

Section 11.1 – Linear Measure

English or Customary Units

Originally, a yard was the distance from the tip of the nose to the end of an outstretched arm of an adult person and a foot was the length of a human foot. Since then, the definition has changed numerous times and is now based in international standards.

Unit	Equivalent in Other Units
yard (yd)	3 ft
foot (ft)	12 in.
mile (mi)	1760 yd, or 5280 ft

Dimensional Analysis (Unit Analysis)

Dimensional analysis is a process of converting from one unit of measure to another using *unit ratios* (ratios equivalent to 1).

Example: Convert the following:

$$200 \text{ ft} = \underline{\hspace{2cm}} \text{ yd}$$

$$3.75 \text{ yd} = \underline{\hspace{2cm}} \text{ in}$$

$$940 \text{ in} = \underline{\hspace{2cm}} \text{ yd}$$

$$8690 \text{ ft} = \underline{\hspace{2cm}} \text{ mi}$$

The Metric System

The *metric system* is a standard based on the meter. It is the official system of measurement everywhere except Myanmar, Liberia, and the United States.

Unit	Abbreviation	Relationship to base unit
kilometer	km	1000 m
hectometer	hm	100 m
dekameter	dam	10 m
<i>meter</i>	<i>m</i>	<i>base unit</i>
decimeter	dm	0.1 m
centimeter	cm	0.01 m
millimeter	mm	0.001 m

Approximate Conversions Between the English and Metric Systems

- 1 km = 0.62 mi
- 1 m = 1.09 yd
- 2.54 cm = 1 in

Example: Convert the following:

$$3.5 \text{ km} = \underline{\hspace{2cm}} \text{ m}$$

$$375 \text{ cm} = \underline{\hspace{2cm}} \text{ hm}$$

$$765 \text{ mm} = \underline{\hspace{2cm}} \text{ dm}$$

$$5.8 \text{ km} = \underline{\hspace{2cm}} \text{ cm}$$

$$70 \text{ miles/hour} = \underline{\hspace{2cm}} \text{ km/hr}$$

$$100 \text{ yds} = \underline{\hspace{2cm}} \text{ m}$$

Greatest Possible Error

The *greatest possible error* (GPE) of a measurement is one-half the smallest unit used.

Example: Determine the GPE for each of the following measurements and interpret.

- a. The height of a window is measured as 60 in.

- b. The width of a piece of board is measured as 10.8 cm.

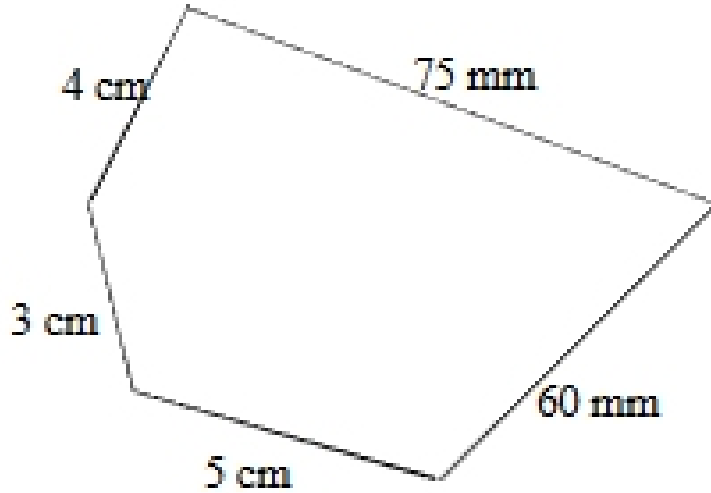
Distance Properties

1. The distance between any two points A and B is greater than or equal to 0, written $AB \geq 0$.
2. The distance between any two points A and B is the same as the distance between B and A , written $AB = BA$.
3. For any three points A , B , and C , the distance between A and B plus the distance between B and C is greater than or equal to the distance between A and C , written $AB + BC \geq AC$.
 - a. **Triangle Inequality** The sum of the lengths of any two sides of a triangle is greater than the length of the third side.

Distance Around a Plane Figure

The **perimeter** of a simple closed curve is the length of the curve. If a figure is a polygon, its perimeter is the sum of the lengths of its sides. A perimeter has linear measure.

Example: What is the perimeter of the figure?



Example: Given a square of any size, stretch a rope tightly around it. Now take the rope off, add 125 inches to it, and put the extended rope back around the square so that the new rope makes a square around the original square. Find d , the distance between the squares.

Circumference of a Circle

- A *circle* is the set of all points in a plane that are equidistant from a given point, the *center*. The distance is the *radius*.
- The *circumference* of a circle is the perimeter and is found by $C = 2\pi r = \pi d$, where r is the radius, d is the diameter, and $\pi = 3.14159\dots$

Arc Length

The *arc length* is a linear distance around a portion of the circumference of a circle. The length of an arc depends on the radius of the circle and the central angle determining the arc.

Example: Determine the length of each arc described below for a circle with radius r .

a. Semicircle

b. Quarter circle

c. Arc with central angle θ