62. Explain the difference between a hypothesis and a scientific theory.

63. Give an example of a scientific law.

64. What reason might the ancient Greeks have had not to question the hypothesis that heavier objects fall faster than lighter objects? *Hint: Did you ever question which falls faster?*

65. Mars Explain what observations led to changes in scientists' ideas about the surface of Mars.

66. A graduated cylinder is marked every mL. How precise a measurement can you make with this instrument?

Mastering Problems

1.1 Mathematics and Physics

67. Convert each of the following measurements to meters.
- **a.** 42.3 cm
- **b.** 6.2 pm
- **c.** 21 km
- **d.** 0.023 mm
- **e.** 214 μm
- **f.** 57 nm

68. Add or subtract as indicated.
- **a.** 5.80×10^{9} s + 3.20×10^{8} s
- **b.** 4.87×10^{-6} m − 1.93×10^{-6} m
- **c.** 3.14×10^{-5} kg + 9.36×10^{-5} kg
- **d.** 8.12×10^{7} g − 6.20×10^{6} g

69. Rank the following mass measurements from least to greatest: 11.6 mg, 1021 μg, 0.000006 kg, 0.31 mg.

70. State the number of significant digits in each of the following measurements.
- **a.** 0.00003 m
- **b.** 64.01 fm
- **c.** 80.001 m
- **d.** 0.720 μg
- **e.** 2.40×10^{6} kg
- **f.** 6×10^{8} kg
- **g.** 4.07×10^{16} m

71. Add or subtract as indicated.
- **a.** 16.2 m + 5.008 m + 13.48 m
- **b.** 5.006 m + 12.0077 m + 8.0084 m
- **c.** 78.05 cm^2 − 32.046 cm^2
- **d.** 15.07 kg − 12.0 kg

72. Multiply or divide as indicated.
- **a.** $(6.2\times10^{18}\ m)(4.7\times10^{-10}\ m)$
- **b.** $(5.6\times10^{-7}\ m)/(2.8\times10^{-12}\ s)$
- **c.** $(8.1\times10^{-4}\ km)(1.6\times10^{-3}\ km)$
- **d.** $(6.5\times10^{5}\ kg)/(3.4\times10^{3}\ m^3)$

73. Gravity The force due to gravity is $F = mg$ where $g = 9.80\ m/s^2$.
- **a.** Find the force due to gravity on a 41.63-kg object.
- **b.** The force due to gravity on an object is 632 $kg\cdot m/s^2$. What is its mass?

74. Dimensional Analysis Pressure is measured in pascals, where 1 Pa = 1 $kg/m\cdot s^2$. Will the following expression give a pressure in the correct units?

$$\frac{(0.55\ kg)(2.1\ m/s)}{9.8\ m/s^2}$$

1.2 Measurement

75. A water tank has a mass of 3.64 kg when it is empty and a mass of 51.8 kg when it is filled to a certain level. What is the mass of the water in the tank?

76. The length of a room is 16.40 m, its width is 4.5 m, and its height is 3.26 m. What volume does the room enclose?

77. The sides of a quadrangular plot of land are 132.68 m, 48.3 m, 132.736 m, and 48.37 m. What is the perimeter of the plot?

78. How precise a measurement could you make with the scale shown in **Figure 1-23?**

Figure 1-23

79. Give the measure shown on the meter in **Figure 1-24** as precisely as you can. Include the uncertainty in your answer.

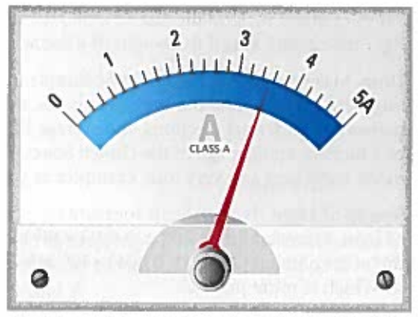

Figure 1-24

80. Estimate the height of the nearest door frame in centimeters. Then measure it. How accurate was your estimate? How precise was your estimate? How precise was your measurement? Why are the two precisions different?

81. Base Units Give six examples of quantities you might measure in a physics lab. Include the units you would use.

82. Temperature The temperature drops from 24°C to 10°C in 12 hours.
- **a.** Find the average temperature change per hour.
- **b.** Predict the temperature in 2 more hours if the trend continues.
- **c.** Could you accurately predict the temperature in 24 hours?

1.3 Graphing Data

83. Figure 1-25 shows the masses of three substances for volumes between 0 and 60 cm^3.
- **a.** What is the mass of 30 cm^3 of each substance?
- **b.** If you had 100 g of each substance, what would be their volumes?
- **c.** In one or two sentences, describe the meaning of the slopes of the lines in this graph.
- **d.** What is the *y*-intercept of each line? What does it mean?

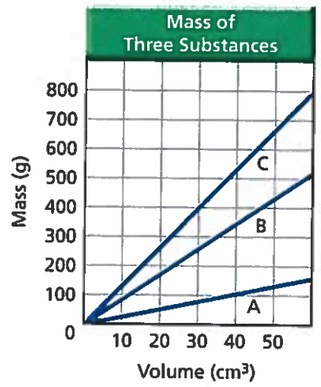

Figure 1-25

84. During a class demonstration, a physics instructor placed a mass on a horizontal table that was nearly frictionless. The instructor then applied various horizontal forces to the mass and measured the distance it traveled in 5 seconds for each force applied. The results of the experiment are shown in **Table 1-5.**

Table 1-5
Distance Traveled with Different Forces

Force (N)	Distance (cm)
5.0	24
10.0	49
15.0	75
20.0	99
25.0	120
30.0	145

- **a.** Plot the values given in the table and draw the curve that best fits all points.
- **b.** Describe the resulting curve.
- **c.** Use the graph to write an equation relating the distance to the force.
- **d.** What is the constant in the equation? Find its units.
- **e.** Predict the distance traveled when a 22.0-N force is exerted on the object for 5 s.

85. The physics instructor from the previous problem changed the procedure. The mass was varied while the force was kept constant. Time and distance were measured, and the acceleration of each mass was calculated. The results of the experiment are shown in **Table 1-6.**

Table 1-6
Acceleration of Different Masses

Mass (kg)	Acceleration (m/s^2)
1.0	12.0
2.0	5.9
3.0	4.1
4.0	3.0
5.0	2.5
6.0	2.0

- **a.** Plot the values given in the table and draw the curve that best fits all points.
- **b.** Describe the resulting curve.
- **c.** According to the graph, what is the relationship between mass and the acceleration produced by a constant force?
- **d.** Write the equation relating acceleration to mass given by the data in the graph.
- **e.** Find the units of the constant in the equation.
- **f.** Predict the acceleration of an 8.0-kg mass.