Module 9: States of Matter and Gas Laws
Topic 4 Content: Ideal Gas Law Presentation Notes

Ideal Gas Law

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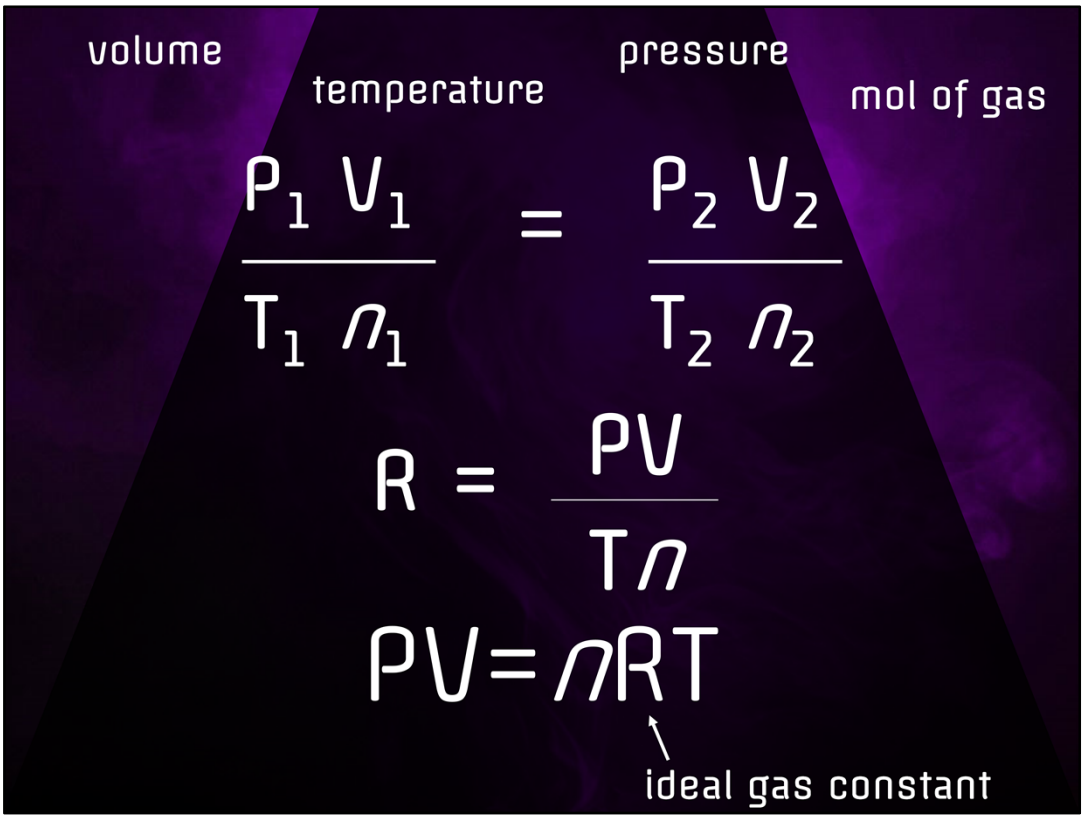

The Combined Gas Law shows you the relationship of a gas is inversely proportional to volume and directly proportional to temperature. Avogadro's Law showed you that volume and pressure are directly proportional to the number of moles of a gas. If you combine both of these gas laws, you can derive the following equation: $P_1 \times V_1/T_1 \times n_1 = P_2 \times V_2/T_2 \times n_2$.

Just like all of the other gas laws, the Ideal Gas Law is a single equation that relates the variables of pressure, volume, temperature, and number of moles of an ideal gas. Using R for the constant, the simplified equation becomes: R = P x V/T x n.

This equation is simplified one more time and becomes: PV=*n*RT. In this equation, the variable R is called the ideal gas constant.

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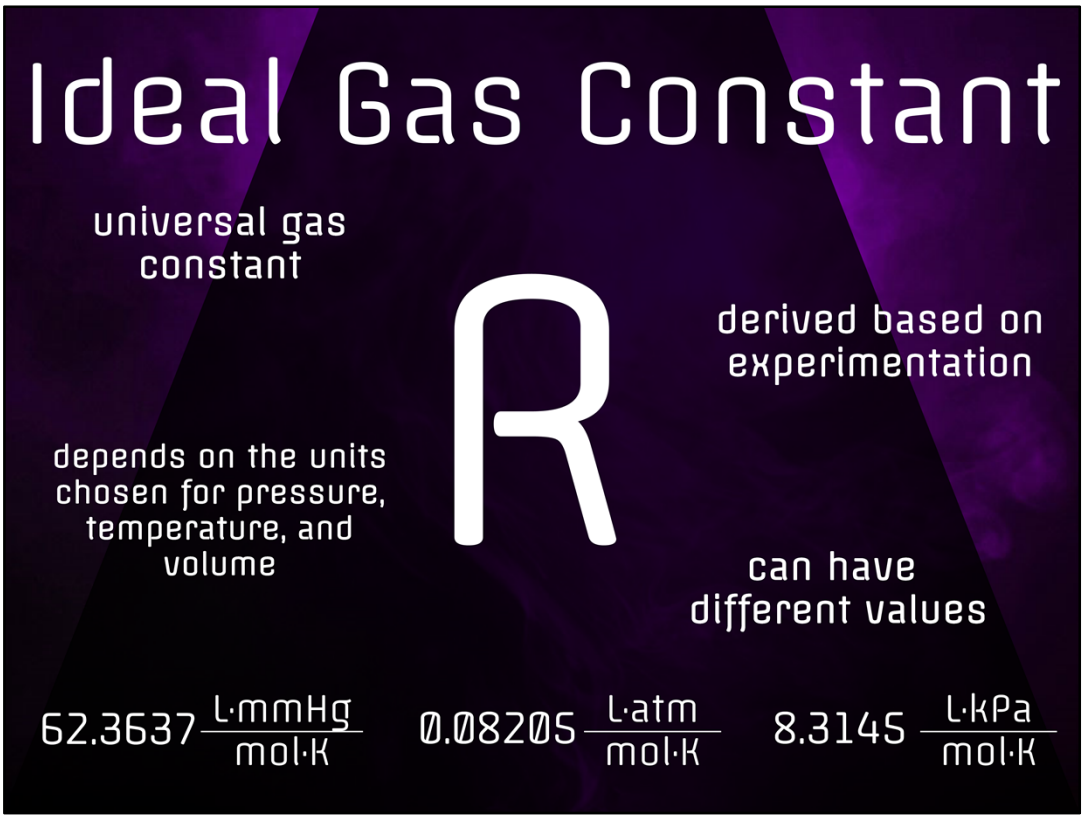
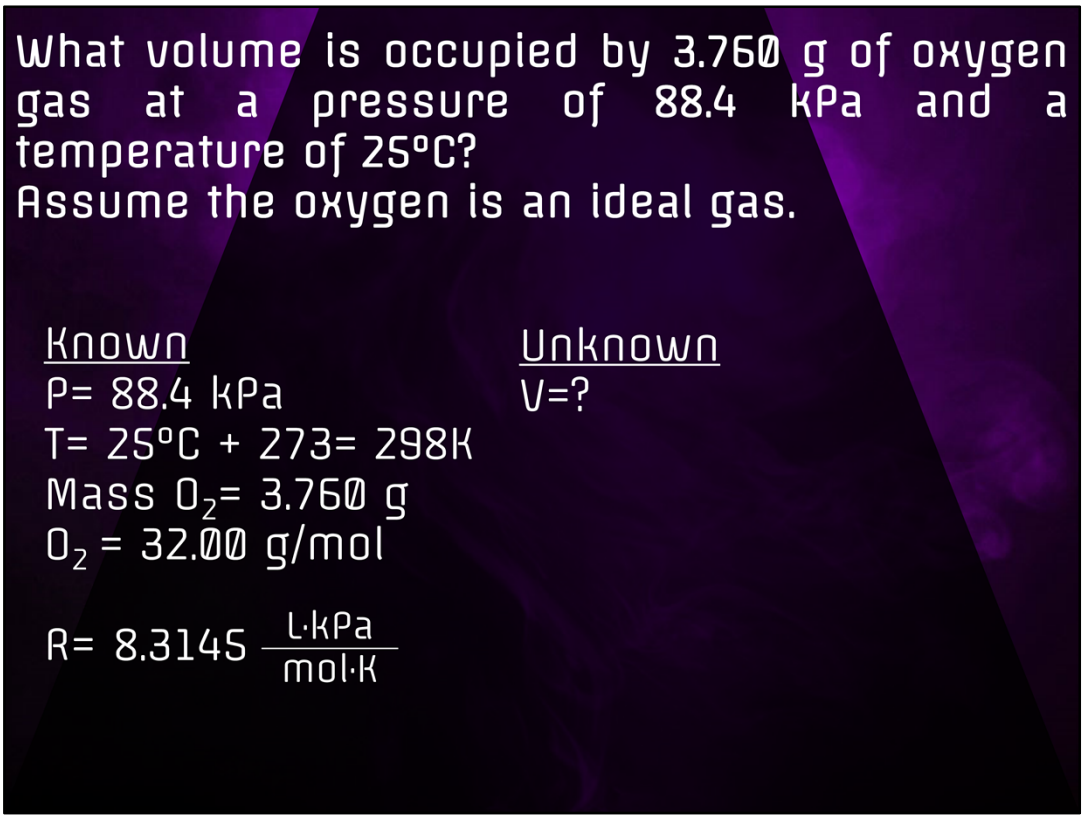


R is the ideal gas constant. Sometimes, it is referred to as the universal gas constant. It has been derived based on experimentation. The value of R depends on the units chosen for pressure, temperature, and volume in the ideal gas equation. You must use Kelvin for temperature, and use SI units for volume. Since you can use different units for pressure, R can have different values.



Now, try this sample problem using the Ideal Gas Law equation.

What volume is occupied by 3.760 g of oxygen gas at a pressure of 88.4 kPa and a temperature of 25°C? Assume the oxygen is an ideal gas.

The best way to solve this problem is to list the known and unknown variables and then solve the problem using mathematics. You will notice that the temperature is listed in Celsius and needs to be converted to Kelvin. Try to solve this problem on your own, and then click ***NEXT*** to view the solution.

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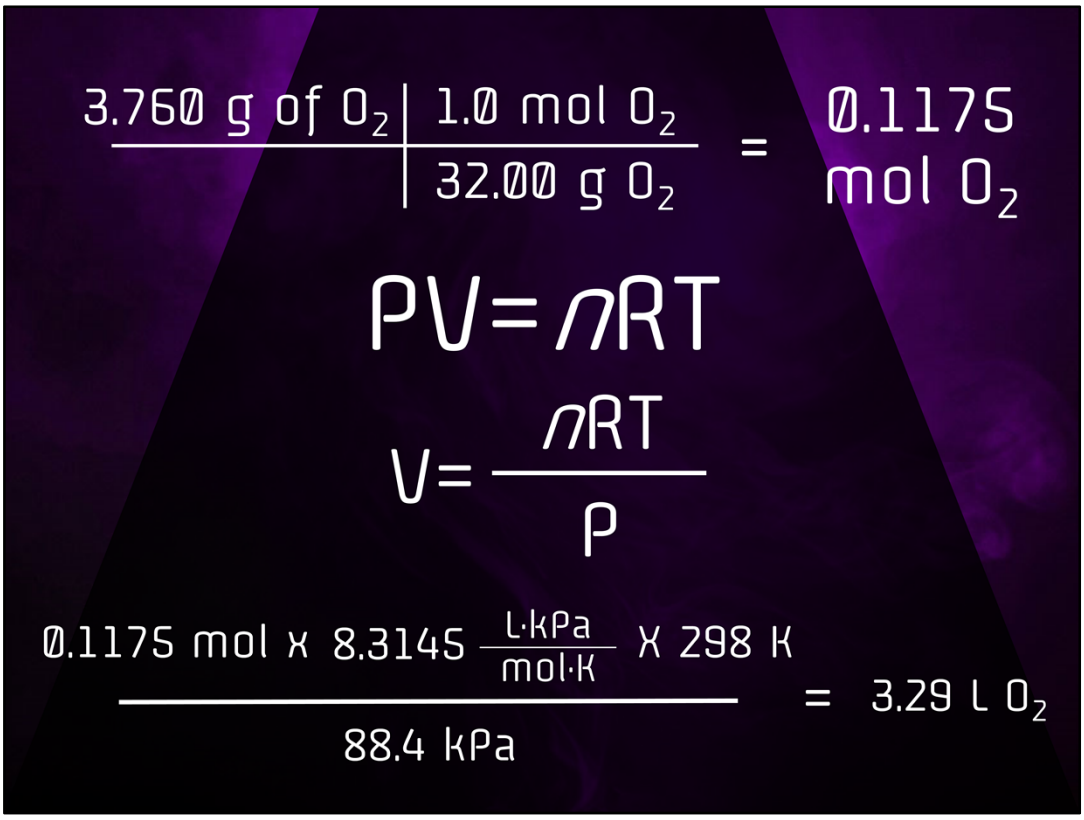

In order to use the ideal gas law equation, you must first determine the number of moles of O_2. In order to complete this important step, you will use the given mass and the molar mass. To calculate the number of moles multiply 3.760 g of O_2 by 1.0 mol of O_2. Then, divide by 32.00 g of O_2. The amount of O_2 equals 0.1175 mol.

Then, use the ideal gas equation to solve for the volume of oxygen. You must rearrange the ideal gas law to solve for V. Now, plug in your known values and solve for V. You can see that V equals 0.1175 mol times 8.3145 kPa • L/K • mol x 298 K divided by 88.4 kPa. The volume is equal to 3.29 L of O_2.