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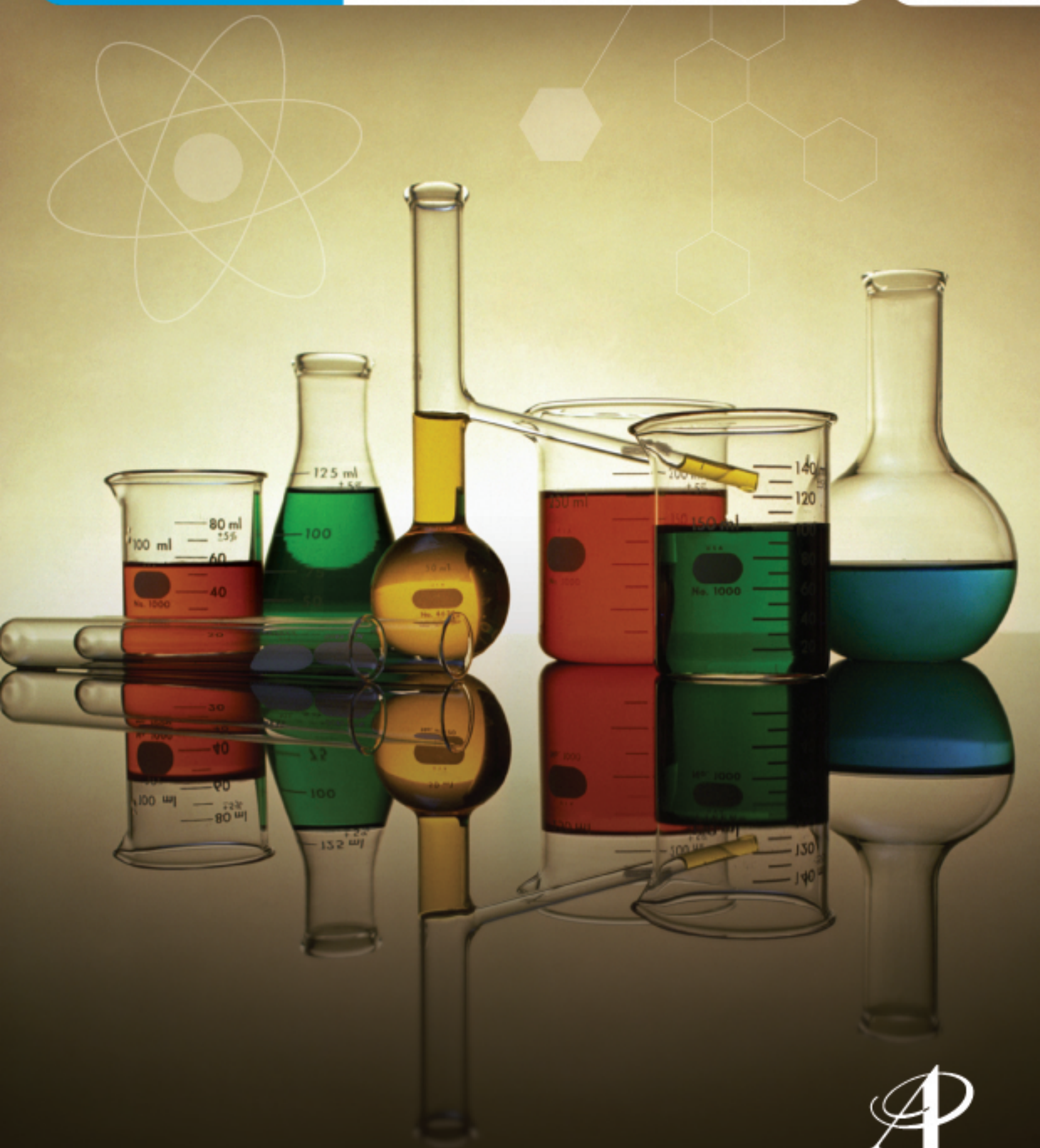
Science



Alpha Omega Publications®

SCIENCE 1201
KINEMATICS

CONTENTS

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KINEMATICS

You are about to begin a study of physics, the fundamental science of the natural world. This course is your opportunity to study laws that God established when He created heaven and earth. We will start with kinematics, which is a branch of mechanics dealing with the mathematical methods of describing motion. Motion is defined as a continuous change of position.

OBJECTIVES

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC®.

When you have finished this LIFEPAC, you should be able to:

1. Identify the fundamental units of physics.
2. Use scientific notation in calculations.
3. Use prefixes of the metric system.
4. Identify and explain scalar quantities.
5. Calculate vectors using vector arithmetic.
6. Distinguish between distance and displacement.
7. Calculate problems involving distance and displacement.
8. Calculate problems involving area, volume, and density.
9. Distinguish between speed (a scalar) and velocity.
10. Calculate problems involving speed and velocity.
11. Distinguish between average speed and average velocity.
12. Calculate problems involving average speed and average velocity.
13. Identify the circumstances that produce acceleration.
14. Calculate problems involving acceleration.
15. Describe a field.
16. Define a model.

Survey the LIFEPAC. Ask yourself some questions about this study. Write your questions here.

I. UNITS, SCALARS, AND VECTORS

Prior to studying motion, you will need to become acquainted with units used in this course—the metric system—and the concept of **scalar** and **vector** quantities.

SECTION OBJECTIVES

Review these objectives. When you have completed this section, you should be able to:

1. Identify the fundamental units of physics.
2. Use scientific notation in calculations.
3. Use prefixes of the metric system.
4. Identify and explain scalar qualities.
5. Calculate vectors using vector arithmetic.

VOCABULARY

Study these words to enhance your learning success in this section.

component	mass	scientific notation
inertia	prefix	time
length	resultant	vector
kinematics	scalar	

UNITS

You will use primarily the *MKS* (meter-kilogram-second) *system* or the *cgs* (centimeter-gram-second) *system* in this course. Let's review these systems.

Time. **Time**, according to Sir Isaac Newton, is that which flows onward uniformly. It is a fundamental, indefinable unit in physics. A day is a logical portion of time. However, the reason for dividing the day into twenty-four portions called *hours* is obscure. The hour is divided into sixty equal portions called *minutes*, and the minute into sixty equal portions called *seconds*.

Length. **Length** is the measurement describing the distance from one location to another. Historically, every nation had its own unit of length. We will use the *meter* (a little longer than a yard) and the *centimeter* (a little less than half an inch) as units of length. Length, too, is a fundamental, indefinable unit in physics.

Mass. The third fundamental unit in physics is **mass**, which can be defined as the quantity of matter that a body possesses. We will use the kilogram (approximately the mass of an object weighing two pounds at sea level) or the *gram*, which is one-thousandth of a kilogram. Please note that the kilogram is *not equal* to 2.2 pounds, because a pound is a unit of force and not a unit of mass. However we can define the kilogram as equivalent to the mass that weighs 2.2 pounds at sea level. This distinction between mass and weight is important and is quite often misstated.

Another means of defining *mass* is to use the term **inertia**, which is the apparent resistance of matter to a change in motion.

All other measurements (with the exception of temperature and electric current) are defined in terms of time, length, and mass.

You should understand these concepts before continuing. Figure 1 lists the fundamental metric units and their multiples and subdivisions. Notice the abbreviations given.

Length
1 meter (m) = the standard unit = 39.37 inches = 3.28 feet
1 centimeter (cm) = 0.01 meter
1 millimeter (mm) = 0.1 centimeter = 0.001 meter
1 kilometer (km) = 1000 meters = 0.621 mile

Time
1 second (s) = the standard unit
1 minute (min) = 60 seconds
1 hour (fur) = 60 minutes = 3600 seconds
1 day = 24 hours = 86,400 seconds

Mass
1 kilogram (kg) =the standard unit
1 gram (g) = 0.001 kilogram
1 milligram (mg) = 0.001 gram = 0.000;001 kg
(1 kilogram corresponds to 2.21 pounds in the sense that the weight of 1 kilogram is 2.21 pounds at sea level.)

FIGURE 1:
METRIC UNITS

Complete these sentences.

1.1 That which flows onward uniformly, of which a day is a logical portion, is called _____ .

1.2 The distance from one place to another is _____ .

1.3 The term used to describe the quantity of matter that a body possesses is _____ .

1.4 The branch of mechanics dealing with the mathematical methods of describing motion is called _____ .

Do this investigation.

Anyone can measure most masses using equal-arm or triple-beam balances, but what about measuring very small objects? Expensive equipment is not necessary.

These supplies will be needed:

- 1 screw
- 1 paper straw
- 2 microscope slides
- 1 needle
- 1 ruler
- 1 razor blade or scissors
- 1 small wood block
- 1 tongue depressor
- 1 clothespin
- paper

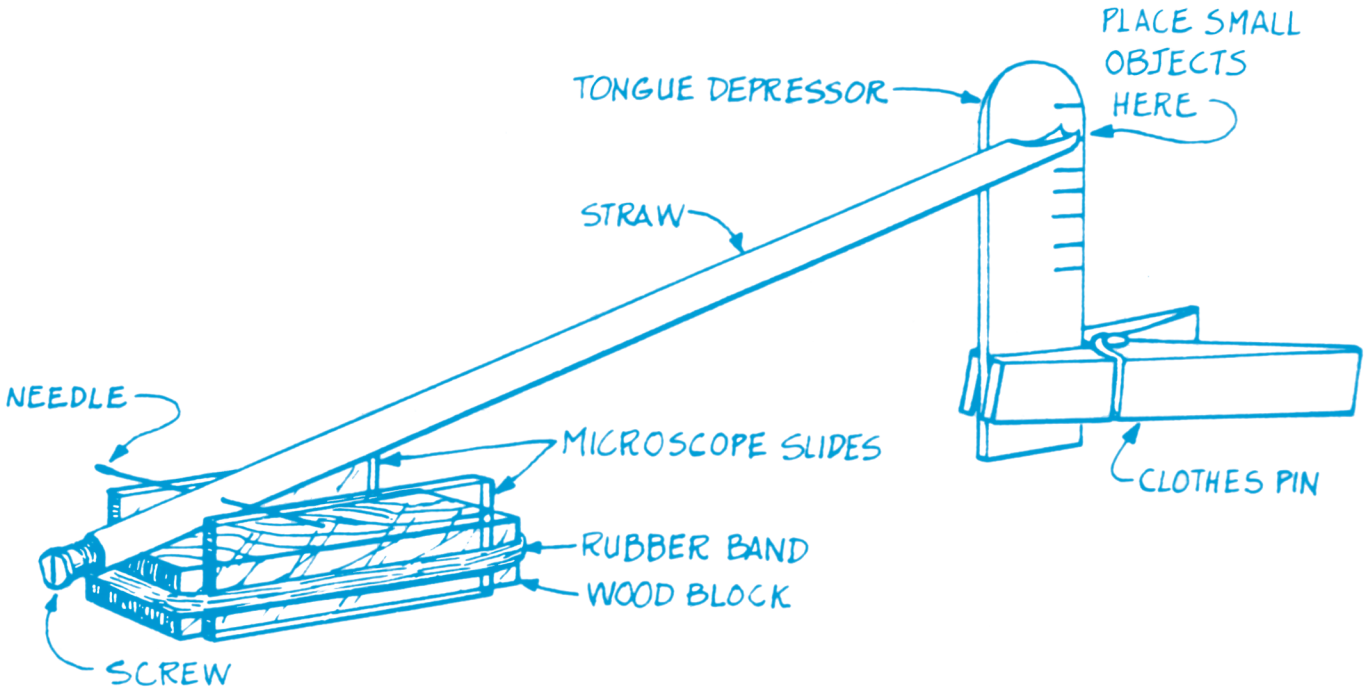

FIGURE 2: SODA STRAW BALANCE

Follow these directions and answer the questions. Place a check in each box when the step is completed.

- ❑ 1. Place the screw about half its length into the straw and determine where the balance is.
- ❑ 2. Balance the straw containing the screw on your finger.
- ❑ 3. Push the needle through the straw at the balance. The needle should be slightly above the centerline of the straw.
- ❑ 4. Cut open the other end so that a lip is formed to hold objects.
- ❑ 5. Balance the straw on the glass slides by turning the screw.
- ❑ 6. Hold the tongue depressor upright with the clothespin.

  You have now constructed a "soda straw" balance. Your "soda straw" balance must be calibrated.

- ❑ 7. Count out 100 sheets of paper (all the same type), and measure the mass in grams on any available scale. Record this answer in 1.5.
- ❑ 8. Measure the length and width of one sheet of paper in centimeters (cm) and calculate the number of square centimeters (cm^2) in one sheet. Record this answer in 1.7.

1.5 What is the mass of 100 sheets of paper? _____

1.6 What is the mass of one sheet of paper? _____

1.7 How many square centimeters are in the one sheet of paper? _____

1.8 What is the mass of 1 cm^2 (square centimeter) of paper? _____