

## Exercises Answers to odd-numbered Exercises are in Appendix I.

### Uncertainty in Measurements (PSS.1)

- What quantity (length, mass, volume, time) is expressed by the following units?  
 (a) centimeter (b) gram  
 (c) milliliter (d) second
- What quantity (length, mass, volume, time) is expressed by the following units?  
 (a) kilometer (b) microgram  
 (c) liter (d) nanosecond
- Which of the following measurements corresponds to metric Ruler A shown in Figure PSS.2?  
 (a) 2.0 cm (b) 2.00 cm  
 (c) 2.05 cm (d) 2.5 cm
- Which of the following measurements corresponds to metric Ruler B shown in Figure PSS.2?  
 (a) 50.0 cm (b) 50.00 cm  
 (c) 50.05 cm (d) 50.5 cm
- Which of the following measurements corresponds to the electronic balance shown in Figure PSS.3?  
 (a) 25 g (b) 25.0 g  
 (c) 25.00 g (d) 25.000 g
- Which of the following measurements corresponds to the electronic balance shown in Figure PSS.3?  
 (a) 75 g (b) 75.0 g  
 (c) 75.22 g (d) 75.518 g
- Which of the following measurements corresponds to the graduated cylinder shown in Figure PSS.4 having an uncertainty of  $\pm 0.5$  mL?  
 (a) 25 mL (b) 25.0 mL  
 (c) 25.5 mL (d) 25.50 mL
- Which of the following measurements corresponds to the buret shown in Figure PSS.4 having an uncertainty of  $\pm 0.05$  mL?  
 (a) 32.0 mL (b) 32.00 mL  
 (c) 32.05 mL (d) 32.58 mL

### Significant Digits (PSS.2)

- State the number of significant digits in each of the following:  
 (a) 0.05 cm (b) 0.50 cm  
 (c) 25.0 cm (d) 20.50 cm
- State the number of significant digits in each of the following:  
 (a)  $1.050 \times 10^2$  cm (b)  $2 \times 10^3$  cm  
 (c)  $3.00 \times 10^{-4}$  cm (d)  $5.0 \times 10^{-5}$  cm
- State the number of significant digits in each of the following:  
 (a) 5.0 g (b) 5.05 g  
 (c) 0.5 g (d) 1055 g
- State the number of significant digits in each of the following:  
 (a)  $1.2 \times 10^0$  g (b)  $4.50 \times 10^1$  g  
 (c)  $5.02 \times 10^{-1}$  g (d)  $100 \times 10^{-2}$  g
- State the number of significant digits in each of the following:  
 (a) 0.5 mL (b) 0.50 mL  
 (c) 5.00 mL (d) 500 mL

- State the number of significant digits in each of the following:

- (a)  $1 \times 10^{-1}$  mL (b)  $1.0 \times 10^{-2}$  mL  
 (c)  $1.00 \times 10^1$  mL (d)  $1.000 \times 10^3$  mL

### Rounding Off Nonsignificant Digits (PSS.3)

- Round off the following to three significant digits:  
 (a) 20.155 (b) 0.204 500 (c) 2055 (d) 0.2065
- Round off the following to three significant digits:  
 (a) 10.25 (b) 10.20 (c) 0.01029 (d) 10,248
- Round off the following to three significant digits:  
 (a)  $1.454 \times 10^1$  (b)  $1.455 \times 10^2$   
 (c)  $1.508 \times 10^{-3}$  (d)  $1.503 \times 10^{-4}$
- Round off the following to three significant digits:  
 (a)  $9.123 \times 10^5$  (b)  $9.456 \times 10^{10}$   
 (c)  $9.000 \times 10^{-7}$  (d)  $9.075 \times 10^{-12}$

### Adding and Subtracting Measurements (PSS.4)

- Add the following measurements and round off the answer:

(a) 0.4 g 0.44 g <u>+ 0.444 g</u>	(b) 15.5 g 7.50 g <u>+ 0.050 g</u>
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- Add the following measurements and round off the answer:

(a) 1.55 cm 36.15 cm <u>+ 17.3 cm</u>	(b) 5.0 cm 16.3 cm <u>+ 0.95 cm</u>
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- Subtract the following measurements and round off the answer:

(a) 242.197 g <u>- 175 g</u>	(b) 27.55 g <u>- 14.545 g</u>
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- Subtract the following measurements and round off the answer:

(a) 22.10 cm <u>- 10.5 cm</u>	(b) 10.0 cm <u>- 0.15 cm</u>
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### Multiplying and Dividing Measurements (PSS.5)

- Multiply the following measurements and round off the answer:  
 (a)  $3.65 \text{ cm} \times 2.10 \text{ cm}$  (b)  $8.75 \text{ cm} \times 1.15 \text{ cm}$   
 (c)  $16.5 \text{ cm} \times 1.7 \text{ cm}$  (d)  $21.1 \text{ cm} \times 20 \text{ cm}$
- Multiply the following measurements and round off the answer:  
 (a)  $1.25 \text{ cm} \times 0.5 \text{ cm}$  (b)  $2.55 \text{ cm} \times 1.1 \text{ cm}$   
 (c)  $12.0 \text{ cm}^2 \times 1.00 \text{ cm}$  (d)  $22.1 \text{ cm}^2 \times 0.75 \text{ cm}$
- Divide the following measurements and round off the answer:  
 (a)  $26.0 \text{ cm}^2 / 10.1 \text{ cm}$  (b)  $9.95 \text{ cm}^3 / 0.15 \text{ cm}^2$   
 (c)  $131.78 \text{ cm}^3 / 19.25 \text{ cm}$  (d)  $131.78 \text{ cm}^3 / 19.2 \text{ cm}$
- Divide the following measurements and round off the answer:  
 (a)  $66.3 \text{ g} / 7.5 \text{ mL}$  (b)  $12.5 \text{ g} / 4.1 \text{ mL}$   
 (c)  $42.620 \text{ g} / 10.0 \text{ mL}$  (d)  $91.235 \text{ g} / 10.00 \text{ mL}$

**Exponential Numbers (PSS.6)**

27. Express each of the following products as a power of 10:  
 (a)  $10 \times 10 \times 10$       (b)  $1/10 \times 1/10 \times 1/10$
28. Express each of the following products as a power of 10:  
 (a)  $10 \times 10 \times 10 \times 10$       (b)  $1/10 \times 1/10 \times 1/10 \times 1/10$
29. Express each of the following products in exponential form:  
 (a)  $2 \times 2 \times 2$       (b)  $1/2 \times 1/2 \times 1/2$
30. Express each of the following products in exponential form:  
 (a)  $3 \times 3 \times 3 \times 3$       (b)  $1/3 \times 1/3 \times 1/3 \times 1/3$
31. Express each of the following ordinary numbers as a power of 10:  
 (a) 1,000,000,000      (b) 0.000 000 01
32. Express each of the following ordinary numbers as a power of 10:  
 (a) 100,000,000,000,000,000  
 (b) 0.000 000 000 000 001
33. Express each of the following powers of 10 as an ordinary number:  
 (a)  $1 \times 10^3$       (b)  $1 \times 10^{-7}$
34. Express each of the following powers of 10 as an ordinary number:  
 (a)  $1 \times 10^{12}$       (b)  $1 \times 10^{-22}$
35. Express each of the following powers of 10 as an ordinary number:  
 (a)  $1 \times 10^1$       (b)  $1 \times 10^{-1}$
36. Express each of the following powers of 10 as an ordinary number:  
 (a)  $1 \times 10^0$       (b)  $1 \times 10^{-10}$

**Scientific Notation (PSS.7)**

37. Express the following ordinary numbers in scientific notation:  
 (a) 80,916,000      (b) 0.000 000 015  
 (c) 335,600,000,000,000      (d) 0.000 000 000 000 927
38. Express the following ordinary numbers in scientific notation:  
 (a) 1,010,000,000,000,000  
 (b) 0.000 000 000 000 456  
 (c) 94,500,000,000,000,000  
 (d) 0.000 000 000 000 000 019 50
39. There are 26,900,000,000,000,000,000,000 atoms in 1 liter of argon gas at standard temperature and pressure. Express this number in scientific notation.

40. There are 269,000,000,000,000,000,000,000 molecules in 10 liters of oxygen gas at standard temperature and pressure. Express this number in scientific notation.
41. The mass of a neon atom is  $3.35 \times 10^{-23}$  g. Express the mass as an ordinary number.
42. The mass of a chlorine molecule is  $1.18 \times 10^{-22}$  g. Express the mass as an ordinary number.

**General Exercises**

43. A Class A 10-mL pipet has an uncertainty of  $\pm 0.01$  mL. Express the volume of the pipet as an ordinary number.
44. A student 10-mL pipet has an uncertainty of  $\pm 0.1$  mL. Express the volume of the pipet as an ordinary number.
45. The velocity of light is 186,282.397 miles per second. Round off this value to three significant digits.
46. The velocity of light is 299,792,458 meters per second. Round off this value to three significant digits.
47. Find the total mass of two brass cylinders, which weigh 126.457 g and 131.6 g.
48. Find the length of magnesium metal ribbon that remains after two 25.0-cm strips are cut from 255 cm of the ribbon.
49. Convert the following exponential numbers to scientific notation.  
 (a)  $352 \times 10^4$       (b)  $0.191 \times 10^{-5}$
50. Convert the following exponential numbers to scientific notation.  
 (a)  $0.170 \times 10^2$       (b)  $0.00350 \times 10^{-1}$

**Challenge Exercises**

51. The mass of a neutron is  $1.6749 \times 10^{-24}$  g, and the mass of a proton is  $1.6726 \times 10^{-24}$  g. What is the total mass of a neutron and a proton?
52. The mass of a neutron is  $1.6749 \times 10^{-24}$  g, and the mass of a proton is  $1.6726 \times 10^{-24}$  g. What is the mass difference of a neutron and a proton?
53. A metric ton is defined as 1000 kg, or  $2.200 \times 10^3$  lb. An English ton is defined as 2000 lb, or  $2.000 \times 10^3$  lb. What is the difference in mass between a metric ton and an English ton expressed in pounds?
54. The distance from Earth to the Moon is  $2.39 \times 10^5$  miles, whereas the distance from the Moon to Mars is  $4.84 \times 10^7$  miles. What is the total distance from Earth to the Moon to Mars?

# Answers to Odd-Numbered Exercises

## Chapter 1

1. water
3. air, earth, fire, water, and ether
5. Robert Boyle
7. Analyze the data and propose a tentative hypothesis.
9. A hypothesis is an initial proposal that is tentative, whereas a theory is a proposal that has been tested extensively.
11. (b) and (d)
13. Antoine Lavoisier
15. agriculture, medicine, and the pharmaceutical, electronics, paper, construction, transportation, and petrochemical industries
17. A solution to the nine-dot problem with only one straight line is to use a *very wide* line; the unconscious assumption regards the thickness of the line.
19. Stare at the point where the blocks intersect. "Flip" the image to view the blocks stacking upward, or downward.
21. The BSN degree typically requires three years of nursing school to earn a diploma and the AARN requires two years. To apply to either program, it is necessary to complete prerequisite chemistry and biology classes.

## Prerequisite Science Skills

1. (a) length; (b) mass; (c) volume; (d) time
3. (a) 2.0 cm; (d) 2.5 cm
5. (d) 25.000 g
7. (b) 25.0 mL; (c) 25.5 mL
9. (a) 1; (b) 2; (c) 3; (d) 4
11. (a) 2; (b) 3; (c) 1; (d) 4
13. (a) 1; (b) 2; (c) 3; (d) 1
15. (a) 20.2; (b) 0.205; (c) 2060; (d) 0.207
17. (a)  $1.45 \times 10^1$ ; (b)  $1.46 \times 10^2$ ; (c)  $1.51 \times 10^{-3}$ ; (d)  $1.50 \times 10^{-4}$
19. (a) 1.3 g; (b) 23.1 g
21. (a) 67 g; (b) 13.01 g
23. (a)  $7.67 \text{ cm}^2$ ; (b)  $10.1 \text{ cm}^2$ ; (c)  $28 \text{ cm}^2$ ; (d)  $400 \text{ cm}^2$
25. (a) 2.57 cm; (b) 66 cm; (c)  $6.846 \text{ cm}^2$ ; (d)  $6.86 \text{ cm}^2$
27. (a)  $10^3$ ; (b)  $(1/10)^3$  or  $10^{-3}$
29. (a)  $2^3$ ; (b)  $(1/2)^3$  or  $2^{-3}$
31. (a)  $1 \times 10^9$ ; (b)  $1 \times 10^{-8}$
33. (a) 1000; (b) 0.000 000 1
35. (a) 10; (b) 0.1
37. (a)  $8.0916 \times 10^7$ ; (b)  $1.5 \times 10^{-8}$ ; (c)  $3.356 \times 10^{14}$ ; (d)  $9.27 \times 10^{-13}$
39.  $2.69 \times 10^{22}$  argon atoms
41. 0.000 000 000 000 000 000 033 5 g/neon atom
43. 10.00 mL ( $\pm 0.01$  mL)
45.  $1.86 \times 10^5$  miles per second
47. 258.1 g
49. (a)  $3.52 \times 10^6$ ; (b)  $1.91 \times 10^{-6}$
51.  $3.3475 \times 10^{-24}$  g
53.  $2.00 \times 10^2$  lb
55. 22 kilograms

## Chapter 2

1. (a) meter; (b) gram; (c) liter; and (d) second
3. (a) Tm; (b) Gg; (c) nL; (d) ps
5. (a) length, (b) mass, (c) volume, and (d) time
7. (a) tera (T); (b) giga (G); (c) milli (m); (d) micro ( $\mu$ )
9. (a) terameter; (b) gigagram; (c) milliliter; (d) microsecond
11. (a)  $1 \times 10^{12} \text{ m} = 1 \text{ Tm}$ ; (b)  $1 \times 10^9 \text{ g} = 1 \text{ Gg}$ ;  
(c)  $1 \text{ L} = 1 \times 10^3 \text{ mL}$ ; (d)  $1 \text{ s} = 1 \times 10^6 \mu\text{s}$
13. (a)  $\frac{1 \times 10^{12} \text{ m}}{1 \text{ Tm}}$  and  $\frac{1 \text{ Tm}}{1 \times 10^{12} \text{ m}}$   
(b)  $\frac{1 \times 10^9 \text{ g}}{1 \text{ Gg}}$  and  $\frac{1 \text{ Gg}}{1 \times 10^9 \text{ g}}$   
(c)  $\frac{1 \text{ L}}{1 \times 10^3 \text{ mL}}$  and  $\frac{1 \times 10^3 \text{ mL}}{1 \text{ L}}$   
(d)  $\frac{1 \text{ s}}{1 \times 10^6 \mu\text{s}}$  and  $\frac{1 \times 10^6 \mu\text{s}}{1 \text{ s}}$
15. (a)  $5.00 \times 10^{-3} \text{ km}$ ; (b)  $5.00 \times 10^2 \text{ cg}$ ; (c) 50.0 dL;  
(d)  $5.00 \times 10^9 \text{ ns}$
17. (a)  $6.50 \times 10^6 \text{ Mm}$ ; (b)  $6.50 \times 10^8 \text{ kg}$ ; (c)  $6.50 \times 10^{-2} \text{ dL}$ ;  
(d) 0.650 ps
19. (a)  $2.54 \text{ cm} = 1 \text{ in.}$ ; (b)  $454 \text{ g} = 1 \text{ lb}$ ; (c)  $946 \text{ mL} = 1 \text{ qt}$   
(d);  $1.00 \text{ s} = 1 \text{ sec}$
21. (a) 9.8 in.; (b) 0.055 lb; (c) 2,370 mL; (d) 2.50 s
23. (a) 1.8 m; (b) 79.5 kg; (c) 0.473 L; (d) 0.273 ds
25. 54 mi/gal
27. 4.91 g copper
29. 40.5% of solution is ethanol
31. 56.3 g water
33. 94.99% copper
35.  $6.25 \text{ cm}^3$
37. 0.825 cm
39. (a) 1000 mL; (b)  $1000 \text{ cm}^3$