

3.2 – Distance and Midpoint Formulas * Square root does not mean divide by 2! *

The Distance Formula → (USED FOR THE COORDINATE PLANE)

The distance "d" between any two points (x_1, y_1) and (x_2, y_2) : $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$
* Distance CANNOT be negative * * ordered pairs * → Plug the coordinates into the formula

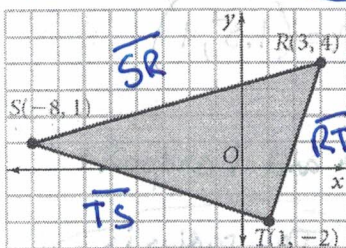
To find the square root: **2nd** $\sqrt{\quad}$ $\rightarrow \sqrt{(144)}$ **ENTER** $\rightarrow 12$

Example 1: Find the distance between point A and point B. Round to nearest tenth. 0.0000
tenths

a.) $A(2, 7)$ and $B(1, 5)$ $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ $d = \sqrt{(2 - 1)^2 + (7 - 5)^2}$ $d = \sqrt{(1)^2 + (2)^2}$ $d = \sqrt{1 + 4}$ $d = \sqrt{5}$ $d = 2.236067977$ $d \approx 2.2$ units	b.) $A(1, -5)$ and $B(3, -2)$ $d = \sqrt{(1 - 3)^2 + (-5 - (-2))^2}$ $= \sqrt{(-2)^2 + (-5 + 2)^2}$ $= \sqrt{(-2)^2 + (-3)^2}$ $= \sqrt{4 + 9}$ $= \sqrt{13}$ $d = 3.605551275$ $d \approx 3.6$ units	c.) $A(-5, 10)$ and $B(8, -4)$ $d = \sqrt{(-5 - 8)^2 + (10 - (-4))^2}$ $= \sqrt{(-13)^2 + (10 + 4)^2}$ $= \sqrt{(-13)^2 + (14)^2}$ $= \sqrt{169 + 196}$ $= \sqrt{365}$ $d = 19.10497317$ $d \approx 19.1$
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Example 2: Find what is asked of the given information.

a.) Find the perimeter of the figure below:



*** ADD ALL THE SIDES! ***
 NEED TO FIND THE LENGTHS OF ALL 3 SIDES!

$P = \overline{SR} + \overline{RT} + \overline{TS}$
 $P = \sqrt{130} + \sqrt{40} + \sqrt{90}$

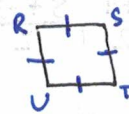
The perimeter is 27.2 units.
 $P \approx 27.2$ units

- ① \overline{SR} $(-8, 1)$ $(3, 4)$
 $d = \sqrt{(-8 - 3)^2 + (1 - 4)^2}$
 $= \sqrt{(-11)^2 + (-3)^2}$
 $= \sqrt{121 + 9}$
 $d = \sqrt{130}$
- ② \overline{RT} $(3, 4)$ $(1, -2)$
 $d = \sqrt{(3 - 1)^2 + (4 - (-2))^2}$
 $= \sqrt{(2)^2 + (4 + 2)^2}$
 $= \sqrt{(2)^2 + (6)^2}$
 $= \sqrt{4 + 36}$
 $d = \sqrt{40}$
- ③ \overline{TS} $(1, -2)$ $(-8, 1)$
 $d = \sqrt{(1 - (-8))^2 + (-2 - 1)^2}$
 $= \sqrt{(1 + 8)^2 + (-3)^2}$
 $= \sqrt{(9)^2 + (-3)^2}$
 $= \sqrt{81 + 9}$
 $d = \sqrt{90}$

*** DO NOT TAKE THE SQUARE ROOT JUST YET! ***

b.) Find the **area of a square** with the vertices

R(2, 10), S(8, 4), T(2, -2), and U(-4, 4)



$A = s^2$

*** Only need to find one side b/c all sides are congruent. ***

① Find \overline{ST}

$(8, 4)$ $(2, -2)$
 x_1, y_1 x_2, y_2

$d = \sqrt{(8 - 2)^2 + (4 - (-2))^2}$
 $= \sqrt{(6)^2 + (4 + 2)^2}$
 $= \sqrt{(6)^2 + (6)^2}$
 $= \sqrt{36 + 36}$
 $= \sqrt{72}$
 $ST = \sqrt{72}$

② Find the Area

$A = s^2$
 $A = (\sqrt{72})^2$
 $A = 72$ units²

Finding the Midpoint of a Line Segment

* - **midpoint (of a segment)** → a point on a line that **divides** the segment in **half**; **2** equal segments.
 The mid-point gives a **location** (x, y) , not a distance.

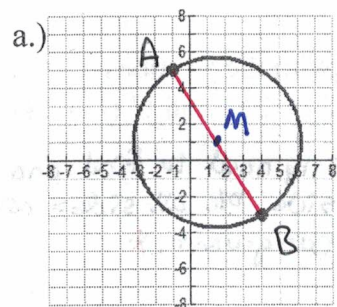
The Midpoint Formula

The midpoint M of a line segment with endpoints (x_1, y_1) and (x_2, y_2) : $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$ *The answer is an ordered pair!*

Example 3: Find the midpoint between point A and point B. Round to nearest tenth.

a.) $A(3, 5)$ and $B(-1, 1)$	b.) $A(-1, 5)$ and $B(-3, 0)$	c.) $A(-3, 7)$ and $B(5, 2)$
$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$ $M = \left(\frac{3 + (-1)}{2}, \frac{5 + 1}{2} \right)$ $= \left(\frac{2}{2}, \frac{6}{2} \right)$ $M = (1, 3)$	$M = \left(\frac{-1 + (-3)}{2}, \frac{5 + 0}{2} \right)$ $= \left(\frac{-4}{2}, \frac{5}{2} \right)$ $M = (-2, 2.5)$	$M = \left(\frac{-3 + 5}{2}, \frac{7 + 2}{2} \right)$ $= \left(\frac{2}{2}, \frac{9}{2} \right)$ $M = (1, 4.5)$

Example 4: Find what is asked of the given information.



Find the center of circle: **Find the Mid-point**

$A(-1, 5)$ $B(4, -3)$

$$M = \left(\frac{-1 + 4}{2}, \frac{5 + (-3)}{2} \right) \rightarrow \left(\frac{3}{2}, \frac{2}{2} \right) \rightarrow M = (1.5, 1)$$

Find the length of the radius: **Use distance formula and 1 endpoint and the midpoint**

$A(-1, 5)$ $M(1.5, 1)$
 x_1, y_1 x_2, y_2

$$d = \sqrt{(-1 - 1.5)^2 + (5 - 1)^2}$$

$$d = \sqrt{(-2.5)^2 + (4)^2}$$

$$d = \sqrt{6.25 + 16}$$

$$d = \sqrt{22.25}$$

$$d \approx 4.7$$

The radius is 4.7 units long.

b.) The midpoint of a line segment is $(-1, 4)$ and the endpoints are $(3, y)$ and $(-5, 10)$.
 What is the value of y ?