CHAPTER

PSS

Prerequisite Science Skills

Section PSS.1 *Measurements*

2. The diameter of a 5¢ nickel coin is approximately 2 cm.

4.

	Unit	Quantity		Unit	Quantity
(a)	meter	length	(b)	kilogram	mass
(c)	liter	volume	(d)	millisecond	time

6. (b) 2.05 cm and (c) 2.00 cm each have an uncertainty of ± 0.05 cm.

8. (d) 25.000 g has a mass uncertainty of ± 0.001 g; thus, an electronic balance.

10. (b) 25.0 mL and (c) 25.5 mL each have an uncertainty of ± 0.5 mL.

Section PSS.2 *Significant Digits*

12.

	Measurement	Significant Digits
(a)	500 cm	1 significant digit
(b)	5000 g	1 significant digit
(c)	0.05 mL	1 significant digit
(d)	0.005 s	1 significant digit

14.

	Measurement	Significant Digits
(a)	5.0 cm	2 significant digits
(b)	5.05 g	3 significant digits
(c)	5.02×10^{-1} mL	3 significant digits
(d)	1.0×10^{-2} s	2 significant digits

16.

	Measurement	Significant Digits
(a)	0.5 cm	1 significant digit
(b)	0.50 g	2 significant digits
(c)	1.00×10^{1} mL	3 significant digits
(d)	1.000×10^{3} s	4 significant digits

Section PSS.3 *Rounding Off Nonsignificant Digits*

18.

	Example	Rounded Off
(a)	20.155	20.2
(b)	0.204 500	0.205
(c)	2055	2060 (2.06×10^3)
(d)	0.2065	0.207

20.

	Example	Rounded Off
(a)	1.454×10^1	1.45×10^1
(b)	1.455×10^2	1.46×10^2
(c)	1.508×10^{-3}	1.51×10^{-3}
(d)	1.503×10^{-4}	1.50×10^{-4}

Section PSS.4 *Adding and Subtracting Measurements*

22. (a) 0.4 g + 0.44 g + 0.444 g = 1.284 g *rounds to* 1.3 g
    (b) 15.5 g + 7.50 g + 0.050 g = 23.050 g *rounds to* 23.1 g

24. (a) 242.197 g – 175 g = 67.197 g *rounds to* 67 g
    (b) 27.55 g – 14.545 g = 13.005 g *rounds to* 13.01 g

Section PSS.5 *Multiplying and Dividing Measurements*

26. (a) $3.65 \text{ cm} \times 2.10 \text{ cm} = 7.665 \text{ cm}^2$ *rounds to* 7.67 cm^2
    (b) $8.75 \text{ cm} \times 1.15 \text{ cm} = 10.0625 \text{ cm}^2$ *rounds to* 10.1 cm^2
    (c) $16.5 \text{ cm} \times 1.7 \text{ cm} = 28.05 \text{ cm}^2$ *rounds to* 28 cm^2
    (d) $21.1 \text{ cm} \times 20 \text{ cm} = 422 \text{ cm}^2$ *rounds to* 400 cm^2

28. (a) $\dfrac{26.0 \text{ cm}^2}{10.1 \text{ cm}} = 2.5743 \text{ cm}$ *rounds to* 2.57 cm
    (b) $\dfrac{9.95 \text{ cm}^3}{0.15 \text{ cm}^2} = 66.333 \text{ cm}$ *rounds to* 66 cm
    (c) $\dfrac{131.78 \text{ cm}^3}{19.25 \text{ cm}} = 6.8457 \text{ cm}^2$ *rounds to* 6.846 cm^2
    (d) $\dfrac{131.78 \text{ cm}^3}{19.2 \text{ cm}} = 6.8635 \text{ cm}^2$ *rounds to* 6.86 cm^2

Section PSS.6 *Exponential Numbers*

30. (a) $10 \times 10 \times 10 \times 10 = 10^4$
    (b) $\frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} = (\frac{1}{10})^4 = 10^{-4}$

32. (a) $3 \times 3 \times 3 \times 3 = 3^4$

(b) $\frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = (\frac{1}{3})^4 = 3^{-4}$

34.

	Number	Scientific Notation
(a)	1×10^{12}	1,000,000,000,000
(b)	1×10^{-22}	0.000 000 000 000 000 000 000 1

36.

	Number	Scientific Notation
(a)	100,000,000,000,000,000	1×10^{17}
(b)	0.000 000 000 000 001	1×10^{-15}

38.

	Scientific Notation	Number
(a)	1×10^{0}	1
(b)	1×10^{-10}	0.000 000 000 1

Section PSS.7 *Scientific Notation*

40.

	Ordinary Number	Scientific Notation
(a)	1,010,000,000,000,000	1.01×10^{15}
(b)	0.000 000 000 000 456	4.56×10^{-13}
(c)	94,500,000,000,000,000	9.45×10^{16}
(d)	0.000 000 000 000 000 019 50	1.950×10^{-17}

42. 2.69×10^{19} helium atoms

44. 6.64×10^{-24} g/helium atom

General Exercises

46. 10.00 mL (± 0.01 mL)

48. 3.00×10^{8} meters per second
The velocity must be expressed in scientific notation because the rounded value, 300,000,000 meters per second, has only one significant digit.

50. 126.457 g + 131.60 g = 258.057 g *rounds to* 258.06 g

52.

	Exponential Number	Scientific Notation
(a)	0.170×10^{2}	1.70×10^{1}
(b)	0.00350×10^{-1}	3.50×10^{-4}

Challenge Exercises

54. Mass of a neutron $= 1.6749 \times 10^{-24}$ g

Mass of a proton $= 1.6726 \times 10^{-24}$ g

Mass difference: $(1.6749 \times 10^{-24}\text{ g}) - (1.6726 \times 10^{-24}\text{ g}) = 2.3 \times 10^{-27}$ g

56. 1 metric ton $=$ 2200 lb $= 2.200 \times 10^{3}$ lb

1 English ton $=$ 2000 lb $= 2.000 \times 10^{3}$ lb

Mass difference: $2.200 \times 10^{3}\text{ lb} - 2.000 \times 10^{3}\text{ lb} = 0.200 \times 10^{3}\text{ lb} = 2.00 \times 10^{2}$ lb