Name: _____

Student Study Guide

40S Chemistry

The Gas Laws

Name _____ Date _____

Gases

Before You Read

Review Vocabulary **Define** *the following terms.*

density _____

stoichiometry _____

_____

kinetic-molecular theory _____

_____

Chapter 9 **Balance** *the following equation.*

___Fe + ___H_2SO_4 ⟶ $Fe_2(SO_4)_3$ + ___H_2

Chapter 11 **Show** *the mole ratios for the following reaction.*

$N_2 + 3H_2 \longrightarrow 2NH_3$

1. **a.** mole ratio of N to H_2

2. **b.** mole ratio of NH_3 to H_2

Chapter 12 **Explain** *how gas particles exert pressure.*

_____

_____

Name _____ Date _____

Gases

Section 1 The Gas Laws

Main Idea — **Details**

Scan *Section 1 of your text. Use the checklist below as a guide.*

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

Write *three facts you discovered about the gas laws.*

1. _____
2. _____
3. _____

New Vocabulary *Use your text to define each term.*

Boyle's law _____

_____

absolute zero _____

Charles's law _____

_____

Gay-Lussac's law _____

_____

combined gas law _____

_____

Name _____ Date _____

Section 1 The Gas Laws (continued)

Main Idea — **Details**

Boyle's Law

Use with Example Problem 1, page 443.

Solve *Read Example Problem 1 in your text.*

You Try It

Problem

Helium gas in a balloon is compressed from 4.0 L to 2.5 L at constant temperature. The gas's pressure at 4.0 L is 210 kPa. Determine the pressure at 2.5 L.

1. **Analyze the Problem**

   Known:

   $V_1 =$ _____

   $V_2 =$ _____

   $P_1 =$ _____

   Unknown:

   P_2 _____

   Use the equation for Boyle's law to solve for P_2.

2. **Solve for the Unknown**

   Write the equation for Boyle's law: _____

   To solve for P_2, divide both sides by V_2. $P_2 =$

   Substitute the known values. $P_2 =$

   Solve for P_2. $P_2 =$ _____

3. **Evaluate the Answer**

   When the volume is _____, the pressure is _____. The answer is in ____, a unit of pressure.

Name _____ Date _____

Section 1 The Gas Laws (continued)

Main Idea — **Details**

Charles's Law

Use with Example Problem 2, page 446.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 2.*

Problem

A gas sample at 40.0°C occupies a volume of 2.32 L. Assuming the pressure is constant, if the temperature is raised to 75.0°C, what will the volume be?

1. Analyze the Problem

Known:

$T_1 =$ _____

$V_1 =$ _____

$T_2 =$ _____

Unknown:

$V_2 =$ _____

Use Charles's law and the known values for T_1, V_1, and T_2 to solve for V_2.

2. Solve for the Unknown

Convert the T_1 and T_2 Celsius temperatures to kelvin:

$T_1 = 273 + 40.0°C =$ _____K $T_2 = 273 + 75.0°C =$ _____ K

Write the equation for Charles's law:

$$=$$

To solve for V_2, multiply both sides by T_2:

$$V_2 =$$

Substitute known values:

$$V_2 =$$

Solve for V_2.

$V_2 =$ _____

3. Evaluate the Answer

When temperature in kelvin increases by a small amount, the volume _____ by a small amount. The answer is in _____, a unit for volume.

Name _____ Date _____

Main Idea

Gay-Lussac's Law

Use with Example Problem 3, page 448.

Details

Solve *Read Example Problem 3 in your text.*

You Try It

Problem

The pressure of a gas stored in a refrigerated container is 4.0 atm at 22.0°C. Determine the gas pressure in the tank if the temperature is lowered to 0.0°C.

1. Analyze the Problem

Known:

$P_1 = 4.0$ atm

$T_1 =$ _____

$T_2 =$ _____

Unknown:

$P_2 = ?$ _____

Use Gay-Lussac's law and the known values for T_1, V_1, and T_2 to solve for V_2.

2. Solve for the Unknown

Convert the T_1 and T_2 Celsius figures to kelvin.

$T_1 =$ ___ + 22.0°C = ___ K

$T_2 = 273 +$ ___ °C = ___ K

Write the equation for Gay-Lussac's law.

To solve for P_2, multiply both sides by T_2.

$P_2 =$

Substitute known values.

$P_2 =$

Solve for P_2.

$P_2 = 3.7$ atm

3. Evaluate the Answer

The temperature _____ and the pressure _____.

Name _____ Date _____

Section 1 The Gas Laws (continued)

Main Idea — **Details**

The Combined Gas Law

Use with page 449.

Describe *the combined gas law.*

_____

_____

Write *the combined gas law equation.*

=

Pressure is inversely proportional to _____ and directly proportional to _____. Volume also is _____ to temperature.

Use with Example Problem 4, page 450.

Solve *Read Example Problem 4 in your text.*

You Try It

Problem

A gas at 100.0 kPa and 30.0°C has an initial volume of 1.00 L. Determine the temperature that could support the gas at 200.0 kPa and a volume of 0.50 L.

1. **Analyze the Problem**

   Known:

   P_1 = _____

   P_2 = _____

   T_1 = _____

   V_1 = _____

   V_2 = _____

   Unknown:

   T_2 = ? °C

   Remember that volume increases as temperature increases, and volume is inversely proportional to pressure.

2. **Solve for the Unknown**

   Convert the T_1 Celsius temperature to kelvin.

   T_1 = _____ + 30.0°C = _____ K

Name _____ Date _____

Section 1 The Gas Laws (continued)

Main Idea — **Details**

Write the combined gas law equation.

To solve for T_2, multiply both sides of the equation by T_2.

$$\frac{\quad}{T_1} = P_2V_2$$

Multiply both sides of the equation by T_1.

$$T_2\, P_1\, V_1 = \_\_\_\_\_$$

Divide both sides of the equation by $P_1\, V_1$.

$$T_2 =$$

Substitute known values.

$$T_2 = \frac{\quad}{100.0\ \text{kPa} \times 1.00\ \text{L}}$$

Solve for T_2.

$$T_2 = 303\ \text{K} - 273\ \text{K} = 30.0°\text{C}$$

3. **Evaluate the Answer**

As pressure _____ and volume _____ in proportional amounts, the temperature remained constant.

Name _____ Date _____

Gases

Section 2 The Ideal Gas Law

Main Idea

Details

Skim *Section 2 of your text. Write three questions that come to mind from reading the headings and the illustration captions.*

1. _____

2. _____

3. _____

New Vocabulary

Use your text to define each term.

Avogadro's principle _____

_____

molar volume _____

_____

standard temperature and pressure (STP) _____

_____

ideal gas constant (R) _____

_____

ideal gas law _____

_____

Name _____ Date _____

Section 2 The Ideal Gas Law (continued)

Main Idea — **Details**

Avogadro's principle

Use with pages 452–453.

Explain *Avogadro's principle by completing the paragraph below.*

Avogadro's principle states that _____

_____.

The _____ volume for a gas is the volume that one mole occupies at _____ of pressure and a temperature of _____.

Convert the following volumes of a gas at STP to moles by using 22.4 L/mol as the conversion factor.

$$2.50\,\text{L} \times \frac{1\,\text{mol}}{22.4\,\text{L}} = \_\_\_\_\_$$

$$7.34\,\text{L} \times \frac{1\,\text{mol}}{22.4\,\text{L}} = \_\_\_\_\_$$

$$4.7\,\text{L} \times \frac{1\,\text{mol}}{22.4\,\text{L}} = \_\_\_\_\_$$

Name _____ Date _____

Section 2 The Ideal Gas Law (continued)

Main Idea	Details
The Ideal Gas Law *Use with pages 454–455.*	**Analyze** *the ideal gas law.* The equation is written _____ = _____ *P* represents _____ *V* represents _____ *n* represents the number of _____ of gas present R represents the _____ _____ represents temperature The ideal gas law states that _____ _____ _____. The value of R depends on the units used for _____.
Real Versus Ideal Gases *Use with pages 457–459.*	**Describe** *the properties of an ideal gas.* _____ _____ **Describe** *the properties of a real gas.* _____ _____

Name _____ Date _____

Section 2 The Ideal Gas Law (continued)

Main Idea — **Details**

The Ideal Gas Law

Use with Example Problem 6, page 455.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 6.*

Problem

Calculate the number of moles of a gas contained in a 3.0-L vessel at 3.00×10^2 K with a pressure of 1.50 atm.

1. Analyze the Problem

Known:

$V =$ _____

$T =$ _____

$P =$ _____

R = _____

Unknown:

$n =$? mol

Use the known values to find the value of n.

2. Solve for the Unknown

Write the ideal gas law equation.

_____

To solve for n, divide both sides by RT.

$n =$

Substitute known values into the equation.

$n =$

Solve for n.

$n =$

$n =$ _____

3. Evaluate the Answer

The answer agrees with the prediction that the number of moles will be _____ one mole. The unit in the answer is the _____.

Name _____ Date _____

Gases

Section 3 Gas Stoichiometry

Main Idea — **Details**

Scan *Section 3 of your text. Use the checklist below as a guide.*

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

Write *three facts you discovered about gas stoichiometry.*

1. _____
2. _____
3. _____

Academic Vocabulary

Define the following terms.

ratio _____