Exercises - Chapter 1

Scientific Notation

A) $X = 299,790,000$

$X = 2.9979 \times 10^{8}$

Enter $a, k = 2.9979, 8$

B) $X = 0.51$

$X = 5.1 \times 10^{-1}$

Enter $a, k = 5.1, -1$

C) $4.0 \times 10^{3} + 4 \times 10^{2}$

→ Put both numbers on the same power of 10

$4.0 \times 10^{3} + 0.4 \times 10^{3} = 4.4 \times 10^{3}$

Enter $a, k = 4.4, 3$

b) $$X = \frac{(6.67 \times 10^{-11})(5.97 \times 10^{24})}{(6.38 \times 10^{6})^{2}}$$

Collect the powers of 10

$$X = \frac{(6.67)(5.97)}{(6.38)^{2}} \times \left(\frac{10^{-11}\ 10^{24}}{10^{12}}\right)$$

$X = (0.97827) \times (10) = 9.78$ 3 significant figures

Enter $a, k = 9.78, 0$

Converting Units

A) $x = 631.1 \text{ inch} \times \left(\frac{2.54 \text{ cm}}{1 \text{ inch}}\right) = 1602.994 \text{ cm}$

Report 3 significant figures $\quad x = 1.60 \times 10^3 \text{ cm}$

$x = 1,600$

B) This requires two conversions

$R = 1.9711 \times 10^4 \text{ yards} \times \left(\frac{3 \text{ ft}}{1 \text{ yard}}\right) \times \left(\frac{1 \text{ mile}}{5280 \text{ ft}}\right)$

$R = 11.198 \text{ miles}$

Report 4 significant figures $\quad R = 11.20 \text{ miles}$

C) $v = 1 \frac{\text{mile}}{\text{hour}} \times \left(\frac{1609 \text{ m}}{\text{mile}}\right) \times \left(\frac{1 \text{ hour}}{3600 \text{ s}}\right)$

$v = 0.4469 \frac{\text{m}}{\text{s}} = 0.447 \frac{\text{m}}{\text{s}}$ (to 3 significant figures)

2. **Picture the Problem**: This is simply a units conversion problem.

Strategy: Multiply the given number by conversion factors to obtain the desired units.

Solution: (a) Convert the units: $$70\ \mu\text{m} \times \frac{1.0\times10^{-6}\ \text{m}}{\mu\text{m}} = \boxed{7.0\times10^{-5}\ \text{m}}$$

(b) Convert the units again: $$70\ \mu\text{m} \times \frac{1.0\times10^{-6}\ \text{m}}{\mu\text{m}} \times \frac{1\ \text{km}}{1000\ \text{m}} = \boxed{7.0\times10^{-8}\ \text{km}}$$

Insight: The inside back cover of the textbook has a helpful chart of the metric prefixes.

17. **Picture the Problem**: This is a significant figures question.

Strategy: Follow the given rules regarding the calculation and display of significant figures.

Solution: 1. (a) The leading zeros are not significant: 0.0000 5 4 has $\boxed{\text{2 significant figures}}$

2. (b) The middle zeros are significant: $3.0\ 0\ 1\times10^{5}$ has $\boxed{\text{4 significant figures}}$

Insight: Zeros are the hardest part of determining significant figures. Scientific notation can remove the ambiguity of whether a zero is significant because any trailing zero to the right of the decimal point is significant.

34. **Picture the Problem**: This is a units conversion problem.

Strategy: Multiply the known quantity by appropriate conversion factors to change the units.

Solution: 1. Convert m/s to ft/s: $$\left(20.0\ \frac{\text{m}}{\text{s}}\right)\left(\frac{3.28\ \text{ft}}{\text{m}}\right) = \boxed{65.6\ \text{ft/s}}$$

2. (b) Convert m/s to mi/h: $$\left(20.0\ \frac{\text{m}}{\text{s}}\right)\left(\frac{1\ \text{mi}}{1609\ \text{m}}\right)\left(\frac{3600\ \text{s}}{1\ \text{h}}\right) = \boxed{44.7\ \text{mi/h}}$$

Insight: Conversion factors are conceptually equal to one, even though numerically they often equal something other than one. They are often helpful in displaying a number in a convenient, useful, or easy-to-comprehend fashion.

47. **Picture the Problem**: This is a units conversion problem.

Strategy: Multiply the known quantity by appropriate conversion factors to change the units.

Solution: 1. (a) Convert m/s to mi/h: $$\left(140\ \frac{\text{m}}{\text{s}}\right)\left(\frac{1\ \text{mi}}{1609\ \text{m}}\right)\left(\frac{3600\ \text{s}}{1\ \text{h}}\right) = \boxed{310\ \frac{\text{mi}}{\text{h}}}$$

2. (b) Convert m/s to m/ms $$\left(140\ \frac{\text{m}}{\text{s}}\right)\left(\frac{1\times10^{-3}\ \text{s}}{1\ \text{ms}}\right) = 0.14\ \frac{\text{m}}{\text{ms}} \times 5.0\ \text{ms} = \boxed{0.70\ \text{m}}$$

Insight: Conversion factors are conceptually equal to one, even though numerically they often equal something other than one. They are often helpful in displaying a number in a convenient, useful, or easy-to-comprehend fashion.