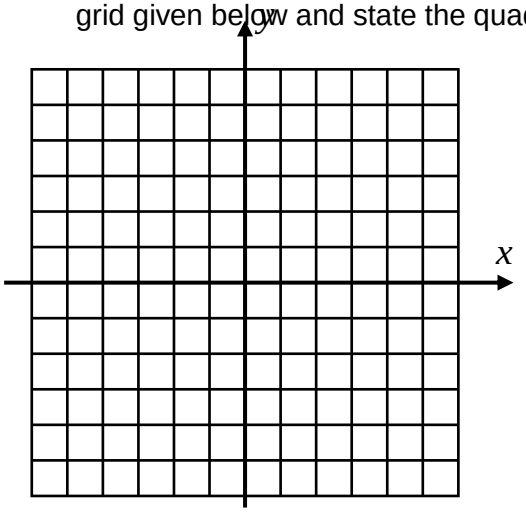
Name: _____ **UNIT 6 BOOK**

The Coordinate Plane & Slopes of Linear Equations
Intro to Geometry

AIM: → To review graphing points & their relationship with linear equations
→ To review the concept of slope
→ To calculate the slope of a line between two points

Ex.1 (a) Label the four quadrants: I, II, III, IV

(b) Given the points $A(1, 2), B(-3, 4), C(2, -5),$ and $D(-4, -6)$, plot and label them on the grid given below and state the quadrant that each point lies in.



QUADRANTS

A: _____

B: _____

C: _____

D: _____

GRAPHING SOLUTIONS TO EQUATIONS

If an ordered pair (x, y) satisfies the equation (makes it a true statement), then it falls on the graph of that equation. Likewise, if a point (x, y) falls on the graph of an equation, then it lies in the solution set of that equation. Thus a graph represents a "picture" of all solutions to an equation.

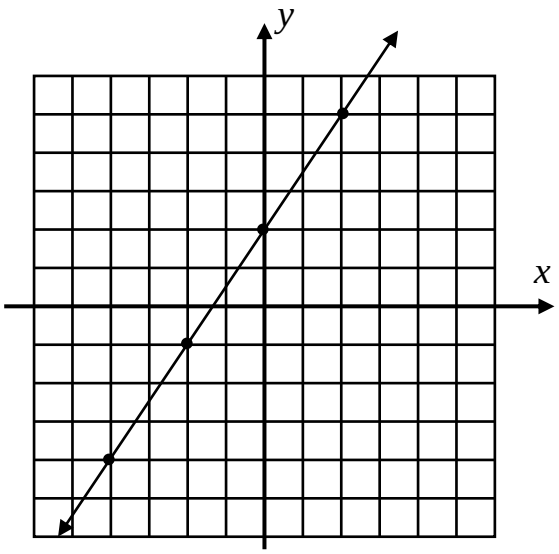
Ex. 2 Given the linear equation $y = 4x - 3$ answer the following questions.

(a) Does the point $(2, 5)$ satisfy this equation? Justify.

(b) Does the point $(2, 5)$ lie on the graph of this linear equation? Explain.

Ex. 3 Find the value of *a* such that the point $(a, 0)$ lies on the graph of $y = -2x + 8$.

Ex. 4 The graph of the equation $2y-3x=4$ is shown at the right. Which of the following ordered pairs is *not* a solution to this equation? *Explain your choice.*



(1) $(-2,-1)$ (3) $(-3,4)$

(2) $(0,2)$ (4) $(2,5)$

Explanation:

SLOPE

The slope of a line is a measure of its steepness. Measuring slope tells us the steepness of a hill, the pitch of a roof, or the incline of a ramp. Graphically, the slope can tell us the rate of change.

DEFINITION OF SLOPE

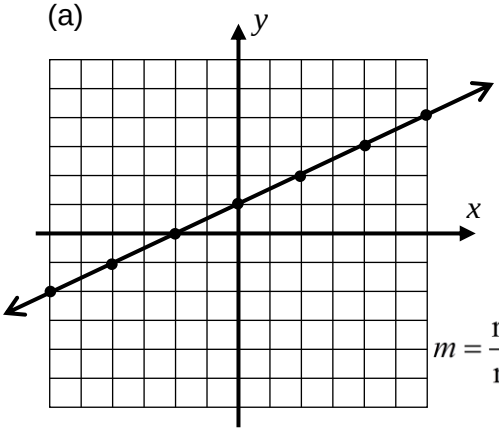
$$\text{slope} = m = \frac{\text{change in } y}{\text{change in } x} = \frac{\Delta y}{\Delta x}$$

SLOPE FORMULA

$$\text{slope} = m = \frac{y_2 - y_1}{x_2 - x_1}$$

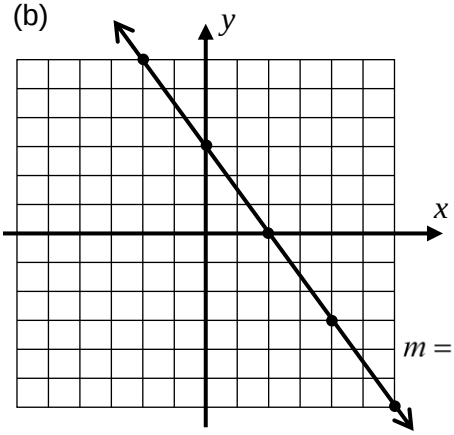
Ex. 1 For each of the following lines, state the slope.

(a)



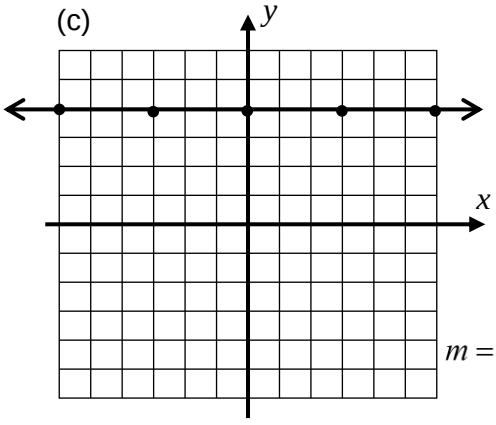
$m = \frac{\text{rise}}{\text{run}} =$

(b)



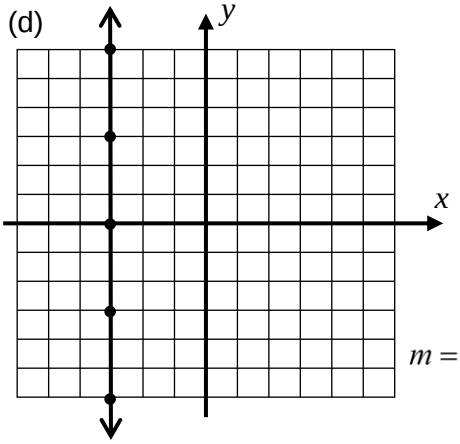
$m = \frac{\text{rise}}{\text{run}} =$

(c)



$m = \frac{\text{rise}}{\text{run}} =$

(d)

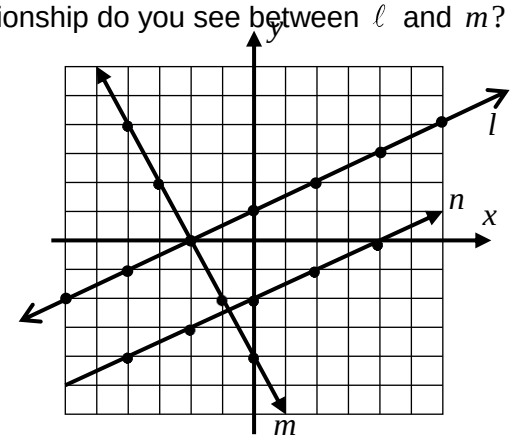


$m = \frac{\text{rise}}{\text{run}} =$

Ex. 2 Determine the slope of the line that contains the given points.

(a) $A(0,2), B(7,3)$ (b) $C(-2,-3), D(-6,-5)$ (c) $E(3,2), B(3,-3)$

Ex. 3 Examine the graphs of lines ℓ, m, and n. What relationship do you see between ℓ and m? ℓ and n? m and n?



Recall: Parallel lines have **equal slopes.**

Fact: If 2 lines are *perpendicular*, their slopes are **negative reciprocals** of one another.

Ex. 4 Find the negative reciprocal of each of the following:

a.) $\frac{2}{3}$ b.) $-\frac{5}{8}$ c.) 8 d.) -3

Ex. 5 Determine whether $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ are *parallel, perpendicular,* or *neither*.

(a) $A(-2,-5), B(4,7), C(0,2), D(8,-2)$

(b) $A(-8,-7), B(4,-4), C(-2,-5), D(1,7)$

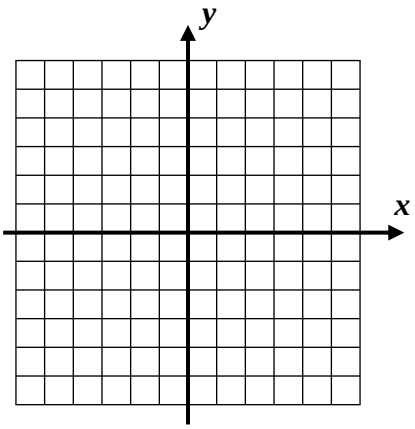
Ex. 6 Line $\overleftrightarrow{AB}$ passes through the points $A(-4, 2)$ and $B(6, -4)$. Line $\overleftrightarrow{AB}$ is parallel to line $\overleftrightarrow{CD}$. What is the slope of $\overleftrightarrow{CD}$? Justify.

Ex. 7 Given the following points: $A(-2, 6)$, $B(1, -5)$, $E(0, -7)$, $F(1,1)$, $L(4,9)$, $M(0,0)$, Find the slope of each line.

(a) $\overleftrightarrow{AB}$ (b) $\overleftrightarrow{LM}$ (c) $\overleftrightarrow{EF}$

(e) a line parallel to $\overleftrightarrow{LM}$ (g) a line perpendicular to $\overleftrightarrow{EF}$ (h) a line parallel to $\overleftrightarrow{AB}$

Ex. 8 The slope of $\overleftrightarrow{AB}$ is $\frac{3}{2}$. $\overleftrightarrow{AB}$ passes through the points $A(-1, -2)$ and $B(3, y)$. Determine the value of *y*. (The use of the grid is optional.)

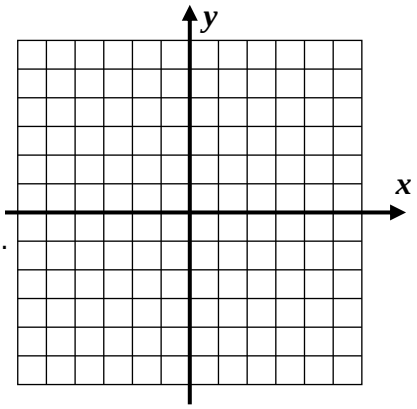


The Coordinate Plane & Slopes of Linear Equations Homework
Intro to Geometry

1. Given the linear equation $y = 5x - 2$, circle each of the following point(s) that lie on the line:
   $(0,-2)$ $(1,4)$ $(3,1)$ $(-2,-12)$

2. Find the slope containing the points $A(4,5)$ and $B(-3,2)$.

Use of this grid is optional

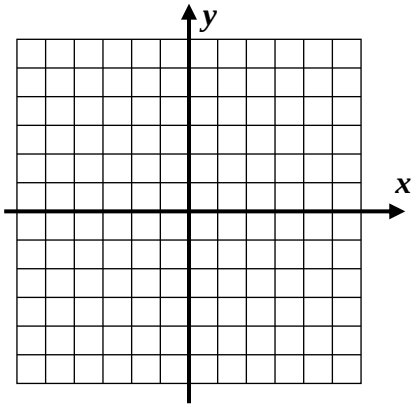


3. Find the slope containing the points $C(-5,-4)$ and $D(-3,-2)$.

4. Determine if the line segments $\overline{AB}$ and $\overline{CD}$ are parallel, perpendicular, or neither if given the following coordinates:
   a.) $A(-2,4)$, $B(2,8)$, $C(-1,5)$, $D(1,3)$ b.) $A(-5,1)$, $B(3,5)$, $C(2,7)$, $D(-2,5)$

5. Find the value of ***k*** if AB has a given slope, ***m***.
   $A(-2,-5)$, $B(k,1)$; $m = 2$

Use of this grid is optional



Equations of Lines
Intro to Geometry

AIM: → To identify the components of a linear equation
→ To write equations of lines given a variety of information
→

A linear equation is an equation whose graph is a straight line. Linear equations are useful in science, business, and many other areas. For example, linear equations can be used to model temperature conversion, exchange rates, cell phone plans, and travel.

Celsius ➡ Fahrenheit

• The equation $f = 32 + \frac{9}{5}c$ converts a temperature in degrees Celsius, *c*, into degrees Fahrenheit, *f*

Verizon Wireless

•$39.99 per month for service
•After 450 minute allowance, calls are charged $0.45 per minute of air time, *t*

Cost *C* after the allowance, is $C = .45t + 39.99$

Understanding how the numbers in a linear equation determine the graph can help you write a linear equation based on information about the graph.

Recall:

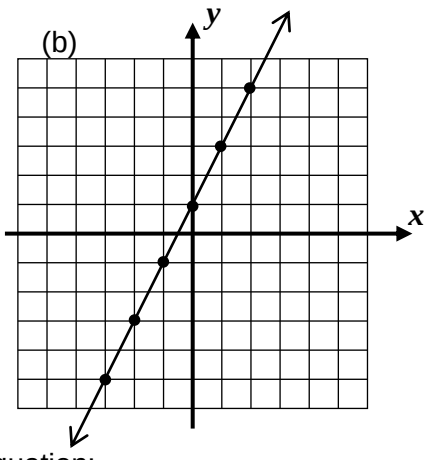
THE SLOPE-INTERCEPT FORM OF A LINE

$$y = mx + b$$

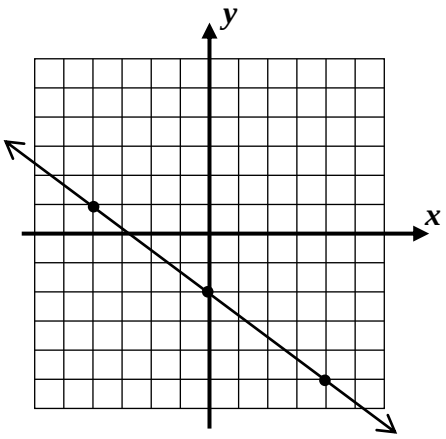
$m = \text{slope}$ and $b = \text{the } y\text{-intercept}$

Ex. 1 Write the equation, in $y = mx + b$ form, for each line shown below.

(a) (b)



Equation: _____



Equation: _____

Ex. 2 Write the equation of a line in $y = mx + b$ form that is parallel to the line $y = 2x + 4$ and has a *y*-intercept of -8.

Ex. 3 Write the equation of a line parallel to $y = \frac{2}{3}x - 2$ and passing through the point $(0,8)$.

Ex. 4 Which of the following lines is parallel to the line $y = -3x + 4$ and has a *y*-intercept of 10?

(1) $y = 4x + 10$ (2) $y = -3x - 10$ (3) $y = -3x + 10$ (4) $y = 4x + 4$

Ex. 5 Write the equation of the line passing through the point (1, 8) with a slope of 3.

Ex. 6 Write the equation of the line passing through the points $(4,10)$ and $(6,11)$.

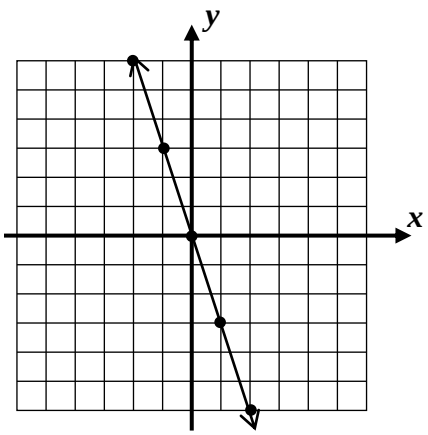
Ex. 7 Write the equation of the line passing through the points $(1,2)$ and $(3,-4)$.

Ex. 8 Write the equation of a line parallel to $y = \frac{3}{5}x - 1$ and passing through the point $(0, -7)$.

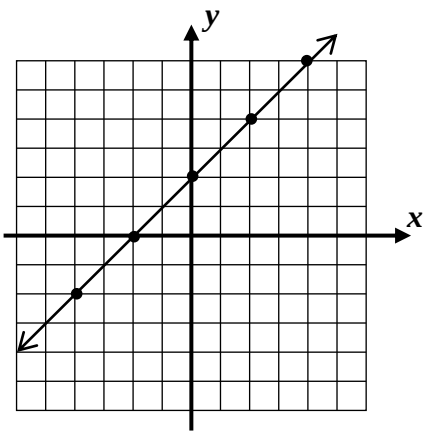
Ex. 9 Write the equation of a line that is perpendicular to $y = 4x + 5$ and that passes through the point $(0, -3)$.

HOMEWORK

1. Write the equation, in $y = mx + b$ form, for each line shown below.



Equation: _____



Equation: _____

2. Write the equation of a line in $y = mx + b$ form that is parallel to the line $y = -3x - 1$ and has a *y*-intercept of 5.

3. Write the equation of a line parallel to $y = \frac{3}{4}x + 2$ and passing through the point $(0, -3)$.

4. Which of the following lines is parallel to the line $y = -2x - 1$ and has a *y*-intercept of 8?

(1) $y = 2x + 8$ (2) $y = -2x - 1$ (3) $y = -2x + 8$ (4) $y = 2x - 1$

5. Write the equation of the line passing through the point (3, 5) with a slope of 2.

6. Write the equation of the line passing through the points $(3,5)$ and $(4,7)$.

7. Write the equation of the line passing through the points $(2,6)$ and $(4,5)$.

8. Write the equation of a line parallel to $y = \frac{2}{5}x - 7$ and passing through the point $(0,2)$.

9. Write the equation of a line that is perpendicular to $y = -\frac{1}{3}x + 5$ and that passes through the point $(0,4)$.

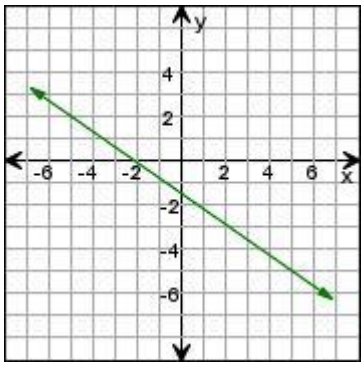
Writing Equations of Lines - Practice
Intro to Geometry

1. Write the following equations in slope-intercept form ($y = mx + b$).

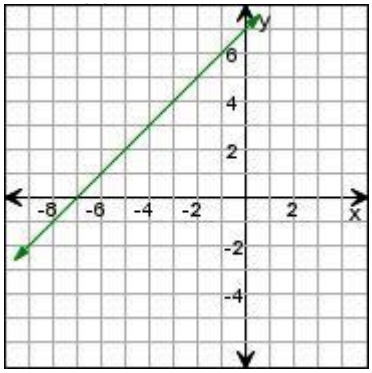
(a) $3x - 2y = -16$	(b) $7y + 9x = -7$	(c) $x = 6 + 3y$

2. Write an equation for each line.

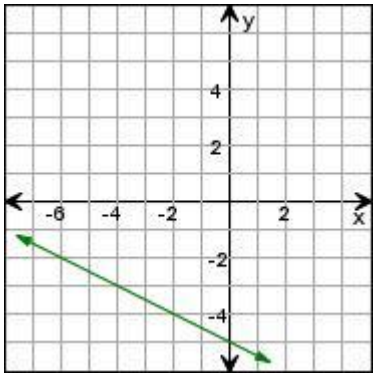
(a)



(b)



(c)



_____ _____ _____

3. Find the slope and *y*-intercept of each line.

(a) $y = 2x + 8$ (b) $4x - 3y = 27$ (c) $-8y - 4x = -24$

4. Write the equation of a line given the following information:

(a) Slope $= 3$, y-intercept $= -7$

(b) Slope $= \frac{1}{4}$, passes through $(0,0)$

(c) Slope $=$ Undefined, passes through $(2,5)$

(d) Passes through the points $(-4,2)$ and $(0,1)$

(e) Slope $= -\frac{2}{7}$, passes through $(7,20)$

(f) Passes through the points $(-4,-5)$ and $(6,0)$

(g) Slope $= -1$, passes through $(3, -1)$

(h) Parallel to the line $y = -5x + 2$ and passes through the point $(-1, 4)$

(i) Parallel to the line $y = 2x - 10$ and passes through the point $(-2, -1)$

(j) Passes through the point $(11, -3)$ and is perpendicular to the line $y = \frac{11}{10}x - 5$

(k) Perpendicular to the line $y = -2x + 10$ and passes through the point $(10, 3)$

(l) Parallel to the line $y = \frac{3}{4}x - 2$ and passes through the point $(-4, 0)$

5. State whether the lines are parallel, perpendicular, or neither.

(a) $\begin{aligned} 7x - y &= 35 \\ y &= 7x - 33 \end{aligned}$

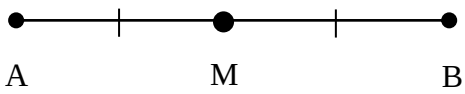
(b) $\begin{aligned} 4x + 5y &= 145 \\ 5x - 4y &= 198 \end{aligned}$

(c) $\begin{aligned} x - 5y &= 115 \\ -2x &= -210 + 10y \end{aligned}$

Midpoint of a Line Segment
Intro to Geometry

AIM: → To recall the definition of midpoint
→ To find the midpoint of a line segment in the coordinate plane

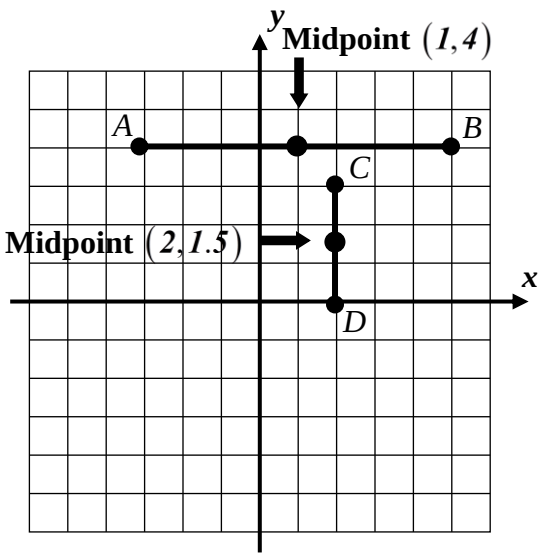
Definition: The midpoint of a line segment is a point of that line segment that divides the segment into two congruent segments.



M is the midpoint of $\overline{AB}$ because $\overline{AM} \cong \overline{MB}$.

There are several ways to determine the midpoint of a line segment in coordinate geometry.

Ex. 1 If the line segments are vertical or horizontal, you can find the midpoint by simply dividing the length of the segment by 2 and counting the value from either of the endpoints.

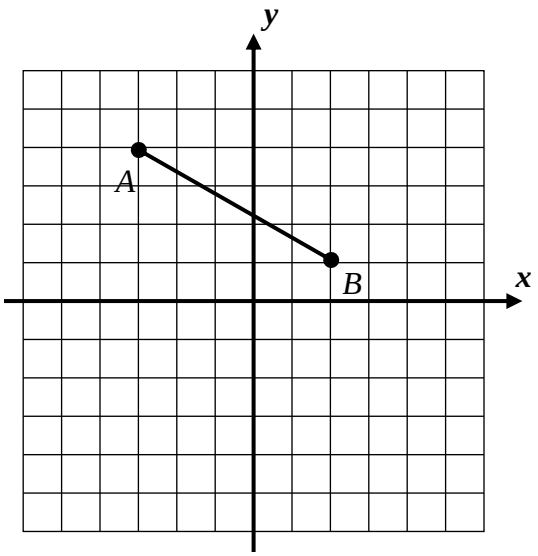


Find the midpoints of $\overline{AB}$ and $\overline{CD}$.

Ex. 2 When you are finding the coordinates of the midpoint of a line segment, you are actually finding the average of the *x*-coordinates and the average of the *y*-coordinates. If the line segment is diagonally positioned, you can use the following formula to find the midpoint:

The midpoint of the segment with endpoints (x_1, y_1) and (x_2, y_2) has coordinates $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

✦This formula works for all line segments (vertical, horizontal, or diagonal).



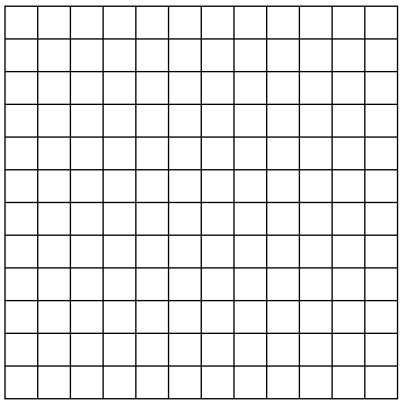
Find the midpoint of $\overline{AB}$.

Practice

1. Determine the coordinates of the midpoint of each line segment with the given endpoints.

(a) $(4,5)$ and $(2,9)$ (b) $(-8,3)$ and $(2,7)$ (c) $(1.4,3.1)$ and $(4.4,0.3)$

2. M is the midpoint of $\overline{CD}$. The coordinates $M(-1,1)$ and $C(1,-3)$ are given. Find the coordinates of point D. *(Use of grid is optional)*



3. The coordinates of quadrilateral $ABCD$ are $A(-3,-1)$, $B(3,1)$, $C(7,5)$, and $D(1,3)$. Do the diagonals bisect each other?

Midpoint of a Line Segment - HOMEWORK
Intro to Geometry

1. Determine the coordinates of the midpoint of each line segment with the given endpoints.

   (a) $(6,4)$ and $(3,-4)$ (b) $(-12,-9)$ and $(12,9)$ (c) $(6.4,3)$ and $(-10.7,4)$

2. The coordinates of the vertices of rectangle $SNOW$ are $S(-1,2)$, $N(-1,4)$, $O(5,4)$, and $W(5,2)$. Do the diagonals bisect each other?

3. A line segment $\overline{RT}$ has an endpoint $R(1,2)$ and a midpoint $S(4,3)$. What are the coordinates of the endpoint T?

4. A line segment $\overline{EF}$ has endpoints $E(5,-1)$ and $F(-3,a)$. The midpoint M has coordinates $(b,4)$. What are the values of a and b?

Distance Formula
Intro to Geometry

AIM: → *To define the distance formula*
→ *To find the distance between points in the coordinate plane using the distance formula*

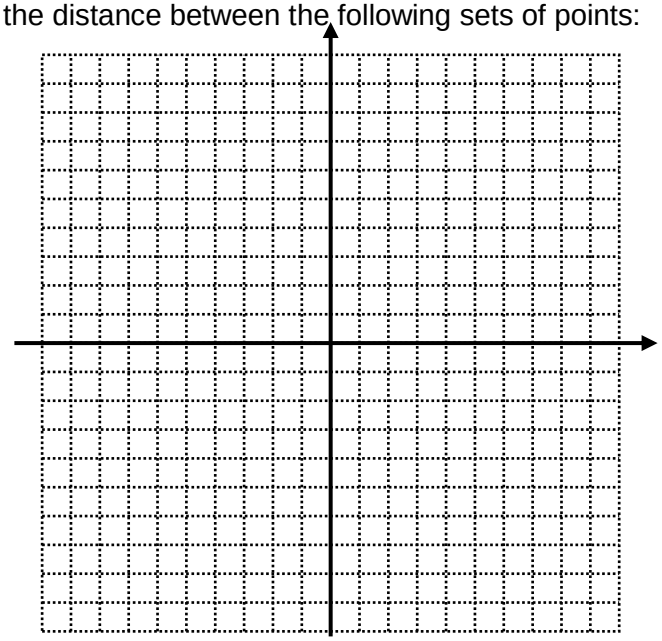
Do Now

Plot on the graph provided, and find the distance between the following sets of points:

(1) A(5, -2) and B(-3, -2)

(2) C(-3, 6) and D(-3, 0)

(3) E(4, 2) and F(-5, -6)



✦Why is it more difficult to find the distance between the points in (3) than in (1) and (2)?

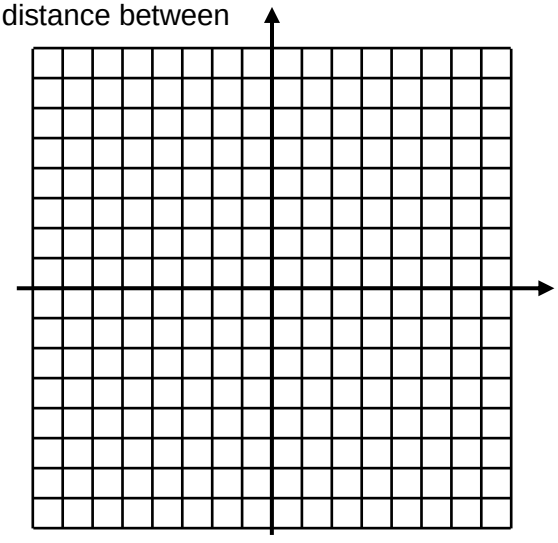
The distance *d* between points $A(x_1, y_1)$ and $B(x_2, y_2)$ is given by the formula:

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

Ex.1 Graph each segment on the grid provided and find the distance between the endpoints. Round answers to the *nearest tenth*.

1. (-5, -1) and (2, 3)

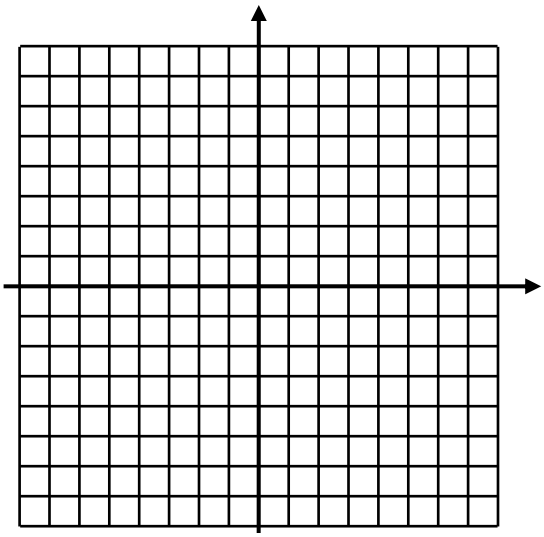
2. (-3, 4) and (2, 6)



Express answers in simplified radical form.

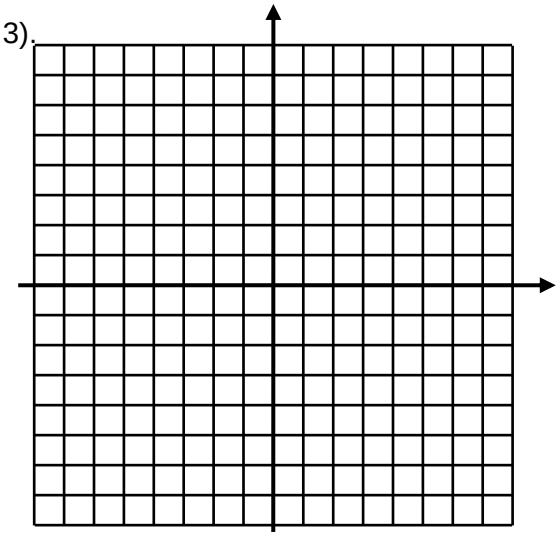
3. (0, 0) and (4, 3)

4. (7, 0) and (0, 7)



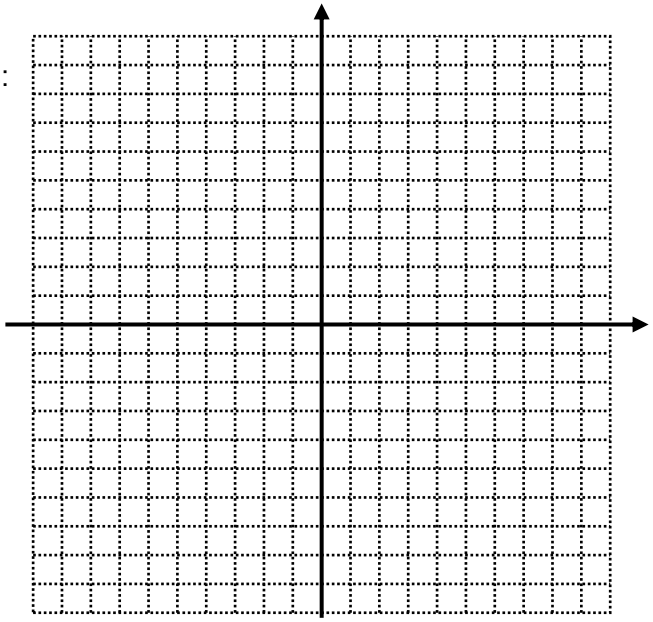
Ex. 2 Graph and label ΔABC if A(3, 0), B(4, 6), and C(1, 3).

Is ΔABC an isosceles triangle?



Ex. 3 Graph the quadrilateral with the following points: A(1, 4), B(4, 9), C(-1, 12), and D(-4, 7).

Show the diagonals are equal in length.



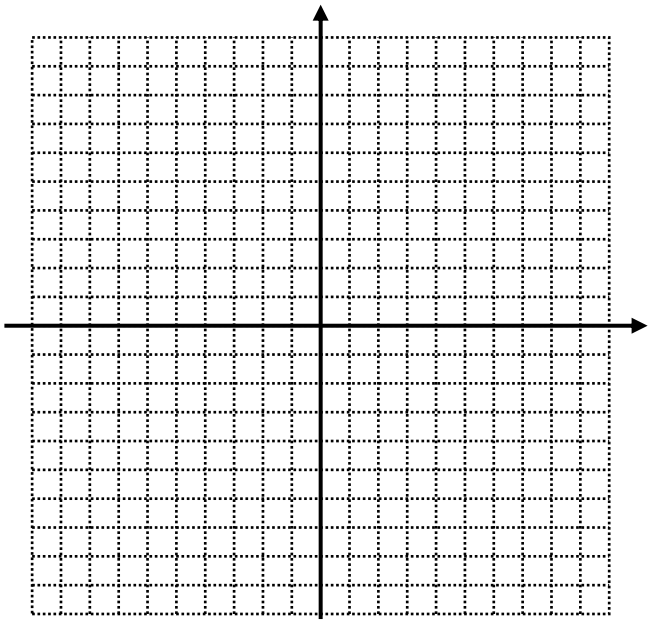
Distance Formula - HOMEWORK
Intro to Geometry

1. Find the distance between the following pairs of points:

(a) A(2, 7) and B(4, 3)

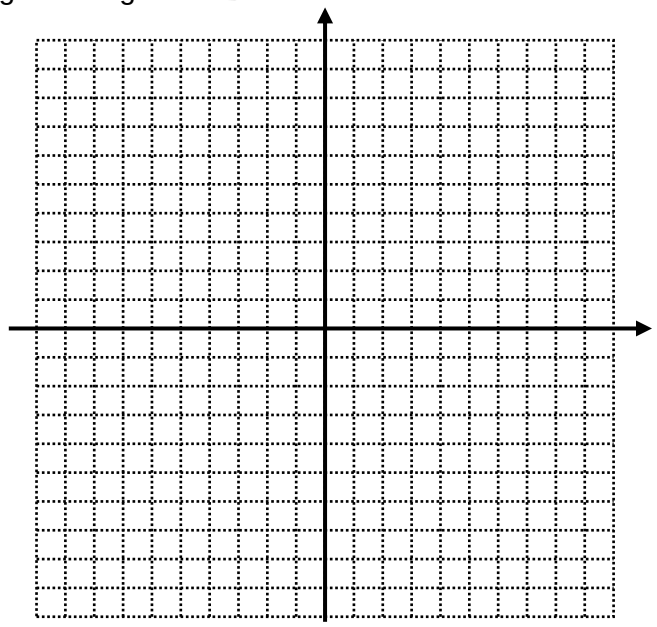
(b) C(-1, -2) and D(5, 4)

(c) E(-5, 0) and F(-9, 6)



2. The vertices of a trapezoid ABCD are A(1, -4), B(10, -4), C(9, 2), and D(2, 2).

Show that the length of diagonal $\overline{AC}$ equals the length of diagonal $\overline{BD}$.



3. A triangle ΔXYZ has the following coordinates X(4, -7), Y(-3, -4), and Z(7, 0).

Show this triangle is an isosceles triangle.