molecule count doubles at the same volume and temperature? Could those rows describe one sealed sample?	**Pressure doubles from 100 kPa to 200 kPa. No, a sealed sample cannot gain molecules.**
4	A sealed sample starts in the first-row state. If its volume shrinks to 1.5 L while its temperature stays at 300 K, what pressure does the equation predict? Show your calculation.	**200 kPa. At fixed N and T, PV stays constant: (100 kPa)(3.0 L) = P(1.5 L), so P = 200 kPa.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Horizontal axis: Volume (L). Vertical axis: Pressure (kPa). Plot (3.0, 150), (4.5, 100), and (6.0, 75), then connect them with a smooth downward curve. At a fixed temperature of 450 K, pressure falls as volume increases because the same molecules have more space.

Accept equivalent calculations and axis labels. The graph should show the three correct points and a decreasing, curved relationship rather than a straight line.