Air Under Pressure

Compare three investigations of the same gas relationships

P.7.5B.2 "Use evidence from multiple scientific investigations to communicate the relationships between pressure, volume, density, and temperature of a gas."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline changes in pressure, volume, temperature, and density, then circle what stayed the same in each investigation so you can compare the evidence.

Three Ways to Test Air

1. In one investigation, students trapped air in a sealed syringe and held it at 20°C. The plunger started at 30 milliliters, and a sensor read 100 kilopascals of pressure. They pushed the plunger until the air filled 15 milliliters; the sensor then read about 200 kilopascals. No air escaped, so the same mass of gas occupied half the space. Its density, or mass in each milliliter, doubled. This test shows what happens when volume changes while temperature and the amount of gas stay fixed.

2. A second group put air in a rigid, sealed container. They placed the container in warm water, raising the air temperature from 20°C to 50°C. Its pressure rose from 100 to about 110 kilopascals. The container could not expand, and no air entered or left. Its volume and density therefore stayed the same even though pressure increased. This result differs from the syringe test: temperature, rather than volume, changed. Together, the tests show why a pressure reading alone does not tell you what happened to a gas.

3. In a third investigation, air was trapped beneath a freely moving piston. The students warmed it from 20°C to 50°C. The gas expanded from 30 to about 33 milliliters, while its pressure stayed near 100 kilopascals because the piston could move outward. Since the same mass of air spread into more space, its density decreased. Compare this with the rigid container: warming raised pressure when volume stayed fixed, but warming raised volume when pressure could stay nearly fixed. How a gas is held matters.

2 ANSWER WITH EVIDENCE

Use the passage

1. In the syringe investigation, how did pressure and density change when the air filled half as much space? Use the readings as evidence.

2. What does the rigid-container investigation show about warming a gas whose volume cannot change? Include pressure and density in your answer.

3. How did warming affect the air beneath the moving piston? Explain the changes in volume, pressure, and density.

4. A student says, “If a gas’s pressure rises, its density must rise too.” Use evidence from two investigations to decide if this is always true.

3 YOUR TURN

Your own words

Imagine a sealed air pouch inside a snug rigid box that keeps it from expanding. Predict how its temperature, pressure, volume, and density change when it is warmed, then predict what happens when the box is opened and the pouch expands while staying warm. Use evidence from at least two investigations.

ANSWER KEY

Air Under Pressure

GRADE 7 · P.7.5B.2

PART 1 · READ AND MARK

Underline changes in pressure, volume, temperature, and density, then circle what stayed the same in each investigation so you can compare the evidence. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In the syringe investigation, how did pressure and density change when the air filled half as much space? Use the readings as evidence.	**When volume fell from 30 to 15 milliliters, pressure rose from 100 to about 200 kilopascals. Density doubled because the same mass of air filled half the space.**
2	What does the rigid-container investigation show about warming a gas whose volume cannot change? Include pressure and density in your answer.	**As temperature rose from 20°C to 50°C, pressure rose from 100 to about 110 kilopascals. Volume and density stayed the same.**
3	How did warming affect the air beneath the moving piston? Explain the changes in volume, pressure, and density.	**Volume rose from 30 to about 33 milliliters, pressure stayed near 100 kilopascals, and density decreased because the same mass of air filled more space.**
4	A student says, "If a gas's pressure rises, its density must rise too." Use evidence from two investigations to decide if this is always true.	**No. In the syringe, pressure and density both rose when volume decreased. In the rigid container, pressure rose during warming, but density stayed the same because volume did not change.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

While the shut box holds the pouch at one volume, warming it raises its temperature and pressure, but its volume and density stay the same. The rigid-container investigation supports this prediction. When the box opens and the pouch expands at the same warm temperature, its volume rises, while its pressure and density fall. The syringe investigation supports this prediction because compressing gas at a steady temperature raised its pressure and density.

Accept qualitative predictions for the pouch; exact readings are not required. Responses should explain that the sealed pouch keeps the same mass of air throughout both stages.