When Gases Change

Trace gas behavior from a syringe to a storage cylinder.

CHE.7.1 "Analyze the behavior of ideal and real gases in terms of pressure, volume, temperature, and number of particles."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each predicted change in pressure or volume, and circle the conditions held fixed for that prediction. Number the two reasons given for why a real gas can depart from the ideal model.

How Much Room Does Air Need?

1. A mechanic traps air in a capped syringe while testing a pump. Pushing the plunger inward gives the same number of particles less room to move. At constant temperature, the particles strike the walls more often per area, so pressure rises as volume falls. Pulling the plunger outward does the opposite. An ideal gas model treats particles as tiny points with no attractions between them. It predicts that, at a fixed temperature and particle count, doubling the volume cuts the pressure in half. This relationship helps explain what the mechanic feels when pressing the plunger.

2. Now consider a bicycle tire sitting in the sun. Its volume changes very little, and no air enters or leaves if the valve stays closed. As the air warms, particles move faster and hit the tire walls harder and more often, so pressure increases. Temperature in gas calculations must be measured in kelvins: doubling the kelvin temperature would double ideal-gas pressure if volume and particle count stayed fixed. If the mechanic pumps more air into the tire and the air returns to its earlier temperature, pressure rises again because more particles strike the walls. These predictions depend on which conditions stay fixed.

3. The ideal model is not perfect for a real gas in a storage cylinder. At low temperatures, gas particles move more slowly, and attractions between them can pull them toward each other. At high pressures, particles are crowded, so their own size takes up a noticeable share of the cylinder's space. Both effects can make measured pressure differ from an ideal prediction at the same volume, temperature, and particle count. At modest pressure and temperatures well above the gas's condensation point, particles are farther apart and attractions usually matter less. Under those conditions, ideal-gas predictions often work well.

2 ANSWER WITH EVIDENCE

Use the passage

1. If the mechanic doubles the syringe's volume without changing its temperature or particle count, what happens to its ideal-gas pressure?

2. Why does pressure rise in the closed bicycle tire as it warms in the sun?

3. After the mechanic pumps more air into the tire and its temperature returns to its earlier value, how does its pressure compare with before? Explain.

4. Why might an ideal-gas prediction be less reliable for gas in a cold, highly pressurized storage cylinder than for gas at modest pressure?

3 YOUR TURN

Your own words

Invent a gas-filled device or setting not named in the passage. Describe two separate changes, predict each effect using ideal-gas reasoning, and explain one condition under which the real gas might behave differently.

ANSWER KEY

When Gases Change

PART 1 · READ AND MARK

Underline each predicted change in pressure or volume, and circle the conditions held fixed for that prediction. Number the two reasons given for why a real gas can depart from the ideal model. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	If the mechanic doubles the syringe's volume without changing its temperature or particle count, what happens to its ideal-gas pressure?	**The pressure falls to half its original value.**
2	Why does pressure rise in the closed bicycle tire as it warms in the sun?	**The tire's volume and particle count stay nearly fixed. Warmer particles move faster and strike the walls harder and more often.**
3	After the mechanic pumps more air into the tire and its temperature returns to its earlier value, how does its pressure compare with before? Explain.	**Pressure is higher because more particles strike the walls while temperature and volume are nearly unchanged.**
4	Why might an ideal-gas prediction be less reliable for gas in a cold, highly pressurized storage cylinder than for gas at modest pressure?	**At low temperature, attractions between particles matter more. At high pressure, the particles' own size takes up a noticeable share of the space.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

A steel flask with a valve holds gas. With the valve closed, warming the gas raises its pressure because volume and particle count stay fixed. If I add gas through the valve and restore the starting temperature, pressure also rises at fixed volume. At very high pressure, particle size matters, so the real pressure may differ from the ideal prediction.

Accept any distinct setting with two predictions that correctly state or imply what remains fixed. The real-gas condition should connect low temperature to attractions or high pressure to particle size.