

WORKBOOK 5: SI UNITS

STATE CONTENT STANDARDS

Investigation and Experimentation, 1e: Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.

MAJOR CONCEPTS

- Learn SI Units
- Learn base, prefixes, and derived SI units
- Learn metric system to measure length, volume, and mass

BEFORE YOU START THIS GUIDE

You *must* know the concepts stated in previous learning guides. Also, be prepared to spend a lot of time learning these units. You'll struggle the rest of the year unless you know these units really well. Take your time and make sure you have everything memorized. Use the StudyStack page on TheChemBook.com to practice.

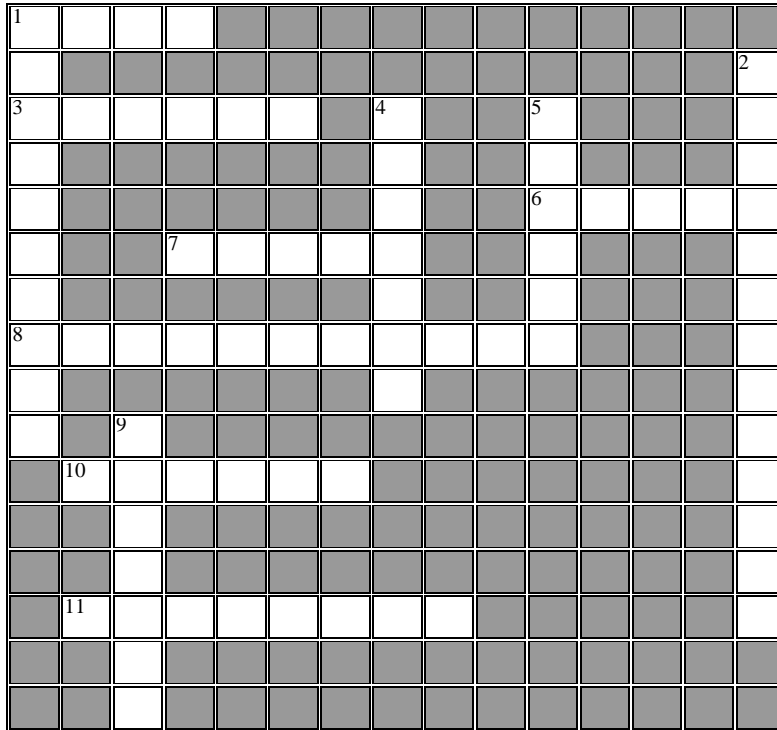
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VOCABULARY

Define each vocabulary word and complete the included crossword and word search puzzles.

- | | | |
|------------|------------------|-----------------|
| 1. Celsius | 5. Liter | 9. SI Units |
| 2. Density | 6. Mass | 10. Temperature |
| 3. Kelvin | 7. Metric System | 11. Units |
| 4. Length | 8. Milliliter | 12. Volume |



DOWN

- 1 cubic centimeter
- 2. The most widely used system of the English system
- 4. A property of matter representing the mass per unit volume
- 5. The amount of 3 dimensional space
- 9. A form of temperature which equals $K+273=?$

ACROSS

- 1. The quantity of matter in an object
- 3. The fundamental Si Units of meters
- 6. Rhymes with meter and it slightly larger than a quart
- 7. Part of a measurement that tells us what scale or standard has been used
- 8. Measure of the random motions of the components of a substance
- 10. SI Unit of temperature
- 11. International system of units based on the metric system

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WORD SEARCH

V N D V O L U M E U W I A W
K I C S F K Q M I L I T E R
P L G V I D E N S I T Y G S
V O S Z X U W N W M K Q G R
N I V L E K N C L Q C B W E
M E T S Y S C I R T E M S T
R Z P E W I W Z T T M X Y I
W F L E N G T H O S Q V P L
T E M P E R A T U R E C C I
A F Y O U N U M M I T W K L
J W L X H P Y Y A M K H R L
H B L C E L S I U S M K S I
R E K G H G C M L C S U I M
W P I X U N I T S P P V D W

Celsius, metric system, density, milliliters, kelvin, SI units, length, temperature, liter, units, mass, and volume

READING GUIDE

Complete Reading Guide 5

CHAPTER 5

1. What are the two types of observations?
2. What is the other name for a quantitative observation?
3. Of what two things must a measurement consist to be meaningful?

5.2 Title: _____

4. What do the units of a measurement tell us?
5. The SI units are based on _____ and _____ derived from the _____.
6. The two most widely used system are _____ and _____.
7. List the name and symbol of the SI unit for...
mass

length

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time

temperature

8. List the symbol and meaning for the SI prefixes...

kilo-

deci-

centi-

milli-

5.3 Title: _____

9. What is volume?

10. What is another name for 1 dm^3 ? _____ What is its abbreviation?

11. What is another name for 1 cm^3 ? _____ What is its abbreviation?

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12. With what piece of laboratory glassware do we often measure volumes of liquids?

13. What do we mean by mass?

14. What are the 3 most commonly used metric units and symbols for mass?

15. With what instrument do we measure mass in the laboratory?

5.8 Title: _____

1. Define density.
2. The volume of a _____ object is often determined _____ by submerge
3. What is the formula for density?
4. The more _____ and the _____ a person has, the higher his or her body density.
5. Define specific gravity.
6. What property of density makes it useful as an aid in identifying substances?
7. If 89.2 mL of a liquid has a mass of 752g, calculate the liquid's density.

COMPLETE SELF-CHECK EXERCISE 5.9 (P. 144).

READING

PART II: Important Facts (List seven important facts found during the reading)

Section 5.2

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Section 5.3

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Section 5.8

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

LECTURE NOTES

5.2 Units

Measurements involve the number and the units. The units' part provides the scale for comparison to other numbers.

A. SI Base Units

In 1960 a committee created a common set of units based on the metric system known as the (SI systems of measurement: Le Systeme International d'Unites)

1. Mass - kilogram, kg

a. Mass is a measure of the amount of matter contained in an object (versus weight?)

(1) Mass does not change with a change in position

b. Weight is a measure of the force of attraction between an object and the earth

(1) Weight may change with a change in position

2. Length - meter, m

3. Time - second, s

4. **Temperature** - kelvin, K

5. **Amount of substance** - mole, mol

B. Prefixes

1. Decimal system with each component a multiple or subdivision of 10

2. Common prefixes used in chemistry

Place the prefix in front of the SI unit (e.g. millimeter, centimeter)

a. milli- = 1/1000

b. centi- = 1/100

c. deci- = 1/10

d. kilo- = 1000

C. Derived Units

1. Combinations of SI base units form derived units

Quantity	Quantity Symbol	Unit	Unit Abbreviation	Derivation
Area	A	Square meter	m ²	length x width
Volume	V	Cubic meter	m ³	Length x width x height
Density	D	Kilogram per cubic meter	Kg/m ³	<u>Mass</u> Volume
<i>Energy</i>	E	Joule	J	Force x length

5.3 Measurements of length, volume, and mass

A. Length

Fundamental SI unit of length is the meter

Table 5.3 prefixes for measuring length		
Kilometer	Km	10^3 m
Meter	M	1 m
Centimeter	Cm	10^{-2} m
Millimeter	Mm	10^{-3} m

B. Volume (VOLUME IS NOT AN SI BASE UNIT; IT IS DERIVED FROM LENGTH)

Definition: three-dimensional space occupied by a substance.

The fundamental SI unit is based on the measure of a 1 meter cube

$$L \times W \times H = 1\text{m}^3$$

Divide cube into 1000 smaller cubes = 1dm^3

This is called a liter ($1\text{L} = 1\text{dm}^3$)

$$1\text{cm}^3 = 1 \text{ millimeter} = (1\text{mL}) = 1 \text{ cc or cubic centimeter}$$

Use a **graduated cylinder** to measure the volume of liquids

Always watch the **meniscus** to determine the correct volume.

C. Mass

Definition: the quantity of matter present in an object

The fundamental SI unit for mass is a kilogram.

In our lab we use a balance to determine mass.

Table 5.5 The most commonly used units for mass

Kilogram	Kg	10^3 g or 1000 grams
gram	G	1 g
Milligram	Mg	10^{-3} g

5.8 Density

Density is a derived unit. We combine the units for mass and volume.

A. Definition: The amounts of matter present in a given volume of substance; that is, **density is mass per unit volume** or the ratio of mass of an object to its volume.

B. The formula:

$D = m/v$ where d is density, m is mass, and v is volume

- i. The **mass** is determined by placing the object on a balance.
- ii. The **volume** of a solid is determined by submerging the object into water and measuring the displaced water.
- iii. Units may be g/mL^3

QUESTIONS AND PROBLEMS

1. Complete the following table

Measurement	SI unit
Length	
Volume	
Mass	
Temperature	

2. Indicate the meaning (as a power of 10) for each of the following prefixes

- | | |
|-----------|-----------|
| a. Kilo- | d. Deci- |
| b. Centi- | e. Nano- |
| c. Milli- | f. Micro- |

3. The length 52.2 mm can also be expressed as _____ cm.

4. Calculate the density in grams per cubic centimeter.

- a. Mass = 4.53 kg; volume = 225 cm³
- b. Mass = 26.3g; volume = 25.0 mL

WARNING

Learning Guide 05 is tricky for many students. Students fail to memorize the SI base units and prefixes – and struggle with Learning Guide 06 because these units are heavily involved in solving chemistry problems. Practice writing the SI base units and prefixes.

Recall that there are two parts to every measurement. The units are just as important as the numbers!