The number 0.003010 has
A) 7 significant figures.
B) 6 significant figures.
C) 4 significant figures.
D) 2 significant figures.

Answer: C
OUT OF BOOK QUESTION

What is \( \frac{0.674}{0.74} \) to the proper number of significant figures?

A) 0.91  
B) 0.911  
C) 0.9108  
D) 0.9

Answer: A
What is the value of $\pi(8.104)^2$, written with the correct number of significant figures?

A) 206.324  
B) 206.323  
C) 206.3  
D) 206  
E) 200

Answer: C
OUT OF BOOK QUESTION

What is the sum of 1.53 + 2.786 + 3.3 written with the correct number of significant figures?
A) 8
B) 7.6
C) 7.62
D) 7.616
E) 7.6160

Answer: B
OUT OF BOOK QUESTION

What is the difference between 103.5 and 102.24 written with the correct number of significant figures?

A) 1
B) 1.3
C) 1.26
D) 1.260
E) 1.2600

Answer: B
What is $56 + (32.00) / (1.2465 + 3.45)$ written with the correct number of significant figures?

A) 62.8
B) 62.812
C) 62.81
D) 63
E) 62.8123846

Answer: D
The length and width of a rectangle are 1.125 m and 0.606 m, respectively. Multiplying, your calculator gives the product as 0.68175. Rounding properly to the correct number of significant figures, the area should be written as

A) 0.7 m².
B) 0.68 m².
C) 0.682 m².
D) 0.6818 m².
E) 0.68175 m².

Answer: C
1.4 •• The density of gold is 19.3 g/cm³. What is this value in kilograms per cubic meter?

1.4. **Identify:** Convert the units from g to kg and from cm³ to m³.

**Set Up:** 1 kg = 1000 g. 1 m = 1000 cm.

**Execute:** \[ 19.3 \text{ g/cm}^3 \times \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) \times \left( \frac{100 \text{ cm}}{1 \text{ m}} \right)^3 = 1.93 \times 10^4 \text{ kg/m}^3 \]
OUT OF BOOK QUESTION

A person on a diet loses 1.6 kg in a week. How many micrograms/second (μg/s) are lost?

A) $2.6 \times 10^3 \, \mu g/s$
B) $1.6 \times 10^5 \, \mu g/s$
C) 44 μg/s
D) $6.4 \times 10^4 \, \mu g/s$

Answer: A
The position \( x \), in meters, of an object is given by the equation

\[
x = A + Bt + Ct^2
\]

where \( t \) represents time in seconds.
What are the SI units of \( A \), \( B \), and \( C \)?

A) m, m, m
B) m, s, s
C) m, s, s²
D) m, m/s, m/s²
E) m/s, m/s², m/s³

Answer: D
OUT OF BOOK QUESTION

Convert a speed of 4.50 km/h to units of ft/min. (1.00 m = 3.28 ft)
A) 0.246 ft/min
B) 82.3 ft/min
C) 165 ft/min
D) 246 ft/min
E) 886 ft/min

Answer: D
OUT OF BOOK QUESTION

The height of the ceiling in a typical home, apartment, or dorm room is closest to
A) 100 cm.
B) 200 cm.
C) 400 cm.
D) 500 cm.

Answer: B
OUT OF BOOK QUESTION

Approximately how many times does an average human heart beat in a year?
A) $4 \times 10^5$
B) $4 \times 10^6$
C) $4 \times 10^7$
D) $4 \times 10^8$
E) $4 \times 10^9$

Answer: C
Estimate the number of times the earth will rotate on its axis during a human's lifetime.

A) $3 \times 10^4$
B) $3 \times 10^5$
C) $3 \times 10^6$
D) $3 \times 10^7$
E) $3 \times 10^8$

Answer: A
A certain CD-ROM disk can store approximately $6.0 \times 10^2$ megabytes of information, where $10^6$ bytes = 1 megabyte.

If an average word requires 9.0 bytes of storage, how many words can be stored on one disk?

A) $6.7 \times 10^7$ words
B) $5.4 \times 10^9$ words
C) $2.1 \times 10^7$ words
D) $2.0 \times 10^9$ words

Answer: A
EXERCISES

1.16 • How many gallons of gasoline are used in the United States in one day? Assume that there are two cars for every three people, that each car is driven an average of 10,000 mi per year, and that the average car gets 20 miles per gallon.

1.16. IDENTIFY: Estimate the number of people and then use the estimates given in the problem to calculate the number of gallons.

SET UP: Estimate $3 \times 10^8$ people, so $2 \times 10^8$ cars.

EXECUTE: $(\text{Number of cars} \times \text{miles/car day})/(\text{mi/gal}) = \text{gallons/day}$

$(2 \times 10^8 \text{ cars} \times 10000 \text{ mi/yr/car} \times 1 \text{ yr}/365 \text{ days})/(20 \text{ mi/gal}) = 3 \times 10^8 \text{ gal/day}$
EXERCISES

1.20 • BIO  Four astronauts are in a spherical space station. (a) If, as is typical, each of them breathes about 500 cm$^3$ of air with each breath, approximately what volume of air (in cubic meters) do these astronauts breathe in a year? (b) What would the diameter (in meters) of the space station have to be to contain all this air?

1.20.  IDENTIFY:  Approximate the number of breaths per minute. Convert minutes to years and cm$^3$ to m$^3$ to find the volume in m$^3$ breathed in a year.

SET UP:  Assume 10 breaths/min. 1 y = (365 d) \left( \frac{24 h}{1 \text{ d}} \right) \left( \frac{60 \text{ min}}{1 \text{ h}} \right) = 5.3 \times 10^5 \text{ min.} 10^2 \text{ cm} = 1 \text{ m} \text{ so}

10^6 \text{ cm}^3 = 1 \text{ m}^3. \text{ The volume of a sphere is } V = \frac{4}{3} \pi r^3 = \frac{1}{6} \pi d^3, \text{ where } r \text{ is the radius and } d \text{ is the diameter. Don’t forget to account for four astronauts.}

EXECUTE:  (a) The volume is (4)(10 breaths/min)(500 \times 10^{-6} \text{ m}^3) \left( \frac{5.3 \times 10^5 \text{ min}}{1 \text{ y}} \right) = 1 \times 10^4 \text{ m}^3/\text{yr.}

(b) \[ d = \left( \frac{6V}{\pi} \right)^{1/3} = \left( \frac{6[1 \times 10^4 \text{ m}^3]}{\pi} \right)^{1/3} = 27 \text{ m} \]
1.14 • With a wooden ruler you measure the length of a rectangular piece of sheet metal to be 12 mm. You use micrometer calipers to measure the width of the rectangle and obtain the value 5.98 mm. Give your answers to the following questions to the correct number of significant figures. (a) What is the area of the rectangle? (b) What is the ratio of the rectangle’s width to its length? (c) What is the perimeter of the rectangle? (d) What is the difference between the length and width? (e) What is the ratio of the length to the width?

**Set Up:** 12 mm has two significant figures and 5.98 mm has three significant figures.

**Execute:** (a) $(12 \text{ mm}) \times (5.98 \text{ mm}) = 72 \text{ mm}^2$ (two significant figures)

(b) \[
\frac{5.98 \text{ mm}}{12 \text{ mm}} = 0.50 \quad \text{(also two significant figures)}
\]

(c) 36 mm (to the nearest millimeter)

(d) 6 mm

(e) 2.0 (two significant figures)
PROBLEMS

1.66 Three horizontal ropes pull on a large stone stuck in the ground, producing the vector forces \( \vec{A} \), \( \vec{B} \), and \( \vec{C} \) shown in Fig. P1.66. Find the magnitude and direction of a fourth force on the stone that will make the vector sum of the four forces zero.

**IDENTIFY:** Let \( \vec{D} \) be the fourth force. Find \( \vec{D} \) such that \( \vec{A} + \vec{B} + \vec{C} + \vec{D} = 0 \), so \( \vec{D} = -(\vec{A} + \vec{B} + \vec{C}) \).

**SET UP:** Use components and solve for the components \( D_x \) and \( D_y \) of \( \vec{D} \).

**EXECUTE:**
- \( A_x = +A \cos 30.0^\circ = +86.6 \text{ N} \), \( A_y = +A \sin 30.0^\circ = +50.0 \text{ N} \).
- \( B_x = -B \sin 30.0^\circ = -40.0 \text{ N} \), \( B_y = +B \cos 30.0^\circ = +69.28 \text{ N} \).
- \( C_x = -C \cos 53.0^\circ = -24.07 \text{ N} \), \( C_y = -C \sin 53.0^\circ = -31.90 \text{ N} \).

Then \( D_x = -22.53 \text{ N} \), \( D_y = -87.34 \text{ N} \) and \( D = \sqrt{D_x^2 + D_y^2} = 90.2 \text{ N} \). \( \tan \alpha = |D_y/D_x| = 87.34/22.53 \). \( \alpha = 75.54^\circ \). \( \phi = 180^\circ + \alpha = 256^\circ \), counterclockwise from the +x-axis.

**EVALUATE:** As shown in Figure 1.66, since \( D_x \) and \( D_y \) are both negative, \( \vec{D} \) must lie in the third quadrant.
EXERCISES

1.51 • For the two vectors \( \vec{A} \) and \( \vec{B} \) in Fig. E1.43, (a) find the scalar product \( \vec{A} \cdot \vec{B} \); (b) find the magnitude and direction of the vector product \( \vec{A} \times \vec{B} \).

**Figure E1.43**

**IDENTIFY:** Apply Eqs. (1.18) and (1.22).

**SET UP:** The angle between the vectors is \( 20^\circ + 90^\circ + 30^\circ = 140^\circ \).

**EXECUTE:** (a) Eq. (1.18) gives \( \vec{A} \cdot \vec{B} = (3.60 \text{ m})(2.40 \text{ m})\cos 140^\circ = -6.62 \text{ m}^2 \).

(b) From Eq. (1.22), the magnitude of the cross product is \( (3.60 \text{ m})(2.40 \text{ m})\sin 140^\circ = 5.55 \text{ m}^2 \) and the direction, from the right-hand rule, is out of the page (the \( +z \)-direction).

**EVALUATE:** We could also use Eqs. (1.21) and (1.27), with the components of \( \vec{A} \) and \( \vec{B} \).
OUT OF BOOK QUESTION

Vector $\vec{A} = 1.00 \hat{i} + -2.00 \hat{j}$ and vector $\vec{B} = 3.00 \hat{i} + 4.00 \hat{j}$.

What are the magnitude and direction of vector $\vec{C} = \vec{A} + \vec{B}$?

A) 7.21 in a direction 33.7° counterclockwise from the positive $x$ axis
B) 6.00 in a direction 63.4° counterclockwise from the positive $x$ axis
C) 4.47 in a direction 6.34° counterclockwise from the positive $x$ axis
D) 4.47 in a direction 26.6° counterclockwise from the positive $x$ axis
E) 7.21 in a direction 56.3° counterclockwise from the positive $x$ axis

Answer: D