

◆ QUALITATIVE AND QUANTITATIVE PROBLEMS ◆

Review and Practice

SSM Solution is in the Student Solutions Manual

Section 1-1 What Is Physics?

1-1.

In Case 1-1, suppose you have been to 20 baseball games, and in all these games you have only seen batters walk off the field after taking a third strike. Can you conclude from this that a batter can *never* advance to first base after a third strike?

You have asked 50 children if they like lollipops. They have all said yes. Does this prove that all children like lollipops?

You hang 10 different weights, one at a time, on a spring. The first two weights are equal. Each weight after that is double the previous weight. Thus, the total weight doubles each time an additional weight is hung. With each added weight, the spring stretches twice as much as previously. Does this *prove* that doubling the weight suspended from the spring always doubles the distance the spring is stretched?

Can you ever prove a law of nature; that is, can you prove that nature *always* behaves in a particular way?

d.

Show Answer

Section 1-2 Measurement and Units

1-2. Below are comparative figures for the Empire State Building in New York and the Pentagon in Washington.

	Empire State Building	Pentagon
Number of stories	102	5
Height in feet	1250	71
Acres of ground covered	about 2	29
Sq. ft. of office space	2.1 million	3.7 million
Volume in cubic ft.	37 million	77 million

Is it meaningful to ask which is the larger building? Explain why or why not.

1-3. Does the duration of time between sunrise and sunset make a good unit of time? Briefly explain.

Show Answer

1-4. The National Institute of Standards and Technology in Gaithersburg, Maryland, declares that the distance between two fine parallel lines on a particular metal rod is a standard unit of length. The rod is then shipped to a research station in Antarctica to be used as a standard for some high-precision measurements. Is there a problem with this? Briefly explain.

1-5. The speed limit on many U.S. highways is 55 miles/hr. What is this speed **a.** in ft/s? **b.** in SI units?

Show Answer

1-6.

How many meters is 20 feet? How many feet is 20 meters?

a.

How many square meters is 20 square feet? How many square feet is 20 square meters?

b.

How many cubic centimeters are there in 20 m^3 ? How many cubic meters are there in 20 cm^3 ?

c.

1-7. **SSM** Judith Jamison, long the principal dancer of the Alvin Ailey Dance Theater, was a striking presence on the stage in part because she was $5' 10''$, or 70 inches tall, a height that had traditionally been considered too tall for a ballet dancer.

What is Ms. Jamison's height in cm?

a.

What is Ms. Jamison's height in meters?

b.

A mischievous publicist for the dance company decides to report Ms. Jamison's height in fictional units as 5 pseudometers tall. For this to be correct, how many inches must there be in a pseudometer?

c.

If instead, the publicist wishes to report Ms. Jamison's height correctly as 20 pseudometers tall, how many inches must there be in a pseudometer?

d.

For her height to be a larger number of units, should each unit be larger or smaller?

e.

Show Answer

1-8. Memory on electronic storage devices is measured in bytes, or in larger units such as kilobytes (kB), megabytes (MB), or gigabytes (GB). Suppose a floppy disk has a memory capacity of 1440 kB.

If a CD (compact disc) has a memory capacity of 700 MB, then compared to the floppy, how many times as much

a. memory capacity does the CD have?

If a DVD (digital video disc or digital versatile disc) has a memory capacity of 4.7 GB, then compared to the CD,

b. how many times as much memory capacity does the DVD have?

1-9. Using the data in Problem 1-2, find **a.** the total area of office space in the Empire State building in SI units. **b.** the total volume of the Pentagon in SI units.

Show Answer

1-10. A runner has just completed a 4-minute mile. What was his average speed (total distance divided by total time) in

m/s?

1-11. A top Major League fastball pitcher can throw a baseball 95 mi/h (miles per hour). What is this speed in m/s?

Show Answer

1-12. A runner is entered in the 5000-meter event. She wishes to know how many miles she is running. Do the conversion for her.

Going Further

*The questions and problems in this group are not organized by section heading, so you must determine for yourself which ideas apply. Some of them will be more challenging than the Review and Practice questions and problems (especially those marked with a * or **).*

1-13. In 1959, members of an MIT fraternity measured the nearby Massachusetts Avenue Bridge by rolling fellow student Oliver Smoot end over end across it and painting a mark after each length. The paint marks have been kept fresh ever since, and you can still read “364.4 SMOOTS” at the MIT end of the bridge. Assuming a reasonable height for Oliver, estimate the length of the bridge in meters.

Show Answer

1-14. A small sample of water from Sludgeport Harbor contains 0.002 g/cm^3 (0.002 g in each cubic centimeter) of a certain pollutant. How many kilograms of this pollutant are contained in each cubic meter of water from the harbor?

1-15.

Estimate the speed (total distance divided by total time) in m/s at which your hair grows. State the assumptions

a. on which you base your calculation.

b. According to our present understanding of continental drift, a continental mass will typically drift a distance of about 3 m in a century. How does the speed at which the continents move compare with the speed at which your hair grows?

Show Answer

1-16. How many hours would it take a person walking at a speed of 1.4 m/s to complete Boston's 20-mile Walk for Hunger?

1-17. In one reference, you read that the average human brain at birth has a mass of about 0.390 kg. In another reference, you find that the mass of the typical adult human brain is about 1350 g. Typically, how many times as massive as a newborn brain is an adult brain?

Show Answer

1-18. Professional basketball player Yao Ming is 7' 6" tall. What minimum height in meters must a doorway have for him to be able to go through the doorway barefoot without having to bend at all?

1-19. A liter (L) is equal to 1000 cm^3 . Allergists are concerned with the volume of air their patients' lungs can hold. An allergist determines that his patient has a lung capacity of 3.9 L. What is this patient's lung capacity in cubic meters?

Show Answer

1-20. An American training schooner puts in at a Caribbean port to get some replacement rope. The captain knows that the rope they buy at home weighs 0.13 pounds per foot (lb/ft). In the islands, weights (actually masses) are in kilograms and lengths in meters. What weight per unit length in kg/m should the captain look for?

1-21. SSM When dealing with thin sheet metal, you might be interested in the mass per unit area rather than the mass per unit volume, or density. The units would then be units of mass divided by units of area. Here are four possibilities:

$$\frac{\text{kg}}{\text{m}^2} \quad \frac{\text{kg}}{\text{cm}^2} \quad \frac{\text{g}}{\text{m}^2} \quad \frac{\text{g}}{\text{cm}^2}$$

The numerical value of the mass per unit area for a particular kind of sheet metal would depend on the units in which it was expressed. Rank the four possible units in order of the numerical value the mass per unit area would have when expressed in each of these units. Order them from least to greatest, making sure to indicate any equalities.

Show Answer

1-22. The label on a paint can says that the coverage is 450 square feet per gallon. What would be the SI units for coverage? See Appendix C for conversion factors. Simplify your answer if possible.