Summary

[The Summary that appears at the end of each Chapter in this book gives a brief overview of the main ideas of the Chapter. The Summary cannot serve to give an understanding of the material, which can be accomplished only by a detailed reading of the Chapter.]

Physics, like other sciences, is a creative endeavor. It is not simply a collection of facts. Important **theories** are created with the idea of explaining **observations**. To be accepted, theories are "tested" by comparing their predictions with the results of actual experiments. Note that, in general, a theory cannot be "proved" in an absolute sense.

Scientists often devise models of physical phenomena. A **model** is a kind of picture or analogy that helps to describe the phenomena in terms of something we already know. A **theory**, often developed from a model, is usually deeper and more complex than a simple model.

A scientific **law** is a concise statement, often expressed in the form of an equation, which quantitatively describes a wide range of phenomena.

Measurements play a crucial role in physics, but can never be perfectly precise. It is important to specify the

Questions

- 1. What are the merits and drawbacks of using a person's foot as a standard? Consider both (a) a particular person's foot, and (b) any person's foot. Keep in mind that it is advantageous that fundamental standards be accessible (easy to compare to), invariable (do not change), indestructible, and reproducible.
- **2.** What is wrong with this road sign:

Memphis 7 mi (11.263 km)?

3. Why is it incorrect to think that the more digits you include in your answer, the more accurate it is?

MisConceptual Questions

[List all answers that are valid.]

- **1.** A student's weight displayed on a digital scale is 117.2 lb. This would suggest her weight is
 - (*a*) within 1% of 117.2 lb. (*b*) exactly 117.2 lb.
 - (b) exactly 117.210.
 - (*c*) somewhere between 117.18 and 117.22 lb.
 - (d) somewhere between 117.0 and 117.4 lb.
- **2.** Four students use different instruments to measure the length of the same pen. Which measurement implies the greatest precision?

(a) 160.0 mm. (b) 16.0 cm. (c) 0.160 m. (d) 0.00016 km. (e) Need more information.

- **3.** The number 0.0078 has how many significant figures? (*a*) 1. (*b*) 2. (*c*) 3. (*d*) 4.
- **4.** How many significant figures does 1.362 + 25.2 have? (a) 2. (b) 3. (c) 4. (d) 5.
- **5.** Accuracy represents
 - (a) repeatability of a measurement, using a given instrument.(b) how close a measurement is to the true value.
 - (c) an ideal number of measurements to make.
 - (d) how poorly an instrument is operating.

uncertainty of a measurement either by stating it directly using the \pm notation, and/or by keeping only the correct number of **significant figures**.

Physical quantities are always specified relative to a particular standard or **unit**, and the unit used should always be stated. The commonly accepted set of units today is the **Système International** (SI), in which the standard units of length, mass, and time are the **meter**, **kilogram**, and **second**.

When converting units, check all **conversion factors** for correct cancellation of units.

Making rough, **order-of-magnitude estimates** is a very useful technique in science as well as in everyday life.

[*The **dimensions** of a quantity refer to the combination of base quantities that comprise it. Velocity, for example, has dimensions of [length/time] or [L/T]. Working with only the dimensions of the various quantities in a given relationship (this technique is called **dimensional analysis**) makes it possible to check a relationship for correct form.]

- **4.** For an answer to be complete, the units need to be specified. Why?
- 5. You measure the radius of a wheel to be 4.16 cm. If you multiply by 2 to get the diameter, should you write the result as 8 cm or as 8.32 cm? Justify your answer.
- **6.** Express the sine of 30.0° with the correct number of significant figures.
- 7. List assumptions useful to estimate the number of car mechanics in (a) San Francisco, (b) your hometown, and then make the estimates.
- **6.** To convert from ft^2 to yd^2 , you should
 - (*a*) multiply by 3.
 - (b) multiply by 1/3.
 - (c) multiply by 9.
 - (d) multiply by 1/9.
 - (e) multiply by 6. (f) multiply by 1/6.
- 7. Which is *not* true about an order-of-magnitude estimation? (*a*) It gives you a rough idea of the answer.
 - (b) It can be done by keeping only one significant figure.
 - (c) It can be used to check if an exact calculation is reasonable.
 - (*d*) It may require making some reasonable assumptions in order to calculate the answer.
 - (e) It will always be accurate to at least two significant figures.
- *8. $[L^2]$ represents the dimensions for which of the following? (*a*) cm².
 - (b) square feet.
 - (c) m^2 .
 - (d) All of the above.