B3 · Boyle's law: pressure and volume · Worked examples and practice

Name: _____ Date: _____

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · Find the new pressure

Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 6.00 L at 120 kPa. It is squeezed to 4.00 L. What is the new pressure?

1. Before: P_1 = 120 kPa, V_1 = 6.00 L. After: V_2 = 4.00 L. The unknown is P_2.
2. $P_2 = P_1V_1 / V_2$ = (120 kPa × 6.00 L) / 4.00 L = 180 kPa.
3. Check: the volume went down, so the pressure went up.

Answer: The new pressure is 180 kPa.

Example 2 · Find the new volume

Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 450 mL at 96.0 kPa. The pressure is raised to 144 kPa. What is the new volume?

1. Before: P_1 = 96.0 kPa, V_1 = 450 mL. After: P_2 = 144 kPa. The unknown is V_2.
2. $V_2 = P_1V_1 / P_2$ = (96.0 kPa × 450 mL) / 144 kPa = 300 mL.
3. Check: the pressure went up, so the volume went down.

Answer: The new volume is 300 mL.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. A trapped gas is squeezed to half its volume at the same temperature. Explain what happens to its pressure.

EASY

2. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 2.00 L at 100 kPa. It is squeezed to 1.00 L. What is the new pressure?

EASY

3. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 10.0 L at 50.0 kPa. The pressure is raised to 100 kPa. What is the new volume?

EASY

4. A trapped gas has a pressure of 80.0 kPa and a volume of 3.00 L. What is its pressure times its volume? The gas is then squeezed at the same temperature. What is pressure times volume now?

MEDIUM

5. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 12.5 L at 96.0 kPa. It expands to 20.0 L. What is the new pressure?

MEDIUM

6. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A syringe holds 60.0 mL of air at 101 kPa. It is squeezed until the pressure is 152 kPa. What is the new volume?

MEDIUM

7. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 2.40 L at 1.25 atm. The pressure drops to 0.800 atm. What is the new volume?

MEDIUM

8. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A gas fills 750 mL at 88.0 kPa. It is squeezed to 550 mL. What is the new pressure?

HARDER

9. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. Use 1 atm = 101.325 kPa = 760 mm Hg. A gas fills 5.00 L at 740 mm Hg. Its pressure changes to 125 kPa. First change 740 mm Hg to kilopascals. Then find the new volume.

HARDER

10. Use Boyle's law, $P_1V_1 = P_2V_2$. The temperature and the amount of gas do not change. A weather balloon holds 800 L of helium at 100 kPa on the ground. High up, the pressure is 25.0 kPa. Find the new volume. Then explain, using particles, why the balloon is bigger.