

# Prerequisite Science Skills

CHAPTER

**PSS**

## Section PSS.1 *Measurements*

- |    | <u>Unit</u>   | <u>Quantity</u> | <u>Unit</u>    | <u>Quantity</u> |
|----|---------------|-----------------|----------------|-----------------|
| 2. | (a) kilometer | length          | (b) microgram  | mass            |
|    | (c) liter     | volume          | (d) nanosecond | time            |
4. (b) 50.00 cm and (c) 50.05 cm each have an uncertainty of  $\pm 0.05$  cm.
6. (c) 75.518 g is the only mass with an uncertainty of  $\pm 0.001$  g.
8. (d) 32.00 mL and 32.05 mL each have an uncertainty of  $\pm 0.05$  mL.

## Section PSS.2 *Significant Digits*

- |     |                              |                           |
|-----|------------------------------|---------------------------|
| 10. | <u>Measurement</u>           | <u>Significant Digits</u> |
|     | (a) $1.050 \times 10^2$ cm   | 4 significant digits      |
|     | (b) $2 \times 10^3$ cm       | 1 significant digit       |
|     | (c) $3.00 \times 10^{-4}$ cm | 3 significant digits      |
|     | (d) $5.0 \times 10^{-5}$ cm  | 2 significant digits      |
| 12. | <u>Measurement</u>           | <u>Significant Digits</u> |
|     | (a) $1.2 \times 10^0$ g      | 2 significant digits      |
|     | (b) $4.50 \times 10^1$ g     | 3 significant digits      |
|     | (c) $5.02 \times 10^{-1}$ g  | 3 significant digits      |
|     | (d) $100 \times 10^{-2}$ g   | 1 significant digit       |
| 14. | <u>Measurement</u>           | <u>Significant Digits</u> |
|     | (a) $1 \times 10^{-1}$ mL    | 1 significant digit       |
|     | (b) $1.0 \times 10^{-2}$ mL  | 2 significant digits      |
|     | (c) $1.00 \times 10^1$ mL    | 3 significant digits      |
|     | (d) $1.000 \times 10^3$ mL   | 4 significant digits      |

### Section PSS.3 Rounding Off Nonsignificant Digits

16.	<u>Example</u>	<u>Rounded Off</u>
(a)	10.25	10.3
(b)	10.20	10.2
(c)	0.01029	0.0103
(d)	10,248	10,200
18.	<u>Example</u>	<u>Rounded Off</u>
(a)	$9.123 \times 10^5$	$9.12 \times 10^5$
(b)	$9.456 \times 10^{10}$	$9.46 \times 10^{10}$
(c)	$9.000 \times 10^{-7}$	$9.00 \times 10^{-7}$
(d)	$9.075 \times 10^{-12}$	$9.08 \times 10^{-12}$

### Section PSS.4 Adding and Subtracting Measurements

20. (a)  $1.55 \text{ cm} + 36.15 \text{ cm} + 17.3 \text{ cm} = 55.00 \text{ cm}$  rounds to 55.0 cm  
(b)  $5.0 \text{ cm} + 16.3 \text{ cm} + 0.95 \text{ cm} = 22.25 \text{ cm}$  rounds to 22.3 cm
22. (a)  $22.10 \text{ cm} - 10.5 \text{ cm} = 11.60 \text{ cm}$  rounds to 11.6 cm  
(b)  $10.0 \text{ cm} - 0.15 \text{ cm} = 9.85 \text{ cm}$  rounds to 9.9 cm

### Section PSS.5 Multiplying and Dividing Measurements

24. (a)  $1.25 \text{ cm} \times 0.5 \text{ cm} = 0.625 \text{ cm}^2$  rounds to  $0.6 \text{ cm}^2$   
(b)  $2.55 \text{ cm} \times 1.1 \text{ cm} = 2.805 \text{ cm}^2$  rounds to  $2.8 \text{ cm}^2$   
(c)  $12.0 \text{ cm}^2 \times 1.00 \text{ cm} = 12.0 \text{ cm}^3$  rounds to  $12.0 \text{ cm}^3$   
(d)  $22.1 \text{ cm}^2 \times 0.75 \text{ cm} = 16.575 \text{ cm}^3$  rounds to  $17 \text{ cm}^3$
26. (a)  $\frac{66.3 \text{ g}}{7.5 \text{ mL}} = 8.84 \text{ g/mL}$  rounds to  $8.8 \text{ g/mL}$   
(b)  $\frac{12.5 \text{ g}}{4.1 \text{ mL}} = 3.04878 \text{ g/mL}$  rounds to  $3.0 \text{ g/mL}$   
(c)  $\frac{42.620 \text{ g}}{10.0 \text{ mL}} = 4.262 \text{ g/mL}$  rounds to  $4.26 \text{ g/mL}$   
(d)  $\frac{91.235 \text{ g}}{10.00 \text{ mL}} = 9.1235 \text{ g/mL}$  rounds to  $9.124 \text{ g/mL}$

### Section PSS.6 Exponential Numbers

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

30. (a)  $3 \times 3 \times 3 \times 3 = 3^4$   
 (b)  $\frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = \left(\frac{1}{3}\right)^4 = 3^{-4}$

- |     |                         |                            |
|-----|-------------------------|----------------------------|
| 32. | <u>Number</u>           | <u>Scientific Notation</u> |
| (a) | 100,000,000,000,000,000 | $1 \times 10^{17}$         |
| (b) | 0.000 000 000 000 001   | $1 \times 10^{-15}$        |

- |     |                     |                                 |
|-----|---------------------|---------------------------------|
| 34. | <u>Number</u>       | <u>Scientific Notation</u>      |
| (a) | $1 \times 10^{12}$  | 1,000,000,000,000               |
| (b) | $1 \times 10^{-22}$ | 0.000 000 000 000 000 000 000 1 |

- |     |                            |                 |
|-----|----------------------------|-----------------|
| 36. | <u>Scientific Notation</u> | <u>Number</u>   |
| (a) | $1 \times 10^0$            | 1               |
| (b) | $1 \times 10^{-10}$        | 0.000 000 000 1 |

**Section PSS.7 Scientific Notation**

- |     |                              |                            |
|-----|------------------------------|----------------------------|
| 38. | <u>Ordinary Number</u>       | <u>Scientific Notation</u> |
| (a) | 1,010,000,000,000,000        | $1.01 \times 10^{15}$      |
| (b) | 0.000 000 000 000 456        | $4.56 \times 10^{-13}$     |
| (c) | 94,500,000,000,000,000       | $9.45 \times 10^{16}$      |
| (d) | 0.000 000 000 000 000 019 50 | $1.950 \times 10^{-17}$    |

40.  $2.69 \times 10^{23}$  oxygen molecules  
 42. 0.000 000 000 000 000 000 000 118 g/ chlorine molecule

**General Exercises**

44. 10.0 mL ( $\pm 0.1$  mL)  
 46.  $3.00 \times 10^8$  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.  
 48. Remaining length:  $255 \text{ cm} - 2(25.0 \text{ cm}) = 205 \text{ cm}$   
 50. 

	<u>Exponential Number</u>	<u>Scientific Notation</u>
(a)	$0.170 \times 10^2$	$1.70 \times 10^1$
(b)	$0.00350 \times 10^{-1}$	$3.50 \times 10^{-4}$

### Challenge Exercises

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

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

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

54. Total distance =  $\left( \begin{array}{l} \text{distance from} \\ \text{Earth to the Moon} \end{array} \right) + \left( \begin{array}{l} \text{distance from the} \\ \text{Moon to Mars} \end{array} \right)$

Total distance:  $2.39 \times 10^5$  miles +  $4.84 \times 10^7$  miles =  $4.86 \times 10^7$  miles

### Online Exercises

56. The lunar samples contained no water, and did not show evidence of living organisms.