Oxygen by the Numbers

Predict the gas produced when hydrogen peroxide breaks down.

CHE.7.6 "Use the ideal gas law to support the prediction of volume, mass, and number of particles produced in chemical reactions (i.e., gas stoichiometry)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the mole ratio in the reaction, circle the values needed to calculate oxygen volume, and number the two calculation steps in order.

Collecting Oxygen at a Science Fair

1. At a science fair, a student uses yeast to break down a measured amount of hydrogen peroxide solution. The yeast supplies a catalyst; it is not consumed. The reaction is $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$. If the peroxide reacts completely, the balanced equation links peroxide used to oxygen formed: two moles of peroxide produce one mole of oxygen.

2. The student collects dry oxygen in a sealed container. Assume all peroxide reacts, no gas escapes, and oxygen behaves ideally. The table gives the peroxide amount, temperature, pressure, and gas constant. First use the balanced equation to find oxygen moles. Then apply PV = nRT, where V is in liters and n is in moles.

CONDITIONS FOR THE SCIENCE FAIR TRIAL

Quantity	Value
Starting H_2O_2	0.500 mol
Oxygen temperature	300 K
Oxygen pressure	1.00 atm
Gas constant, R	0.0821 L·atm/(mol·K)

3. Oxygen amount can also be reported as mass or a count of molecules. One mole of O_2 has a mass of 32.0 g and contains 6.02×10^{23} molecules. Multiply oxygen moles by either value for a prediction. Changing temperature or pressure changes volume, not mass or molecule count, if no gas escapes.

2 ANSWER WITH EVIDENCE

Use the passage

1. What volume of O_2 will the trial produce? Show the mole ratio and ideal gas law calculation.

2. What mass of O_2 will the trial produce? Show how you use the reaction ratio.

3. How many O_2 molecules will the trial produce? Show your calculation.

4. If the oxygen temperature rises to 600 K while pressure and starting peroxide amount stay the same, what volume is predicted? Show your calculation.

3 YOUR TURN

Your own words

Plan a new trial using 0.800 mol H_2O_2, with oxygen collected at 325 K and 1.25 atm. Predict the volume, mass, and number of O_2 molecules produced, showing how you use the reaction ratio and ideal gas law.

Oxygen by the Numbers

PART 1 · READ AND MARK

Underline the mole ratio in the reaction, circle the values needed to calculate oxygen volume, and number the two calculation steps in order. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What volume of O_2 will the trial produce? Show the mole ratio and ideal gas law calculation.	**0.500 mol H_2O_2 produces 0.250 mol O_2. V = nRT/P = (0.250)(0.0821)(300)/(1.00) = 6.16 L.**
2	What mass of O_2 will the trial produce? Show how you use the reaction ratio.	**0.500 mol H_2O_2 produces 0.250 mol O_2; (0.250 mol)(32.0 g/mol) = 8.00 g O_2.**
3	How many O_2 molecules will the trial produce? Show your calculation.	**(0.250 mol O_2)(6.02 × 10^{23} molecules/mol) = 1.51 × 10^{23} O_2 molecules.**
4	If the oxygen temperature rises to 600 K while pressure and starting peroxide amount stay the same, what volume is predicted? Show your calculation.	**The reaction still produces 0.250 mol O_2. V = (0.250)(0.0821)(600)/(1.00) = 12.3 L.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

0.800 mol H_2O_2 × (1 mol O_2/2 mol H_2O_2) = 0.400 mol O_2. V = nRT/P = (0.400)(0.0821)(325)/(1.25) = 8.54 L. Mass = (0.400 mol)(32.0 g/mol) = 12.8 g. Molecules = (0.400 mol)(6.02 × 10^{23} molecules/mol) = 2.41 × 10^{23} O_2 molecules.

Accept equivalent calculations with reasonable rounding. Predictions assume complete reaction and dry, ideal oxygen with no gas loss.