Measurement / Conversions Lecture

Concept Building

$$\cancel{A} \cdot \frac{\cancel{D}}{\cancel{A}} \cdot \frac{\cancel{C}}{\cancel{D}} \cdot \frac{B}{\cancel{C}} = \boxed{B}$$

How many inches are in 1.0 miles?

$$? \text{ in.} = 1.0\ \cancel{\text{mi}} \cdot \frac{5280\ \cancel{\text{ft}}}{1\ \cancel{\text{mi}}} \cdot \frac{12\ \text{in}}{1\ \cancel{\text{ft}}} = \boxed{63{,}000\ \text{in}}$$

Table 1.4 Some Prefixes for Powers of Ten Used with "Metric" (SI and cgs) Units

Power	Prefix	Abbreviation
10^{-18}	atto-	a
10^{-15}	femto-	f
10^{-12}	pico-	p
10^{-9}	nano-	n
10^{-6}	micro-	μ
10^{-3}	milli-	m
10^{-2}	centi-	c
10^{-1}	deci-	d
10^{1}	deka-	da
10^{3}	kilo-	k
10^{6}	mega-	M
10^{9}	giga-	G
10^{12}	tera-	T
10^{15}	peta-	P
10^{18}	exa-	E

A backyard is 215 yards long and 102 feet wide. What are the dimensions of the backyard in meters?

$$? \text{ m} = 215 \text{ y}\cancel{\text{d}}\text{s} \cdot \frac{0.9144 \text{ m}}{1 \text{ y}\cancel{\text{d}}} = \boxed{197 \text{ m}}$$

$$? \text{ m} = 102 \cancel{\text{f}}\text{t} \cdot \frac{1 \text{ m}}{3.281 \cancel{\text{f}}\text{t}} = \boxed{31.1 \text{ m}}$$

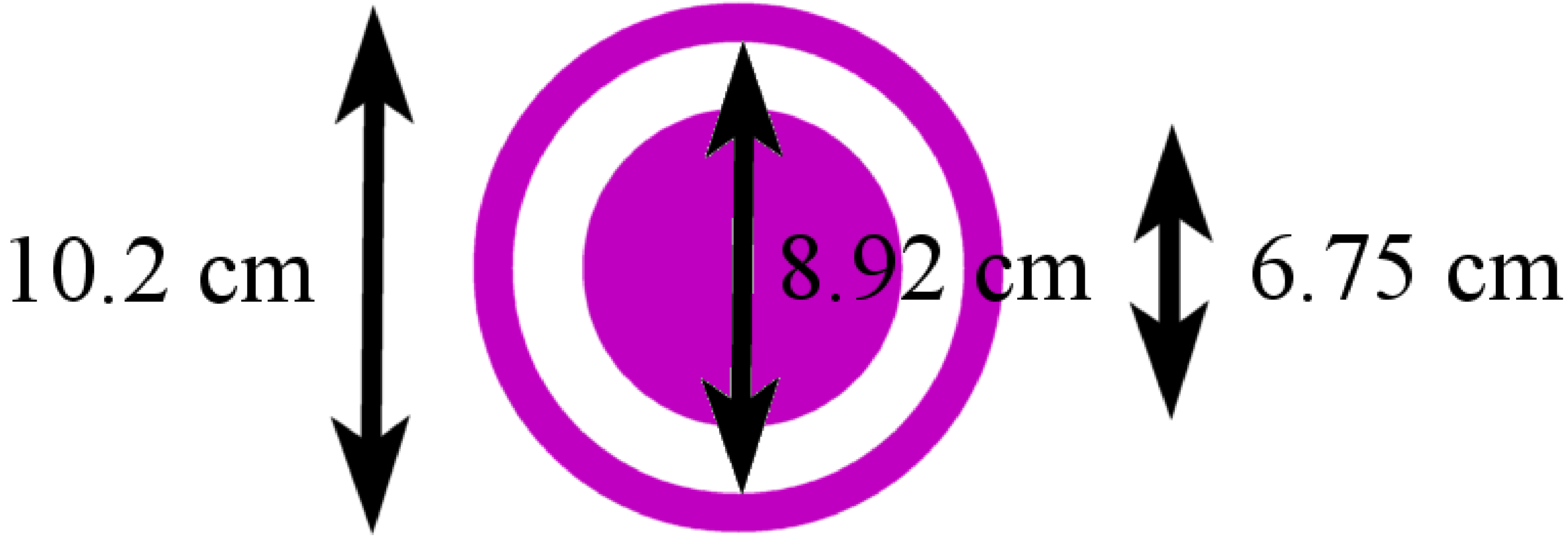
A driveway is 16.7 meters long. What is its distance in inches?

$$? \text{ in} = 16.7 \cancel{\text{m}} \cdot \frac{39.37 \text{ in}}{1 \cancel{\text{m}}} = \boxed{657 \text{ in}}$$

A car travels 65 miles per hour. What is it's speed in m/s?

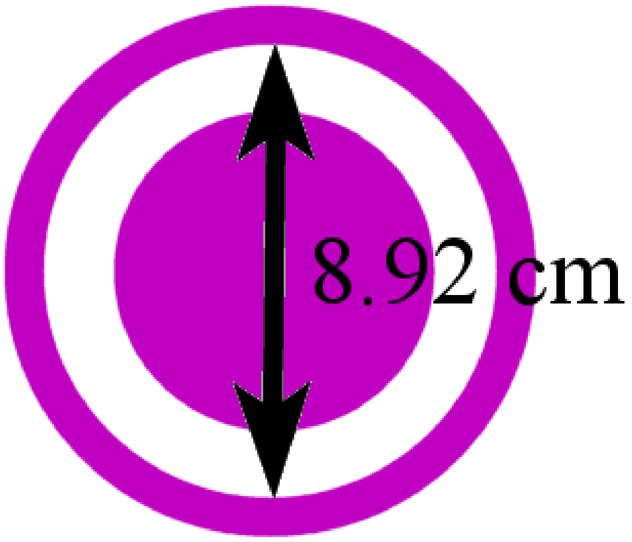
$$? \text{ m/s} = \frac{65 \cancel{\text{mi}}}{1 \cancel{\text{hr}}} \cdot \frac{1609 \text{ m}}{1 \cancel{\text{mi}}} \cdot \frac{1 \cancel{\text{hr}}}{3600 \text{ s}} = \boxed{29 \text{ m/s}}$$

Calculate the area of the unshaded portion of the diagram below in cm^2.



$$A_1 = \pi r^2 = \pi\left(\frac{6.75\ \text{cm}}{2}\right)^2 = 35.8\ \text{cm}^2$$

$$A_2 = \pi r^2 = \pi \left(\frac{8.92 \text{ cm}}{2} \right)^2 = 62.5 \text{ cm}^2$$



$$A_2 - A_1 = 62.5\ \text{cm}^2 - 35.8\ \text{cm}^2 = \boxed{26.7\ \text{cm}^2}$$

The density of mercury is 13.6 g/cm^3. Convert this to lbs/ft^3.

$$? \text{ lbs/ft}^3 = \frac{13.6 \cancel{\text{g}}}{\cancel{\text{c}}\text{c}} \cdot \frac{1 \text{ lb}}{454 \cancel{\text{g}}} \cdot \frac{1 \times 10^6 \cancel{\text{c}}\text{c}}{1 \cancel{\text{m}}^3} \cdot \frac{0.0283 \cancel{\text{m}}^3}{1 \text{ ft}^3} = \boxed{848 \text{ lbs/ft}^3}$$

Based on your previous answer, how many cm^3 would a 17 pound pool of mercury occupy?

$$? \ cm^3 = 17 \ \cancel{lbs} \cdot \frac{1 \ \cancel{ft}^3}{848 \ \cancel{lbs}} \cdot \frac{0.0283 \ \cancel{m}^3}{1 \ \cancel{ft}^3} \cdot \frac{1 \times 10^6 \ cc}{1 \ \cancel{m}^3} = \boxed{570 \ cm^3}$$

The dimensions of a box are:
11 ft x 24 in x 37 cm.
What is the volume of the box in cubic inches?

$$? \text{ in}^3 = \left(11\,\cancel{\text{ft}} \cdot \frac{12\text{ in}}{1\,\cancel{\text{ft}}}\right) \cdot \left(24\text{ in}\right) \cdot \left(37\,\cancel{\text{cm}} \cdot \frac{1\text{ in}}{2.54\,\cancel{\text{cm}}}\right) = \boxed{46{,}000\text{ in}^3}$$

- Several carpet installers make measurements for carpet installation in the different rooms of a restaurant, reporting their measurements with inconsistent accuracy.
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- BANQUET HALL: 14.71 m x 7.46 m
- MEETING ROOM: 4.8221 m x 5.1 m
- DINING ROOM: 13.8 m x 9 m
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- Compute the areas for **(a)** the banquet hall, **(b)** the meeting room, and **(c)** the dining room, taking into account (as always) significant figures. **(d)** What total area of carpet is required for these rooms? All values are to be reported in (m^2).

a) $(14.71\text{ m})\cdot(7.46\text{ m}) = \boxed{11\overline{0}\text{ m}^2}$ $109.7366\ (\textit{too many sig. fig.})$

b) $(4.822\text{ m})\cdot(5.1\text{ m}) = \boxed{25\text{ m}^2}$ $24.5922\ (\textit{too many sig. fig.})$

c) $(13.8\text{ m})\cdot(9\text{ m}) = \boxed{100\text{ m}^2}$ $124.2\ (\textit{too many sig. fig.})$

d) $(11\overline{0}\text{ m}^2) + (25\text{ m}^2) + (100\text{ m}^2) = \boxed{200\text{ m}^2}$ $235\ (\textit{too many sig. fig.})$

- If a car is traveling at a speed of 28.0 m/s, **(a)** what is its speed in mi/h, and **(b)** in km/h?

$$\left(\frac{28.0\ \cancel{\text{m}}}{\cancel{\text{s}}}\right)\left(\frac{1\ \text{mi}}{1609\ \cancel{\text{m}}}\right)\left(\frac{3600\ \cancel{\text{s}}}{1\ \text{hr}}\right) = \boxed{62.6\ \text{mi/h}}$$

$$\left(\frac{28.0\ \cancel{\text{m}}}{\cancel{\text{s}}}\right)\left(\frac{1\ \text{km}}{1000\ \cancel{\text{m}}}\right)\left(\frac{3600\ \cancel{\text{s}}}{1\ \text{hr}}\right) = \boxed{101\ \text{km/h}}$$

- The traffic light turns green, and the driver of a high-performance car slams the accelerator to the floor. The accelerometer registers 22.0 m/s^2. Convert this reading to **(a)** km/min^2 and also to **(b)** ft/s^2.

$$\left(\frac{22.0\ \cancel{\text{m}}}{\cancel{\text{s}}^2}\right)\left(\frac{1\ \text{km}}{1000\ \cancel{\text{m}}}\right)\left(\frac{60\ \cancel{\text{s}}}{1\text{min}}\right)^2 = \boxed{79.2\ \text{km/min}^2}$$

$$\left(\frac{22.0\ \cancel{\text{m}}}{\text{s}^2}\right)\left(\frac{3.281\ \text{ft}}{1\ \cancel{\text{m}}}\right) = \boxed{72.2\ \text{ft/s}^2}$$

- An airplane travels $x = 4.50 \times 10^2$ km due east and then travels an unknown distance y due north. Finally, it returns to its starting point by traveling a distance of $r = 525$ km. **(a)** How far (in km) did the airplane travel in the northerly direction? **(b)** What is the answer (in km) if both the distance traveled due east and the direct return distance are both doubled?

$$\sin\theta = \frac{\text{side opposite } \theta}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{side adjacent to } \theta}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{side opposite } \theta}{\text{side adjacent to } \theta}$$

$$r^2 = x^2 + y^2$$

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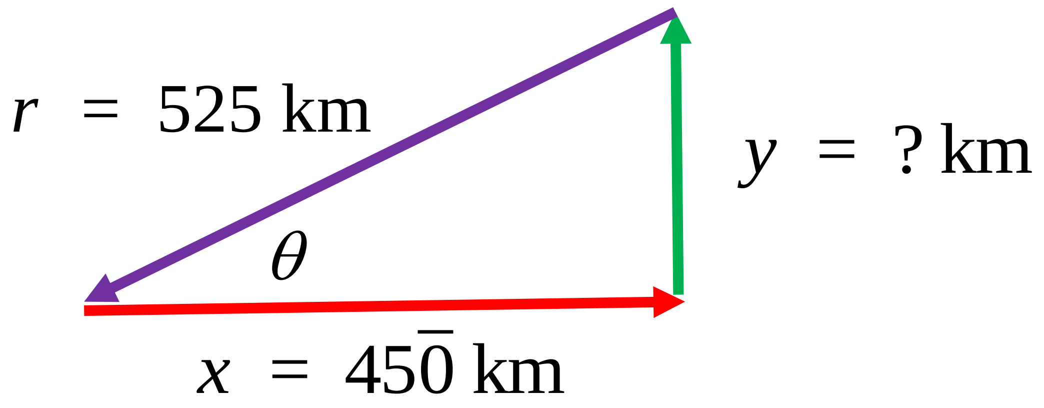

$$\therefore \; y^2 = r^2 - x^2$$

$$\therefore \; y = \sqrt{r^2 - x^2} = \sqrt{(525\ \text{km})^2 - \left(4.50 \times 10^2\ \text{km}\right)^2} = \boxed{27\bar{0}\ \text{km}}$$

$$\therefore \; y = \sqrt{r^2 - x^2} = \sqrt{(2 \cdot 525\ \text{km})^2 - \left(2 \cdot 45\bar{0}\ \text{km}\right)^2} = \boxed{541\ \text{km}}$$

- A person measures the height of a building by walking out a distance of 46.0 m from its base and shining a flashlight beam toward the top. When the beam is elevated at an angle of 39.0° with respect to the horizontal, (*as shown similarly in lecture Figure 1.8)* the beam just strikes the top of the building.

- **(a)** If the flashlight is held at a height of 2.00 m, find the height of the building (in meters).
- **(b)** Calculate the length (in meters) of the light beam.

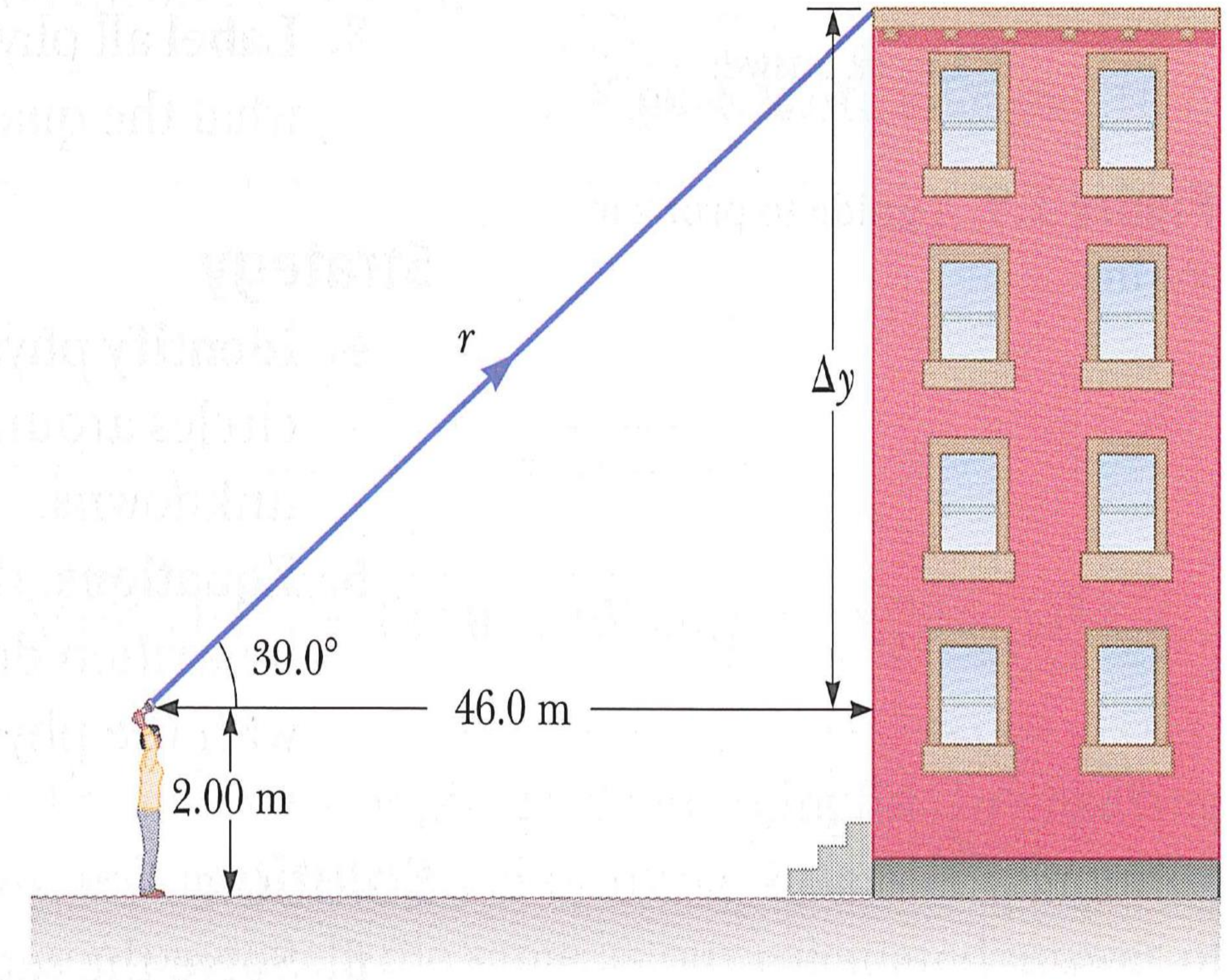

Figure 1.8

Photos/Illustrations courtesy of *College Physics*, 9th edition.

$$\sin\theta = \frac{\text{side opposite } \theta}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{side adjacent to } \theta}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{side opposite } \theta}{\text{side adjacent to } \theta}$$

$$r^2 = x^2 + y^2$$

$$\tan 39.0^\circ = \frac{\Delta y}{46.0\ \text{m}}$$

$$\therefore \quad \Delta y = (\tan 39.0^\circ)(46.0\ \text{m}) = 37.2\ \text{m}$$

37.2500 will initiate the even/odd rule

$$\therefore \quad \Sigma y = 37.2\ \text{m} + 2.00\ \text{m} = \boxed{39.2\ \text{m}}$$

$$r = \sqrt{x^2 + y^2} = \sqrt{(37.2\ \text{m})^2 + (46.0\ \text{m})^2} = \boxed{59.2\ \text{m}}$$