Pressure Under Investigation

Use particle motion to predict gas pressure.

CHE.7 "Plan and carry out investigations to determine how the atomic and molecular motion in chemical and physical processes is related to the kinetic molecular theory. a..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the statements linking temperature to particle motion and collisions to pressure, circle the gas equation, and write the same number beside the two trials that isolate a volume change.

Air in a Piston Chamber

1. A lab team traps dry air in a sealed piston chamber. They can warm the chamber, move its piston, or add measured amounts of air. A sensor reads absolute pressure. In each trial, the team waits until the gas reaches a steady temperature, measured in kelvins. The table records the conditions. In trial A, the pressure is about 1.00 atmosphere.

GAS CHAMBER TRIALS

Trial	Amount n (mol)	Temperature T (K)	Volume V (L)
A	0.10	300	2.46
B	0.10	330	2.46
C	0.10	300	4.92
D	0.20	300	2.46

2. Gas particles move randomly and strike the chamber walls. Pressure comes from these collisions. Temperature measures average particle kinetic energy, so warmer gas has faster particles on average. A pressure change can reflect changes in how often particles strike the walls, how hard they strike, or both. Predict changes by tracking what differs between trials.

3. For an ideal gas, PV = nRT, where P is absolute pressure, V is volume, n is the amount in moles, T is kelvin temperature, and R is constant. At fixed n and T, P is proportional to 1/V. A graph with P on the vertical axis and 1/V on the horizontal axis should be a straight line.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare trials B and A. Predict the pressure in B, and explain the change using particle motion and wall collisions.

2. Compare trials C and A. Predict the pressure in C, and explain what happens to wall collisions.

3. Which has greater pressure, B or D? Calculate both pressures and explain how particle motion and particle number affect the comparison.

4. For a graph of P against 1/V, give the coordinates for A and C as (1/V, P). Why should additional trials at the same n and T follow a straight line?

3 YOUR TURN

Your own words

Design a trial E that differs from every trial in the table. Choose n as 0.10 or 0.20 mol, T as 300 or 330 K, and V as 2.46 or 4.92 L; then show your pressure calculation from A and explain how each change from A affects wall collisions.

Pressure Under Investigation

PART 1 · READ AND MARK

Underline the statements linking temperature to particle motion and collisions to pressure, circle the gas equation, and write the same number beside the two trials that isolate a volume change. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare trials B and A. Predict the pressure in B, and explain the change using particle motion and wall collisions.	**B is about 1.10 atm because its kelvin temperature is 1.10 times A's. At the same volume and amount, faster particles strike the walls more often and harder.**
2	Compare trials C and A. Predict the pressure in C, and explain what happens to wall collisions.	**C is about 0.50 atm because its volume is twice A's. With the same amount and temperature, particles strike each unit of wall area less often.**
3	Which has greater pressure, B or D? Calculate both pressures and explain how particle motion and particle number affect the comparison.	**B is about 1.10 atm, and D is about 2.00 atm, so D is greater. D's particles move more slowly on average, but it has twice as many particles as A, producing more wall collisions overall.**
4	For a graph of P against 1/V, give the coordinates for A and C as (1/V, P). Why should additional trials at the same n and T follow a straight line?	**A is approximately (0.407 L^{-1}, 1.00 atm), and C is approximately (0.203 L^{-1}, 0.50 atm). At fixed n and T, P is proportional to 1/V.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

For trial E, I choose n = 0.20 mol, T = 330 K, and V = 4.92 L. From A, P = 1.00 atm × (0.20/0.10) × (330/300) × (2.46/4.92) = 1.10 atm. More particles increase wall collisions, and the higher temperature makes particles move faster and strike harder. The larger volume reduces collisions per unit of wall area, leaving a net pressure increase.

Accept small rounding differences. For trial E, check that the conditions differ from all four listed trials and that the pressure calculation and collision explanation account for every changed variable.