

Math 45 SSM 2/e 3.1 Rectangular Coordinate System and Equations in Two Variables

Objectives: 1) Plot ordered pairs on a rectangular coordinate system

2) Identify location of points:

x-axis

y-axis

Quadrants I, II, III or IV.

3) Determine if a given ordered pair is a solution of an equation in two variables

4) Given an x-value and an equation in 2 variables, find the y-value to make an ordered pair solution.

5) Given a y-value and an equation in 2 variables, find the x-value to make an ordered pair solution.

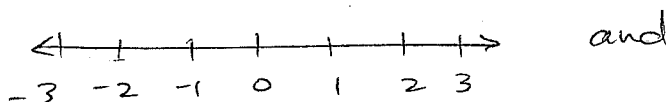
6) Given only an equation in two variables, find several ordered pair solutions to make a table

7) Given only an equation in two variables, find several ordered pair solutions with integer coordinates (no fractions). to make a table

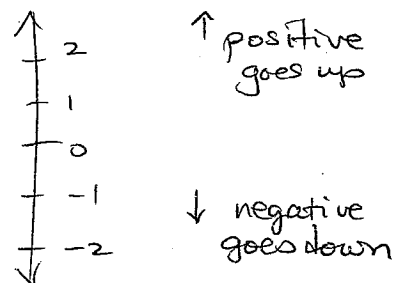
Goal Needed for 3.2

Rectangular coordinate system:

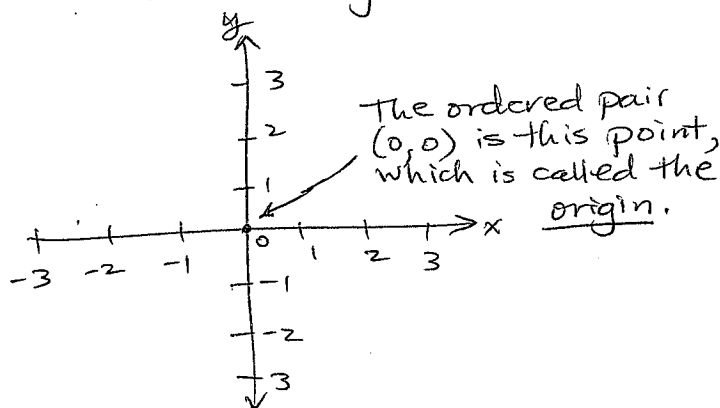
- Two number lines



and



But drawn as one system, with lines crossing at both zeros.



The horizontal number line is called the x-axis.

The vertical number line is called the y-axis.

- A point on the rectangular coordinate system is given as an ordered pair

Example $(0,0)$ is an ordered pair

* The order is the x axis always is listed first, then y. *

To plot a point,

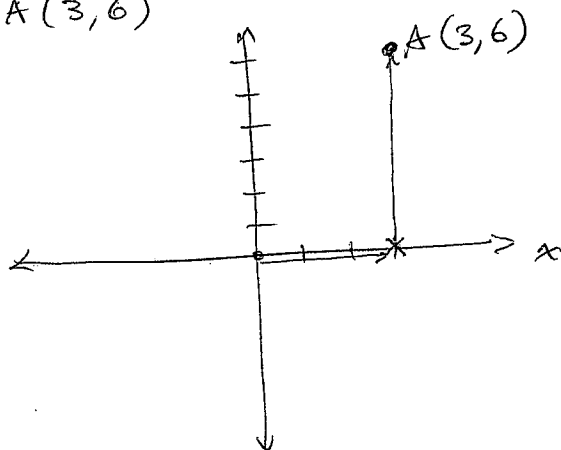
step 1: start at the origin, $(0,0)$.

step 2: look at the x -coordinate.
if x is positive move right
if x is negative move left

step 3: look at the y -coordinate, continue from location at the end of step 2.
if y is positive move up
if y is negative move down.

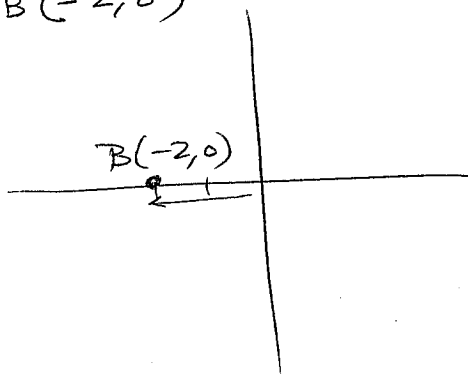
Plot the points:

① $A(3,6)$

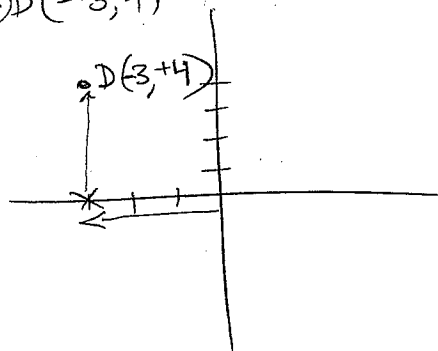


$x=3$, positive
from origin, go right 3 units
 $y=6$ positive
from x , go up 6 units
plot point A at $(3,6)$

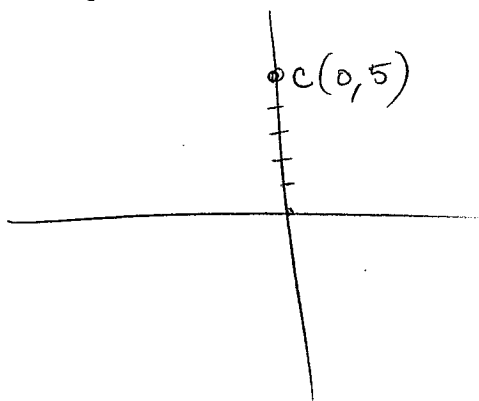
② $B(-2,0)$



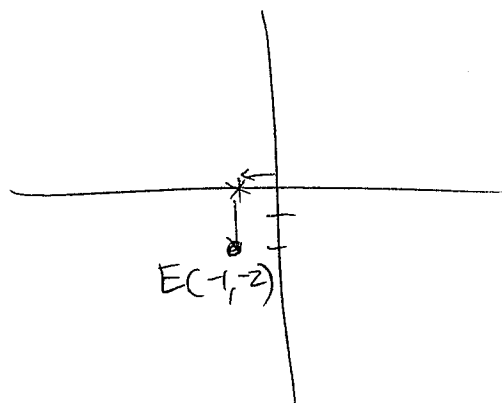
④ $D(-3,4)$



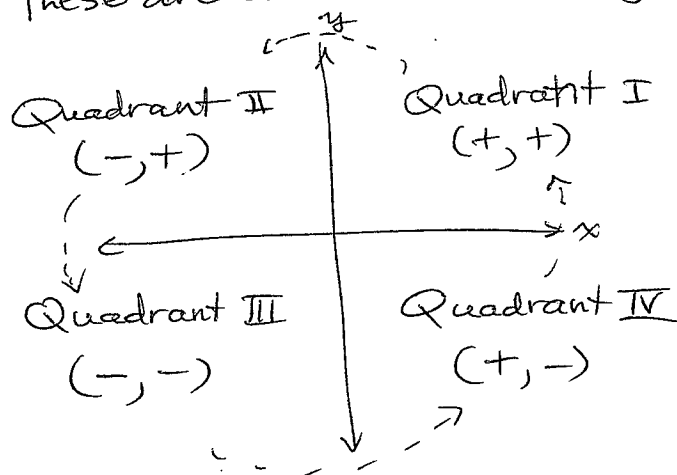
③ $C(0,5)$



⑤ $E(-1,-2)$



If we consider the area of the plane, the rectangular coordinate system divides the plane into four regions, called quadrants. These are abbreviated using Roman Numerals I, II, III, IV, numbered in counter-clockwise order.



To describe the location of a point, we say one of the following:

- QI
- QII
- QIII
- QIV
- x-axis
- y-axis

Identify the locations of points A-E given in ①-⑤

- ⑥: ① A(3,6) in QI
- ⑦ ② B(-3,0) on x-axis
- ⑧ ③ C(0,5) on y-axis
- ⑨ ④ D(-3,4) in QII
- ⑩ ⑤ E(-1,-2) in QIII

The reason we need the rectangular coordinate system is to give us a better way to demonstrate the solutions of an equation in two variables, instead of making a list.

⑪ Determine if (2,3) is a solution $x + 2y = 8$

step 1: substitute 2 for x in equation and 3 for y in equation.

$$2 + 2(3) = 8$$

step 2: Evaluate using the order of operations

$$2 + 6 = 8$$

$$8 = 8$$

step 3: If result is true, the ordered pair is a solution, write yes.

If result is false, the ordered pair is not a solution, write no.

YES (2,3) is a solution of $x + 2y = 8$

(12) Determine if $(6, -1)$ is a solution of $3x - 2y = -1$

$$3(6) - 2(-1) = -1$$

$$18 + 2 = 1$$

$$20 = 1$$

false

No $(6, -1)$ is not a solution of $3x - 2y = -1$

(13) If $(3, ?)$ is a solution of $x + 2y = 8$, find the y-coordinate.

step 1: Replace x by 3 in given equation

$$(3) + 2y = 8$$

step 2: Solve for (isolate) y in the equation.

$$\begin{array}{r} 3 + 2y = 8 \\ -3 \quad -3 \end{array}$$

subtract 3

$$\frac{2y}{2} = \frac{5}{2}$$

divide by 2

$$\boxed{y = \frac{5}{2} \text{ or } y = 2.5}$$

$\Rightarrow$ The ordered pair solution is $(3, \frac{5}{2})$.

(14) If $(?, 1)$ is a solution of $x + 2y = 8$, find the x-coordinate.

step 1: Replace y by 1 in given equation.

$$x + 2(1) = 8$$

step 2: Solve for (isolate) x in the equation.

$$\begin{array}{r} x + 2 = 8 \\ -2 \quad -2 \end{array}$$

subtract 2

$$\boxed{x = 6}$$

$\Rightarrow$ The ordered pair solution is $(6, 1)$.

(15) How many values of x might our textbook give us?

infinitely many

Also, infinitely many y -values.
 $\Rightarrow$ There are infinitely many solutions to an equation in 2 variables

GOAL: Organize the ordered pair solutions of an equation.

One way to organize ordered pairs is to make a table, either vertically or horizontally.

(16) Complete the table by finding solutions of $x+2y=8$

	x	y	(x,y)
a)	3		
b)		1	
c)	4		
d)		0	
e)	0		

a) we did $x=3$ in (13) $\Rightarrow y = \frac{5}{2}$

b) we did $y=1$ in (14) $\Rightarrow x=6$.

c) set $x=4$ in equation, solve for y .

$$\begin{array}{r} 4+2y=8 \\ -4 \quad -4 \\ \hline 2y=4 \\ \frac{2}{2} \quad \frac{2}{} \\ \hline y=2 \end{array}$$

d) set $y=0$ in equation, solve for x

$$x+2(0)=8$$

$$x+0=8$$

$$\Rightarrow x=8$$

e) set $x=0$ in equation, solve for y

$$0+2y=8$$

$$\frac{2y}{2} = \frac{8}{2}$$

$$\Rightarrow y=4$$

Completed table:

x	y	(x,y)
3	$\frac{5}{2}$	$(3, \frac{5}{2})$
6	1	$(6, 1)$
4	2	$(4, 2)$
8	0	$(8, 0)$
0	4	$(0, 4)$

(17) Complete the table by finding solutions to
 $y = 7.87 + 0.066508x$

Note: Equations can be in many formats. This one has x on the RHS and has decimals. You can rearrange an equation if you like by

- adding or subtracting any term to both sides
- multiplying every term by an LCD or useful power of 10 to clear fractions or decimals

	a)	b)	c)
x	50	100	250
y			

Note: This table is horizontal, not vertical. The numbers 50, 100 and 250 are in the row corresponding to x .

a) subst $x=50$, solve for y .
 $y = 7.87 + 0.066508(50)$
 $y = 11.1954$

b) subst $x=100$, solve for y
 $y = 7.87 + 0.066508(100)$
 $y = 14.5208$

c) subst $x=250$, solve for y
 $y = 7.87 + 0.066508(250)$
 $y =$

x	50	100	250
y	11.1954	14.5208	24.497

Food for thought: If you are given an equation, like $3x + 5y = 15$ and asked to find both x and y to get a solution, what will you do?

Extra Practice: Complete the tables to find solutions of the given equations.

(18) $\frac{x}{2} - \frac{y}{2} = 1$

x	y
	0
0	
	-5

x	y
2	0
0	-2
-3	-5

Clear fractions - mult all by 2

$$2 \cdot \frac{x}{2} - 2 \cdot \frac{y}{2} = 2 \cdot 1$$

$$x - y = 2$$

subst $y = 0$ $x - 0 = 2$
 $x = 2$

subst $x = 0$ $0 - y = 2$
 $-y = 2$
 $y = -2$

subst $y = -5$ $x - (-5) = 2$
 $x + 5 = 2$
 $\underline{-5} \quad \underline{-5}$
 $x = -3$

(19) $x = 2$

x	y
	-4
	0
	8

x	y
2	-4
2	0
2	8

No y-variable!

x is always 2!

(20) $y = -3$

x	y
-4	
1	
12	
0	

x	y
-4	-3
1	-3
12	-3
0	-3

no x-variable!
y is always -3.

(21) $y = -3x + 1$

x	y
-2	
-1	
4	
0	

x	y
-2	7
-1	4
4	13
0	1

set $x = -2$
 $y = -3(-2) + 1$
 $= 6 + 1$
 $= 7$

set $x = -1$
 $y = -3(-1) + 1$
 $= 3 + 1$
 $= 4$

set $x = 4$
 $y = 3(4) + 1$
 $= 12 + 1$
 $= 13$

Set $x = 0$
 $y = 3(0) + 1$
 $= 0 + 1$
 $= 1$

(22) $y = -x^2 - 4$

x	y
0	
1	

set $x = 0$ $y = -(0)^2 - 4$
 $= 0 - 4$
 $= -4$

set $x = 1$ $y = -(1)^2 - 4$
 $= -5$

x	y
0	-4
1	-5