ANSWER KEY.

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Gas Laws and KMT Lab Check

AP Chemistry | ANSWER KEY

Open the Gas Laws and KMT Lab and open **Lab check**. For each question, press **Set up the lab**, make the change yourself, and answer in the lab. Record your readings and explanations here.

1. **Squeeze the gas.** Set up 1.00 mol N_2 at 300 K in 10.0 L with temperature held. Record the gas law pressure. Then move the volume to 5.0 L and record the new pressure. Explain the change using particle collisions.

   Before: 2.46 atm. After: 4.92 atm. The pressure doubles.
   Check: P_1V_1 = (2.46 atm)(10.0 L) = 24.6 L·atm and P_2V_2 = (4.92 atm)(5.0 L) = 24.6 L·atm.
   Half the volume gives the particles half the room, so they hit the walls twice as often. The speeds do not change, because the temperature is held.

2. **Find absolute zero.** Open Graphs, choose V vs T, press Run sweep, and turn on the °C axis. At what temperature does the dashed line reach zero volume? Explain why gas law calculations use kelvins.

   About −273 °C, which is 0 K.
   Volume is proportional to the kelvin temperature, so the line reaches zero volume at 0 K. 0 °C is only where water freezes. Gas particles still move there, so ratios only work in kelvins.

3. **Light and heavy particles.** In the Speeds tab, compare He and Ar at 300 K. Record each average speed. How do their average kinetic energies compare? Show that the speed ratio is about the square root of the mass ratio.

   He: 1,260 m/s. Ar: 399 m/s. Both have the same average kinetic energy, (3/2)*RT* = 3.74 kJ/mol.
   Speed ratio: 1,260 ÷ 399 = 3.16. Square root of the mass ratio: √(39.95 g/mol ÷ 4.003 g/mol) = √9.98 = 3.16. Helium is about 3.2 times faster.
   KE = ½mv^2 is the same for both, so the lighter helium atoms must move faster.

4. **Share the pressure.** Set up a mixture of 1.00 mol He, 0.50 mol Ar and 0.50 mol Kr at 300 K in 10.0 L. Record the total pressure and the partial pressure of helium. Show the partial pressure with the mole fraction.

   Total: 4.92 atm. Helium: 2.46 atm.
   X_{He} = 1.00 mol ÷ 2.00 mol = 0.500, so P_{He} = 0.500 × 4.92 atm = 2.46 atm.
   Partial pressure follows moles, not mass. At the same temperature each mole adds the same pressure.

5. **When helium is not ideal.** Choose Real gas. Set up 1.00 mol He at 300 K in 2.50 L with temperature held, then squeeze it to 0.25 L. Record PV/nRT. Is it above or below 1? Which part of PV/nRT grew, and why?

   PV/nRT = 1.100, above 1. The particle volume part grew.
   The pressure is about 108 atm, higher than the ideal 98.5 atm. At 0.25 L the atoms fill a real share of the container, so the free space is less than *V*. Helium atoms barely attract each other, so the particle volume effect wins.

Completion code: **varies by student (starts with GLC).** Score: **the number right on the first try, 0 to 5. Paste the code into the Completion Code Checker to confirm it.**

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