Virden Collegiate Institute

30S Chemistry

Behavior of Gases
Student Study Guide

Gases

Before You Read

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

density

stoichiometry

kinetic-molecular theory

Chapter 10 **Balance** *the following equation.*

$$\_\_Fe + \_\_H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + \_\_H_2$$

Chapter 12 **Show** *the mole ratios for the following reaction.*

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

a. mole ratio of N to H_2

b. mole ratio of NH_3 to H_2

Chapter 13 **Explain** *how gas particles exert pressure.*

Gases

Section 14.1 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 _____

_____

Charles's law _____

_____

Gay-Lussac's law _____

_____

Academic Vocabulary *Define the following term.*

theory _____

Main Idea — Details

Kinetic Theory

Use with pages 419–420.

List *the five assumptions the kinetic theory makes about gases.*

1. _____
2. _____
3. _____
4. _____
5. _____

Boyle's Law

Use with Example Problem 14-1, page 422.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 14-1.*

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.

Main Idea — Details

Charles's Law

Use with Example Problem 14–2, page 425.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 14-2.*

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: Unknown:

T_1 = _____

V_1 = _____ V_2 = ___

T_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.

Main Idea — Details

Gay-Lussac's Law

Use with Example Problem 14-3, page 426.

Solve *Read Example Problem 14-3 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 _____.

Gases

Section 14.2 The Combined Gas Law and Avogadro's Principle

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.*

combined gas law _____

_____

Avogadro's principle _____

_____

molar volume _____

Academic Vocabulary *Define the following term.*

convert _____

Main Idea — Details

The Combined Gas Law

Use with page 428.

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 14-4, page 429.

Solve *Read Example Problem 14-4 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

Section 14.2 The Combined Gas Law and Avogadro's Principle (continued)

Main Idea — **Details**

Write the combined gas law equation.

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

$$\frac{\quad}{T_1} = P_2 V_2$$

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.

Avogadro's Principle

Use with pages 430–431.

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 _____.

Gases

Section 14.3 The Ideal Gas Law

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 the ideal gas law.*

1. _____
2. _____
3. _____

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

ideal gas constant (R) _____

_____

ideal gas law _____

_____

Academic Vocabulary *Define the following term.*

volume _____

Name _____ Date _____

Section 14.3 The Ideal Gas Law (continued)

Main Idea — **Details**

The Ideal Gas Law

Use with pages 434–435.

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 _____.

Describe *the properties of an ideal gas.*

_____

_____

Describe *the properties of a real gas.*

_____

_____

Main Idea — Details

The Ideal Gas Law–Using Moles

Use with Example Problem 14-7, pages 436–437.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 14-7.*

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 R*T*.

$n =$

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 ____ .

Gases

Section 14.4 Gas Stoichometry

Main Idea — **Details**

Scan *Section 4 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.*

react _____

involve _____

affect _____

proportion _____

Main Idea — Details

Calculations Involving Only Volume

Use with page 440.

Indicate *the moles and volume for the reaction below. Use Figure 14-12 as a reference.*

$2C_4H_{10}(g) + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O(g)$

___ moles	___ moles	___ moles	___ moles
___ volume	___ volumes	___ volumes	___ volumes

The coefficients in the balanced equation represent _____ amounts and relative _____.

Volume-Volume Problems

Use with Example Problem 14-9, page 441.

Summarize *Fill in the blanks to help you take notes while you read Example Problem 14-9.*

Problem

Determine the volume of oxygen gas needed for the complete combustion of 4.00 L of propane gas (C_3H_8).

1. Analyze the Problem

Known: Unknown:

V of C_3H_8 = _____ V of O_2 = ? L

Use the known volume of 4.00 L to find the volume needed for the combustion.

2. Solve for the Unknown

Write the balanced equation for the combustion of C_3H_8.

_____

Write the volume ratio.

Multiply the known volume of propane by the volume ratio to find the volume of O_2.

3. Evaluate the Answer

The coefficients of the reactants show that the quantity of _____ consumed is greater than the amount of propane. The unit of the answer is the ___, a unit of volume.

Gases Chapter Wrap-Up

After reading the chapter, review what you have learned. Match each of the gas laws with its equation.

—— Ideal gas law	**1.** $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
—— Gay-Lussac's law	**2.** $P_1V_1 = P_2V_2$
—— Charles's law	**3.** $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
—— Combined gas law	**4.** $PV = nRT$
—— Boyle's law	**5.** $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Review

Use this checklist to help you study.

- ☐ Study your Science Notebook for this chapter.
- ☐ Study the vocabulary words and scientific definitions.
- ☐ Review daily homework assignments.
- ☐ Reread the chapter and review the tables, graphs, and illustrations.
- ☐ Review the Section Assessment questions at the end of each section.
- ☐ Look over the Study Guide at the end of the chapter.

Real-World Connection

Explain why the volume of a balloon increases as you blow into it instead of bursting immediately from the added pressure.