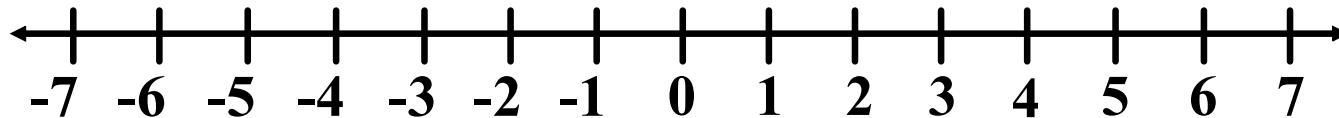


1-3 Distance and Midpoints

When we ask for the distance between two things, we are wanting to know *how far apart* they are.

How we calculate the distance depends on the figure we are looking at or the question we are asking.

We can ask the distance between any two points on a number line:

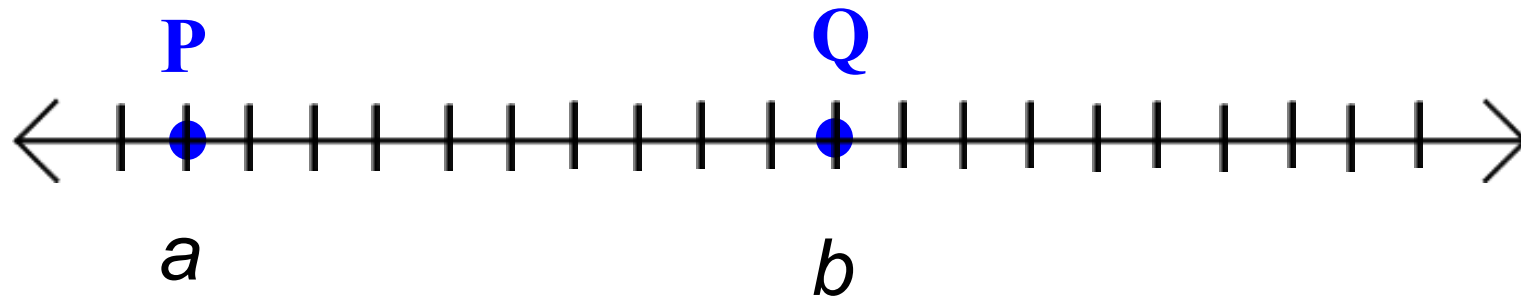


What is the distance between 2 and -4?

Between -3 and 0? Between 3 and 0?

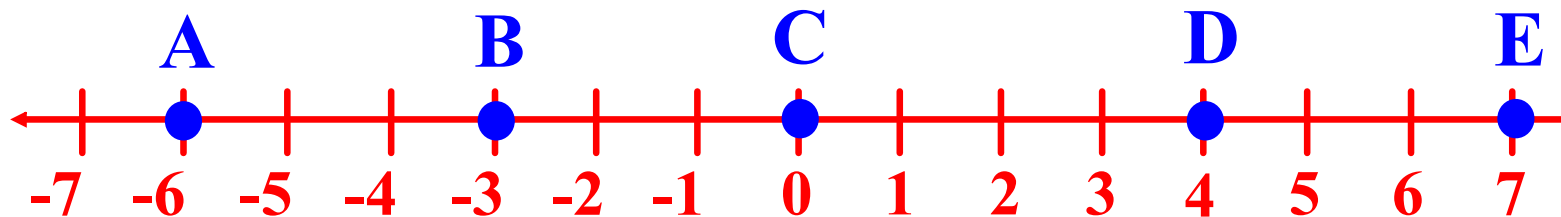
Measuring a line segment

The measure of a line segment is the absolute value of the **DIFFERENCE** of the coordinates of the endpoints.



$$PQ = |a - b|$$

$$PQ = |b - a|$$



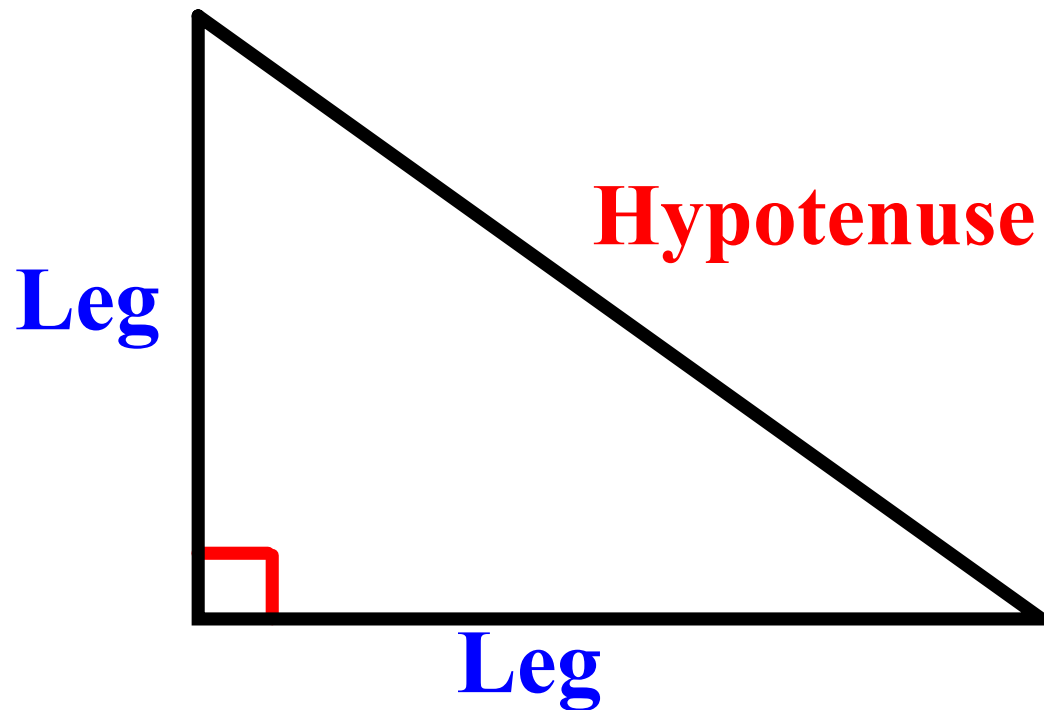
$$AB = |-6 - (-3)| \quad CE = |0 - 7| \quad DE = ?$$

$$AB = |-6 + 3| \quad CE = |-7| \quad AC = ?$$

$$AB = |-3| \quad CE = 7 \quad BD = ?$$

$$AB = 3$$

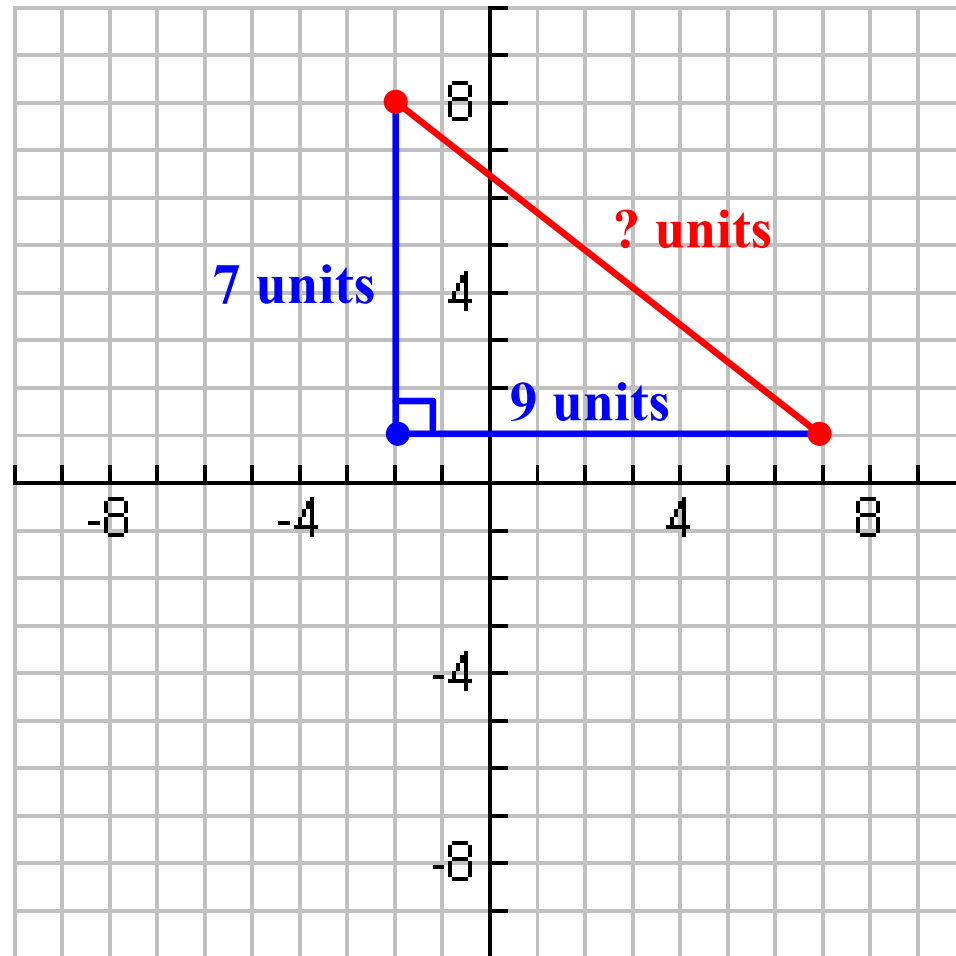
Right Triangle



The Pythagorean Theorem

In A right triangle, if a and b are the lengths of the legs and c is the length of the hypotenuse, then the following equation is always true:

$$a^2 + b^2 = c^2$$



The Distance Formula

On the coordinate plane, the distance between any 2 pts. with coordinates (x_1, y_1) and (x_2, y_2) can be found by the following formula:

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Definition: Midpoint

The midpoint of a segment is the point on the segment that divides the segment into two congruent segments.

**The midpt. of \overline{AB} is the pt. X
between A and B such that $AX = XB$**



Draw \overline{PQ} with midpoint M .

Midpoint Formulas

1. On a number line, the coordinate of the midpt. of a segment whose endpts. have coordinates a and b can be found by:

$$\frac{a + b}{2}$$

The coordinates on a number line of J and K are -12 and 16, respectively. Find the coordinate of the midpoint of \overline{JK}

2. On the coordinate plane, the coordinates of the midpoint of a segment whose endpoints are (x_1, y_1) and (x_2, y_2) are:

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Find the coordinates of the midpoint of \overline{GH} for $G(8, -6)$ and $H(-14, 12)$.

You can also find the coordinates of an endpoint of a segment if you know the coordinates of its other endpoint and its midpoint.

Find the coordinates of D if E(-6,4) is the midpoint of \overline{DF} and F has coordinates (-5,-3).

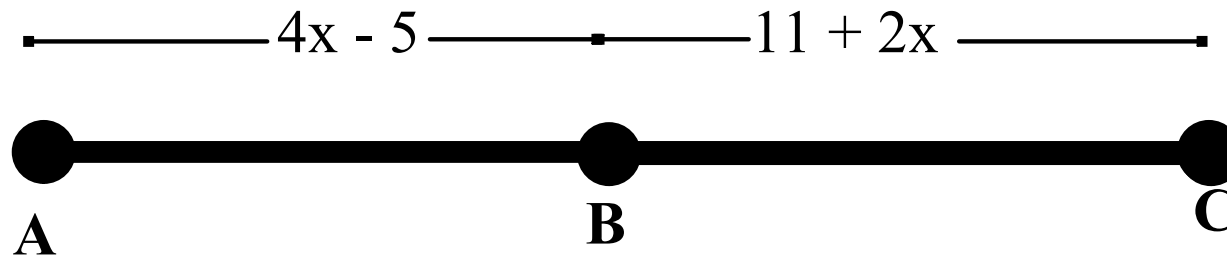
Write separate equations for the x and the y coordinates:

$$\begin{aligned}x_m &= \frac{x_1 + x_2}{2} & y_m &= \frac{y_1 + y_2}{2} \\-6 &= \frac{-5 + x_2}{2} & 4 &= \frac{-3 + y_2}{2} \\-12 &= -5 + x_2 & 8 &= -3 + y_2 \\-7 &= x_2 & 11 &= y_2\end{aligned}$$

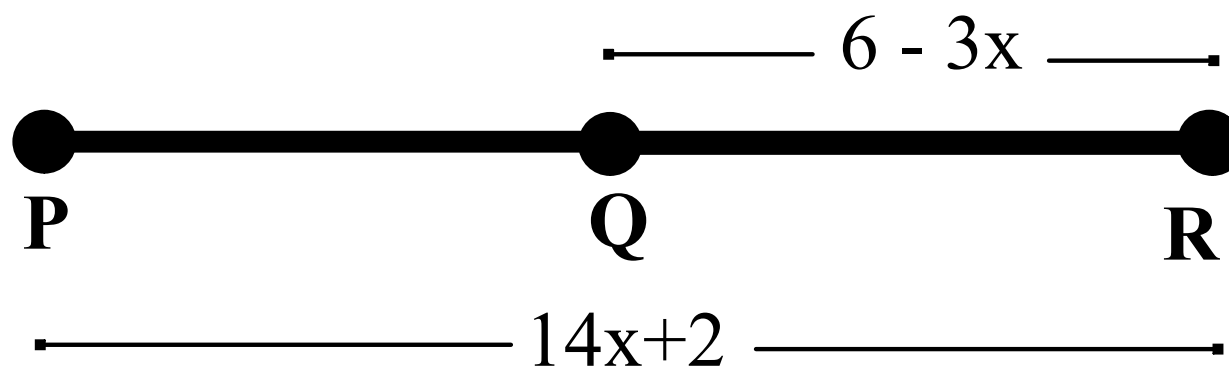
The coordinates of D are (-7,11).

We can also use the fact that the midpoint creates two congruent segments to help us answer other questions:

Find AC, AB, and BC if B is the midpoint of \overline{AC} .



What is PR if Q is the midpoint of \overline{PR} ?



Definition: Segment Bisector

Any segment, line, or plane that intersects a segment at its midpt.

(Also see diagram at top of page 25 in the text.)

