

# WHAT VARIABLE MUST BE HELD CONSTANT TO USE THE COMBINED GAS LAW? A. MASS OF GAS SAMPLE B. NUMBER OF MOLES

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UNDERSTANDING THE BEHAVIOR OF GASES IS FUNDAMENTAL IN CHEMISTRY, PHYSICS, AND MANY ENGINEERING DISCIPLINES. THE COMBINED GAS LAW IS A VITAL TOOL THAT HELPS SCIENTISTS AND STUDENTS PREDICT HOW A GAS'S PRESSURE, VOLUME, AND TEMPERATURE ARE RELATED UNDER DIFFERENT CONDITIONS. HOWEVER, TO EFFECTIVELY APPLY THE COMBINED GAS LAW, IT'S CRUCIAL TO RECOGNIZE WHICH VARIABLES MUST REMAIN CONSTANT DURING THE PROCESS. THIS ARTICLE EXPLORES THE CORE CONCEPTS BEHIND THE COMBINED GAS LAW, EMPHASIZING THE IMPORTANCE OF HOLDING CERTAIN VARIABLES CONSTANT—SPECIFICALLY FOCUSING ON WHETHER THE MASS OF THE GAS SAMPLE OR THE NUMBER OF MOLES MUST BE KEPT CONSTANT.

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## INTRODUCTION TO THE GAS LAWS

THE STUDY OF GASES INVOLVES UNDERSTANDING HOW THEY RESPOND TO CHANGES IN PRESSURE, VOLUME, AND TEMPERATURE. SEVERAL FUNDAMENTAL GAS LAWS DESCRIBE THESE RELATIONSHIPS:

- BOYLE'S LAW: AT CONSTANT TEMPERATURE AND AMOUNT OF GAS, PRESSURE AND VOLUME ARE INVERSELY PROPORTIONAL.
- CHARLES'S LAW: AT CONSTANT PRESSURE AND AMOUNT OF GAS, VOLUME AND TEMPERATURE ARE DIRECTLY PROPORTIONAL.
- GAY-LUSSAC'S LAW: AT CONSTANT VOLUME AND AMOUNT OF GAS, PRESSURE AND TEMPERATURE ARE DIRECTLY PROPORTIONAL.

THESE LAWS ARE SPECIAL CASES OF THE MORE COMPREHENSIVE COMBINED GAS LAW, WHICH CONSOLIDATES THEIR PRINCIPLES INTO A SINGLE EQUATION.

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## THE COMBINED GAS LAW EXPLAINED

THE COMBINED GAS LAW RELATES PRESSURE, VOLUME, AND TEMPERATURE FOR A FIXED AMOUNT OF GAS. IT IS EXPRESSED AS:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

WHERE:

- $(P_1, V_1, T_1)$ : INITIAL PRESSURE, VOLUME, AND TEMPERATURE.
- $(P_2, V_2, T_2)$ : FINAL PRESSURE, VOLUME, AND TEMPERATURE.

THIS FORMULA ALLOWS US TO CALCULATE THE CHANGE IN ONE VARIABLE WHEN THE OTHERS CHANGE, PROVIDED CERTAIN CONDITIONS ARE MET.

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# WHAT VARIABLES MUST BE HELD CONSTANT?

IN APPLYING THE COMBINED GAS LAW, UNDERSTANDING WHICH VARIABLES ARE HELD CONSTANT IS ESSENTIAL FOR ACCURATE CALCULATIONS. THE KEY QUESTION IS: WHAT VARIABLE MUST BE CONSTANT TO ENSURE THE LAW APPLIES CORRECTLY?

THE ANSWER HINGES ON THE CONDITIONS OF THE GAS SAMPLE DURING THE PROCESS. THE TWO MAIN VARIABLES IN QUESTION ARE:

- A. MASS OF GAS SAMPLE
- B. NUMBER OF MOLES

LET'S ANALYZE EACH TO UNDERSTAND THEIR ROLE.

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## OPTION A: MASS OF GAS SAMPLE

MASS OF GAS SAMPLE REFERS TO THE TOTAL WEIGHT OF THE GAS BEING CONSIDERED. IT RELATES TO THE QUANTITY OF GAS IN TERMS OF GRAMS. WHEN THE MASS REMAINS UNCHANGED, IT MEANS NO GAS IS ADDED OR REMOVED DURING THE PROCESS.

IMPLICATIONS:

- IF THE MASS OF GAS REMAINS CONSTANT, THEN THE NUMBER OF MOLES (WHICH IS DIRECTLY RELATED TO MASS) ALSO REMAINS CONSTANT, ASSUMING THE GAS'S MOLAR MASS IS UNCHANGED.
- HOLDING MASS CONSTANT IS OFTEN A PRACTICAL APPROACH IN LABORATORY SETTINGS, WHERE GASES ARE CONTAINED WITHIN A SEALED VESSEL THAT DOES NOT EXCHANGE GAS WITH THE SURROUNDINGS.

DOES THE COMBINED GAS LAW REQUIRE THE MASS TO BE CONSTANT?

- NOT NECESSARILY. THE LAW FUNDAMENTALLY DEPENDS ON THE NUMBER OF MOLES, WHICH IS A MEASURE OF THE AMOUNT OF GAS, NOT JUST MASS.
- BECAUSE DIFFERENT GASES HAVE DIFFERENT MOLAR MASSES, THE SAME MASS OF DIFFERENT GASES CORRESPONDS TO DIFFERENT NUMBERS OF MOLES.
- THEREFORE, UNLESS EXPLICITLY SPECIFIED, THE COMBINED GAS LAW PRESUMES THE AMOUNT OF GAS (IN MOLES) REMAINS UNCHANGED, WHICH IS DIRECTLY RELATED TO THE MASS BUT NOT NECESSARILY IDENTICAL, ESPECIALLY IF THE GAS'S MOLAR MASS IS KNOWN.

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## OPTION B: NUMBER OF MOLES

NUMBER OF MOLES (n) SIGNIFIES THE AMOUNT OF GAS IN TERMS OF MOLECULES OR PARTICLES, CALCULATED AS:

$$n = \frac{\text{Mass}}{\text{Molar Mass}}$$

WHY IS THIS IMPORTANT?

- THE COMBINED GAS LAW ASSUMES A FIXED QUANTITY OF GAS, REPRESENTED BY A CONSTANT NUMBER OF MOLES.
- WHEN THE NUMBER OF MOLES REMAINS CONSTANT, IT ENSURES THAT THE AMOUNT OF GAS DOES NOT CHANGE DURING THE PROCESS, MAKING THE LAW APPLICABLE DIRECTLY.

IN PRACTICE:

- If gas is added or removed from the system, the number of moles changes, violating the assumptions of the combined gas law.
- For accurate calculations, the system must be closed to gas exchange, keeping the number of moles constant.

CONCLUSION:

The number of moles is the variable that must be held constant to validly apply the combined gas law. Since the law relates to the behavior of a fixed amount of gas, ensuring the number of moles remains unchanged is critical.

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## Why Is Holding The Number Of Moles Crucial?

Holding the number of moles constant ensures the law's accuracy because:

- It isolates the effects of pressure, volume, and temperature on a fixed amount of gas.
- It prevents confounding variables where changes in the amount of gas could influence the observed relationships.
- It simplifies calculations and predictions, as the law does not account for changes in the quantity of gas.

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## Practical Considerations In Experiments

In real-world applications and laboratory experiments, maintaining a constant number of moles involves:

- Using sealed containers or closed systems to prevent gas exchange.
- Avoiding leaks or gas addition/removal during experiments.
- Ensuring temperature and pressure changes are within controlled parameters.

By controlling these factors, scientists can confidently apply the combined gas law to analyze and predict gas behavior.

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## Summary And Key Takeaways

| Variable           | Must Be Held Constant To Use The Combined Gas Law | Explanation                                                                                                                                                                                   |
|--------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mass of Gas Sample | No                                                | While related to the amount of gas, changing mass does not necessarily impact the law unless it changes the number of moles. Since mass depends on molar mass, it's not the primary variable. |
| Number of Moles    | Yes                                               | The combined gas law assumes a fixed amount of gas, represented by a constant number of moles, making this variable essential to hold constant.                                               |

In essence:

- The combined gas law applies when the number of moles of gas remains unchanged.
- Maintaining a constant mass is important but secondary, as long as it correlates to a fixed number of moles.
- For most accurate applications, controlling the number of moles via sealed systems is best practice.

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# FINAL THOUGHTS

UNDERSTANDING WHICH VARIABLES TO CONTROL IS FUNDAMENTAL FOR APPLYING THE COMBINED GAS LAW CORRECTLY. THE LAW'S VALIDITY HINGES ON KEEPING THE NUMBER OF MOLES CONSTANT BECAUSE IT DIRECTLY RELATES TO THE AMOUNT OF GAS UNDER CONSIDERATION. CHANGES IN PRESSURE, VOLUME, AND TEMPERATURE ARE INTERDEPENDENT, BUT THESE RELATIONSHIPS ARE ONLY VALID WHEN THE QUANTITY OF GAS REMAINS FIXED.

IN CONCLUSION, THE VARIABLE THAT MUST BE HELD CONSTANT TO USE THE COMBINED GAS LAW IS B. NUMBER OF MOLES. ENSURING THIS CONDITION ALLOWS FOR ACCURATE PREDICTIONS AND CALCULATIONS OF GAS BEHAVIOR IN VARIOUS SCIENTIFIC AND INDUSTRIAL APPLICATIONS.

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## REFERENCES:

- ATKINS, P., & DE PAULA, J. (2010). PHYSICAL CHEMISTRY. OXFORD UNIVERSITY PRESS.
- ZUMDAHL, S. S., & ZUMDAHL, S. A. (2014). CHEMISTRY: AN ATOMS FIRST APPROACH. CENGAGE LEARNING.
- UNIVERSITY LABORATORY MANUALS AND ACADEMIC RESOURCES ON GAS LAWS.

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REMEMBER: PROPER EXPERIMENTAL SETUP AND UNDERSTANDING THE CORE ASSUMPTIONS BEHIND THE GAS LAWS ARE ESSENTIAL FOR ACCURATE SCIENTIFIC WORK.

# FREQUENTLY ASKED QUESTIONS

## WHAT VARIABLE MUST BE HELD CONSTANT WHEN USING THE COMBINED GAS LAW?

THE NUMBER OF MOLES OF GAS MUST BE HELD CONSTANT.

## IN THE COMBINED GAS LAW, WHY IS THE NUMBER OF MOLES OF GAS KEPT CONSTANT?

BECAUSE CHANGING THE NUMBER OF MOLES WOULD ALTER THE AMOUNT OF GAS, AFFECTING THE RELATIONSHIP BETWEEN PRESSURE, VOLUME, AND TEMPERATURE, WHICH THE LAW ASSUMES REMAINS FIXED.

## DOES THE MASS OF THE GAS SAMPLE NEED TO BE CONSTANT TO APPLY THE COMBINED GAS LAW?

YES, BECAUSE THE MASS DIRECTLY RELATES TO THE NUMBER OF MOLES; MAINTAINING THE SAME MASS ENSURES THE NUMBER OF MOLES STAYS CONSTANT.

## CAN THE COMBINED GAS LAW BE USED IF THE MASS OF THE GAS SAMPLE CHANGES?

NO, THE COMBINED GAS LAW ASSUMES THE NUMBER OF MOLES (OR MASS) REMAINS CONSTANT; IF IT CHANGES, THE LAW NO LONGER APPLIES DIRECTLY.

## HOW ARE MASS AND NUMBER OF MOLES RELATED IN THE CONTEXT OF THE COMBINED GAS LAW?

MASS AND NUMBER OF MOLES ARE DIRECTLY PROPORTIONAL; KEEPING THE MASS CONSTANT ENSURES THE NUMBER OF MOLES REMAINS UNCHANGED DURING CALCULATIONS.

# ADDITIONAL RESOURCES

WHAT VARIABLE MUST BE HELD CONSTANT TO USE THE COMBINED GAS LAW? A. MASS OF GAS SAMPLE B. NUMBER OF MOLES

WHEN DELVING INTO THE FASCINATING WORLD OF GASES AND THEIR BEHAVIOR UNDER VARYING CONDITIONS, THE COMBINED GAS LAW STANDS OUT AS A FUNDAMENTAL PRINCIPLE THAT LINKS PRESSURE, VOLUME, AND TEMPERATURE. A COMMON QUESTION AMONG STUDENTS AND PROFESSIONALS ALIKE IS: WHAT VARIABLE MUST BE HELD CONSTANT TO USE THE COMBINED GAS LAW? THE ANSWER IS CRUCIAL FOR CORRECTLY APPLYING THE LAW AND ACCURATELY PREDICTING HOW GASES RESPOND TO CHANGES IN THEIR ENVIRONMENT. IN THIS GUIDE, WE WILL EXPLORE THIS QUESTION IN DEPTH, EXAMINING THE ROLES OF THE MASS OF THE GAS SAMPLE AND THE NUMBER OF MOLES, AND CLARIFYING WHICH VARIABLE MUST REMAIN UNCHANGED FOR THE LAW TO HOLD TRUE.

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## UNDERSTANDING THE COMBINED GAS LAW

BEFORE DIVING INTO THE SPECIFICS OF WHICH VARIABLE MUST BE HELD CONSTANT, IT'S ESSENTIAL TO UNDERSTAND WHAT THE COMBINED GAS LAW ACTUALLY STATES. THE LAW IS A SYNTHESIS OF BOYLE'S LAW, CHARLES'S LAW, AND GAY-LUSSAC'S LAW, AND IT DESCRIBES THE RELATIONSHIP BETWEEN PRESSURE (P), VOLUME (V), AND TEMPERATURE (T) FOR A FIXED AMOUNT OF GAS.

MATHEMATICALLY, THE COMBINED GAS LAW IS EXPRESSED AS:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

WHERE:

- $(P_1, V_1, T_1)$  ARE THE INITIAL PRESSURE, VOLUME, AND TEMPERATURE,
- $(P_2, V_2, T_2)$  ARE THE FINAL PRESSURE, VOLUME, AND TEMPERATURE.

THIS LAW ASSUMES THAT THE AMOUNT OF GAS REMAINS CONSTANT DURING THE PROCESS. IT ALLOWS US TO PREDICT HOW ONE PROPERTY OF A GAS WILL CHANGE WHEN THE OTHERS ARE VARIED, PROVIDED THAT CERTAIN VARIABLES ARE HELD CONSTANT.

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## THE CORE QUESTION: WHICH VARIABLE MUST BE HELD CONSTANT?

THE CENTRAL POINT OF THIS DISCUSSION IS UNDERSTANDING THE CONSTRAINTS UNDER WHICH THE COMBINED GAS LAW APPLIES. SPECIFICALLY, WHICH VARIABLE MUST BE HELD CONSTANT:

- A. MASS OF GAS SAMPLE
- B. NUMBER OF MOLES

THIS DISTINCTION IS FUNDAMENTAL BECAUSE IT INFLUENCES HOW WE INTERPRET AND APPLY THE LAW IN REAL-WORLD SCENARIOS.

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## CLARIFYING THE VARIABLES: MASS VS. MOLES

### A. MASS OF GAS SAMPLE

THE MASS OF A GAS SAMPLE REFERS TO THE TOTAL WEIGHT OF THE GAS, TYPICALLY MEASURED IN GRAMS OR KILOGRAMS. IF THE MASS REMAINS CONSTANT, IT IMPLIES THAT NO GAS HAS BEEN ADDED OR REMOVED FROM THE SAMPLE DURING THE PROCESS.

### B. NUMBER OF MOLES

THE NUMBER OF MOLES ( $n$ ) REPRESENTS THE AMOUNT OF SUBSTANCE, A FUNDAMENTAL UNIT IN CHEMISTRY THAT RELATES DIRECTLY TO THE NUMBER OF PARTICLES (ATOMS, MOLECULES, OR IONS). THE MOLE CONCEPT PROVIDES A STANDARDIZED WAY TO QUANTIFY THE AMOUNT OF GAS INDEPENDENT OF ITS MASS, ESPECIALLY CONSIDERING GASES' MOLAR MASSES.

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## THE RELATIONSHIP BETWEEN MASS AND MOLES

UNDERSTANDING THE DISTINCTION BETWEEN MASS AND MOLES IS CRUCIAL BECAUSE THEY ARE RELATED BUT NOT IDENTICAL:

$$\text{NUMBER OF MOLES } (n) = \frac{\text{MASS } (m)}{\text{MOLAR MASS } (M)}$$

- IF THE MOLAR MASS REMAINS CONSTANT (WHICH IT DOES FOR A PURE SUBSTANCE), THEN A CHANGE IN MASS DIRECTLY AFFECTS THE NUMBER OF MOLES.
- CONVERSELY, IF THE NUMBER OF MOLES REMAINS CONSTANT, THEN THE MASS REMAINS CONSTANT ONLY IF THE MOLAR MASS DOES NOT CHANGE.

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## WHICH VARIABLE MUST BE HELD CONSTANT IN THE COMBINED GAS LAW?

THE KEY TO CORRECTLY APPLYING THE COMBINED GAS LAW LIES IN UNDERSTANDING THAT IT INHERENTLY ASSUMES THE AMOUNT OF GAS, EXPRESSED IN TERMS OF MOLES, REMAINS UNCHANGED DURING THE PROCESS.

THEREFORE, THE VARIABLE THAT MUST BE HELD CONSTANT IS:

> B. NUMBER OF MOLES

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## WHY MUST THE NUMBER OF MOLES BE HELD CONSTANT?

THE COMBINED GAS LAW IS DERIVED FROM THE IDEAL GAS LAW:

$$PV = nRT$$

WHERE:

- $P$  = PRESSURE,
- $V$  = VOLUME,
- $n$  = NUMBER OF MOLES,
- $R$  = IDEAL GAS CONSTANT,
- $T$  = TEMPERATURE.

IN DERIVING THE COMBINED GAS LAW, THE ASSUMPTION IS THAT  $n$  REMAINS CONSTANT. WHEN  $n$  IS CONSTANT, THE LAW SIMPLIFIES TO RELATE PRESSURE, VOLUME, AND TEMPERATURE ALONE, WITHOUT THE COMPLICATION OF CHANGING AMOUNTS OF GAS.

IMPLICATIONS OF HOLDING  $n$  CONSTANT:

- THE LAW IS APPLICABLE DURING PROCESSES WHERE NO GAS IS ADDED OR REMOVED.
- THE GAS SAMPLE REMAINS CHEMICALLY UNCHANGED; ITS AMOUNT IN MOLES STAYS CONSTANT.
- THE LAW ACCURATELY PREDICTS HOW PRESSURE, VOLUME, AND TEMPERATURE CHANGE RELATIVE TO EACH OTHER.

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## WHY NOT JUST THE MASS OF GAS?

WHILE KEEPING THE MASS OF GAS SAMPLE CONSTANT MIGHT SEEM SUFFICIENT, IN PRACTICE, IT'S NOT THE PRIMARY VARIABLE FOR THE LAW'S VALIDITY. THIS IS BECAUSE:

- DIFFERENT GASES WITH THE SAME MASS CAN HAVE DIFFERENT MOLAR MASSES, LEADING TO DIFFERENT NUMBERS OF MOLES.
- THE BEHAVIOR DESCRIBED BY THE COMBINED GAS LAW DEPENDS ON THE NUMBER OF PARTICLES (MOLES), NOT JUST THE TOTAL MASS.

IN OTHER WORDS:

- TWO SAMPLES OF GASES WITH THE SAME MASS BUT DIFFERENT MOLAR MASSES DO NOT BEHAVE IDENTICALLY UNDER THE SAME CONDITIONS.
- FOR ACCURATE APPLICATION OF THE LAW, THE FOCUS MUST BE ON THE NUMBER OF MOLES (WHICH DIRECTLY RELATES TO PARTICLE COUNT), NOT JUST MASS.

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## PRACTICAL EXAMPLES AND APPLICATIONS

EXAMPLE 1: A SEALED CONTAINER WITH A FIXED AMOUNT OF GAS IS HEATED FROM 20°C TO 100°C. SINCE NO GAS ENTERS OR LEAVES, THE NUMBER OF MOLES REMAINS CONSTANT. THE COMBINED GAS LAW CAN BE USED TO CALCULATE THE NEW PRESSURE OR VOLUME, PROVIDED YOU KEEP THE MOLES CONSTANT.

EXAMPLE 2: IN A LABORATORY, A GAS SAMPLE IS TRANSFERRED FROM ONE VESSEL TO ANOTHER, OR A GAS IS COMPRESSED OR EXPANDED, BUT NO GAS IS ADDED OR REMOVED. AGAIN, THE NUMBER OF MOLES REMAINS UNCHANGED, MAKING THE COMBINED GAS LAW APPLICABLE.

COUNTER-EXAMPLE: IF GAS IS PUMPED IN OR OUT OF THE SYSTEM, THE NUMBER OF MOLES CHANGES, AND THE COMBINED GAS LAW NO LONGER APPLIES UNLESS ADJUSTMENTS ARE MADE TO ACCOUNT FOR THIS CHANGE.

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## SUMMARY OF KEY POINTS

- THE COMBINED GAS LAW ASSUMES A FIXED AMOUNT OF GAS—MEANING THE NUMBER OF MOLES REMAINS CONSTANT.
- HOLDING THE NUMBER OF MOLES CONSTANT ENSURES THAT THE PREDICTIONS AND CALCULATIONS BASED ON THE LAW ARE VALID.
- MASS OF THE GAS SAMPLE IS NOT THE PRIMARY VARIABLE; INSTEAD, THE NUMBER OF MOLES (WHICH RELATES DIRECTLY TO THE PARTICLES PRESENT) IS CRUCIAL FOR THE LAW'S APPLICATION.
- IF THE AMOUNT OF GAS CHANGES, THE IDEAL GAS LAW MUST BE MODIFIED OR EXPANDED TO ACCOUNT FOR THIS VARIATION.

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## FINAL THOUGHTS

UNDERSTANDING WHICH VARIABLE MUST BE HELD CONSTANT WHEN APPLYING THE COMBINED GAS LAW IS FUNDAMENTAL FOR ACCURATE SCIENTIFIC ANALYSIS. WHILE THE MASS OF THE GAS SAMPLE MIGHT SEEM LIKE AN OBVIOUS CANDIDATE, IT IS THE NUMBER OF MOLES THAT FUNDAMENTALLY GOVERNS THE BEHAVIOR OF GASES IN THIS CONTEXT. RECOGNIZING THIS DISTINCTION ALLOWS CHEMISTS, PHYSICISTS, AND STUDENTS TO CORRECTLY APPLY THE LAW AND INTERPRET EXPERIMENTAL RESULTS WITH CONFIDENCE.

IN CONCLUSION:

THE VARIABLE THAT MUST BE HELD CONSTANT TO USE THE COMBINED GAS LAW IS B. NUMBER OF MOLES.

## **What Variable Must Be Held Constant To Use The Combined Gas Law A Mass Of Gas Sample B Number Of Moles**

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