

MPM1DI

Unit 6: Graphing Linear Relations

Name: _____

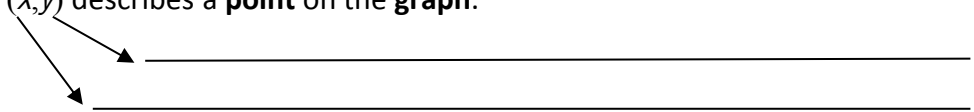
Relations and their Representations

A **relation** is a description of how two quantities are connected. The two quantities that change together are called _____. One quantity will depend on the other and is called the _____ **variable**. The other is the _____ **variable** and is the variable whose values you choose.

A **relation** can be represented using one or more of the following:

1. _____
2. _____
3. _____
4. _____
5. _____

In graphing, an ordered pair, (x,y) describes a **point** on the **graph**.



The data applicable in a relation can be either **discrete** or **continuous**. _____ data *cannot* be broken into smaller parts so the points on the graph are connected with a **dotted** line. _____ data *can* be broken down into smaller and smaller parts and still have meaning so the points on the graph are connected with a **solid** line.

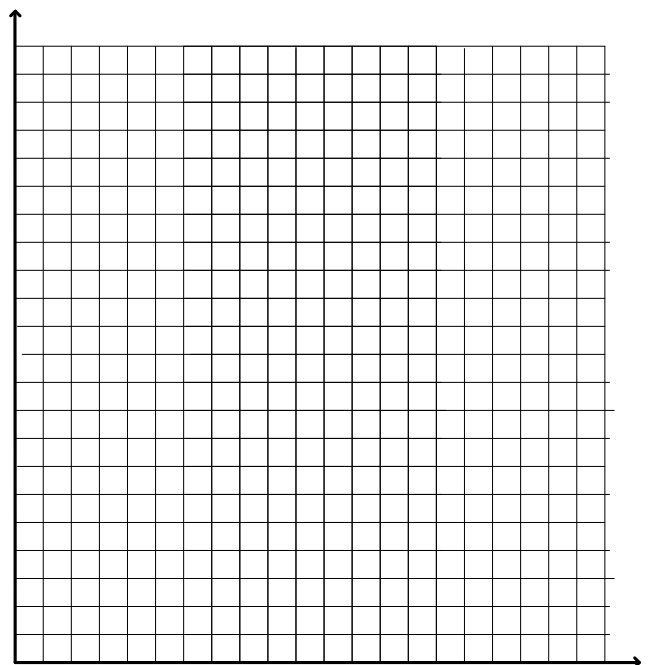
Ex. 1. A plumber charges a flat fee of \$50 plus \$35/ h for a service call.

- a) What is the independent variable?
- b) What is the dependent variable?
- c) Write an **equation** to represent the plumber’s charges in terms of hours of service.

d) Complete a **table of values** for up to 8 hours.

e) **Graph** the relation for up to 8 hours.

f) Identify this relation as **linear** or **non-linear** with reasons.



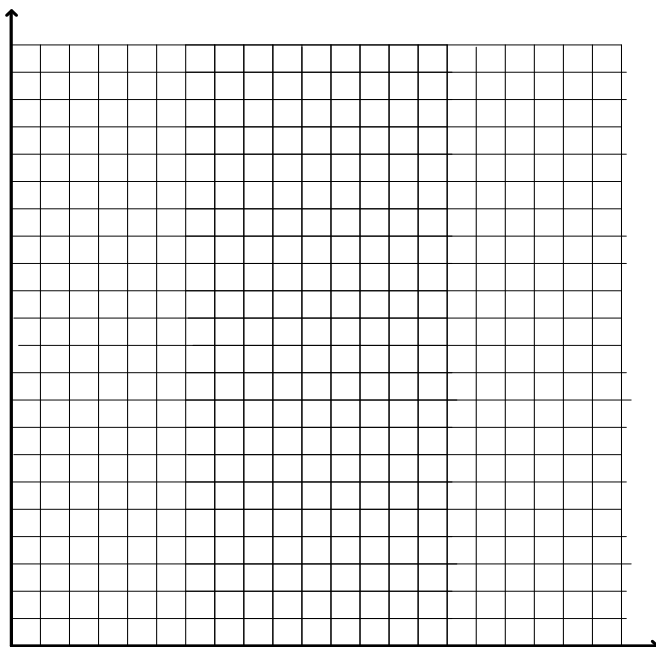
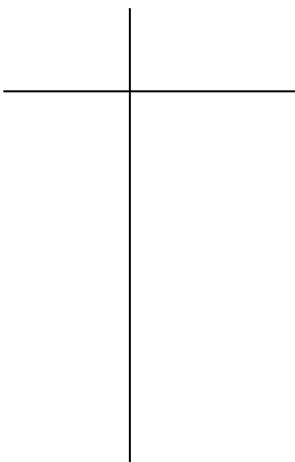
Ex. 2. Not all relations are linear. Look at the relationship between side length and volume of a cube, where side length is measured in cm and volume is measured in cm^3 .

a) What is the independent variable?

b) What is the dependent variable?

c) Write an **equation** to represent the volume of the cube in terms of its side length.

d) Complete a **table of values** for this relation.

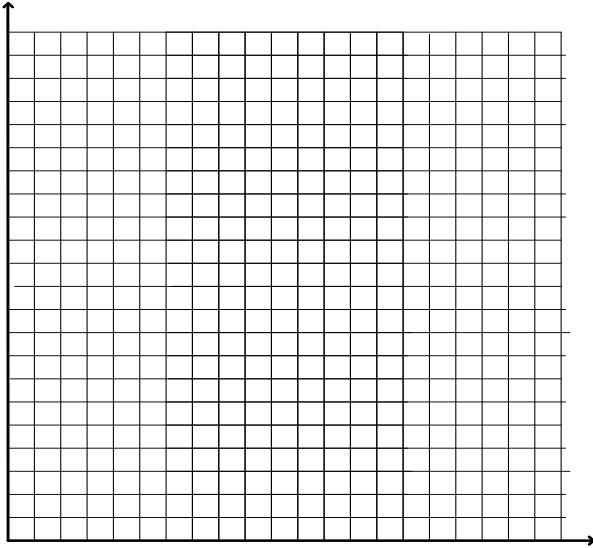


e) **Graph** the relation.

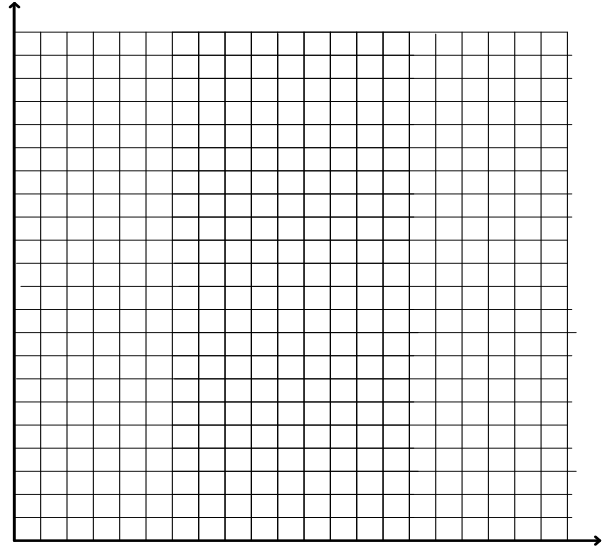
f) Identify this relation as **linear** or **non-linear** with reasons.

Grids For Homework: p. 146-148

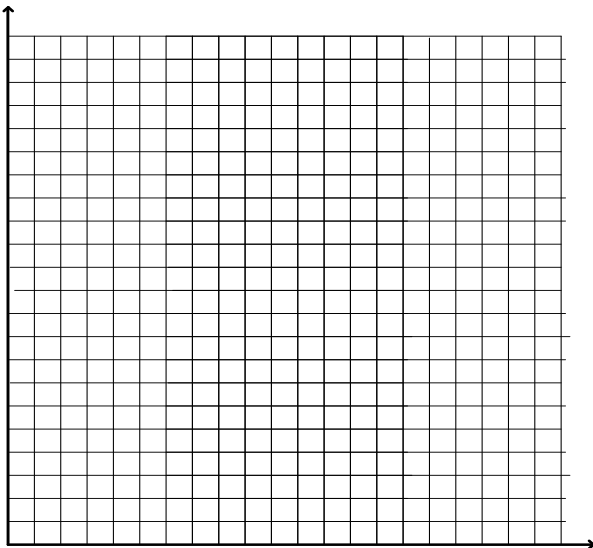
#2a)



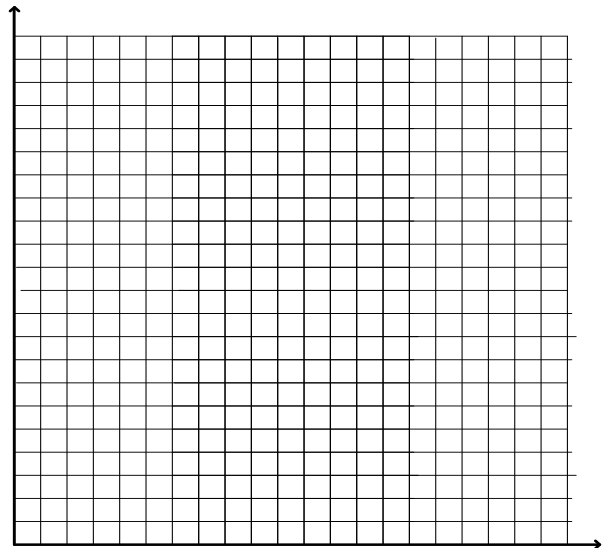
#2b)



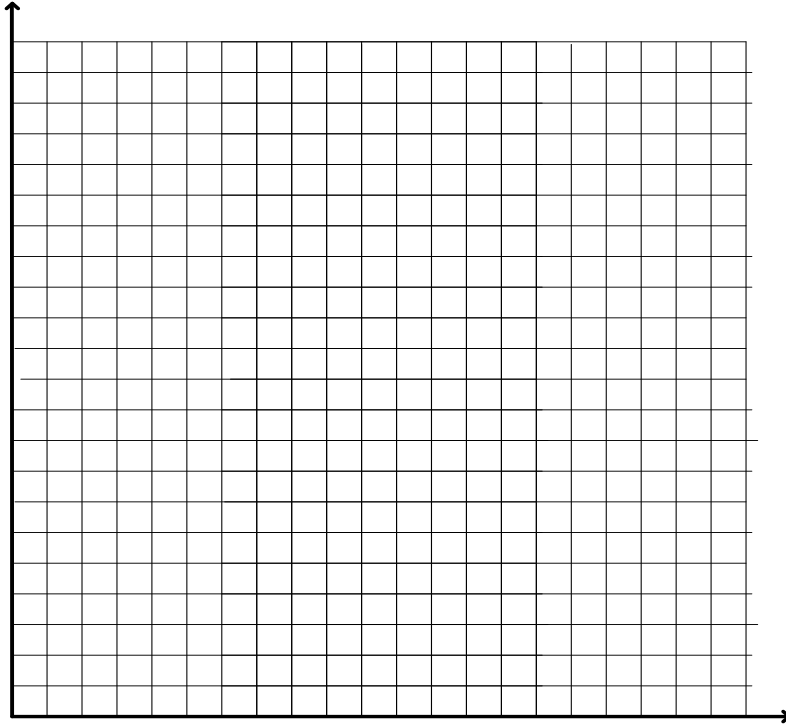
#3a)



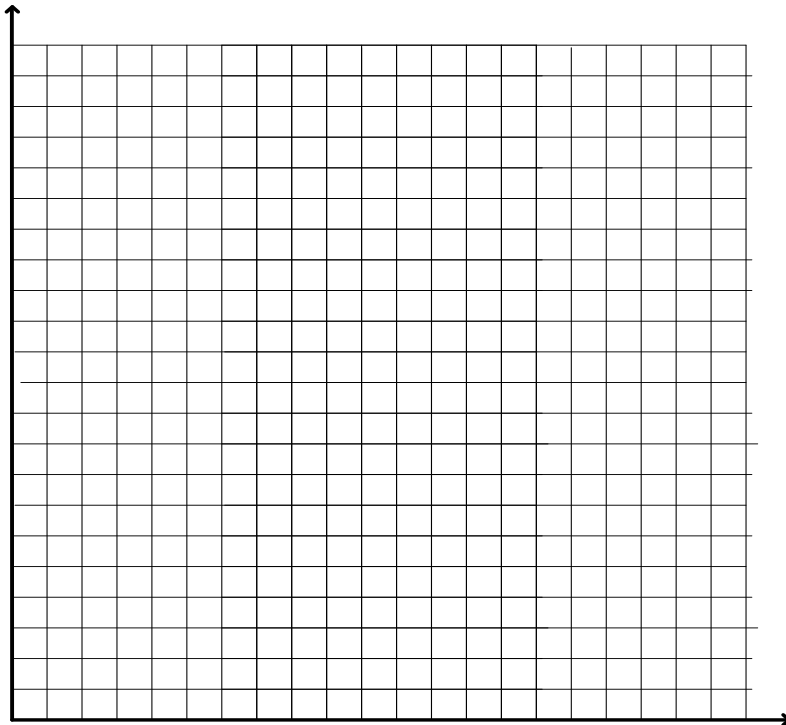
#3b)



#5.



#10.



Properties of Linear and Non-Linear Relations

Direct Variation: - is a linear relation in which one variable is a multiple of the other
 - the equation looks like $y = mx$
 - $(0,0)$ is an ordered pair in the table of values and a point on the graph

Partial Variation: - is a relation in which one variable is a multiple of the other plus a constant amount.
 - the equation looks like $y = mx + b$
 - $(0,0)$ is not an ordered pair in the table of values or a point on the graph

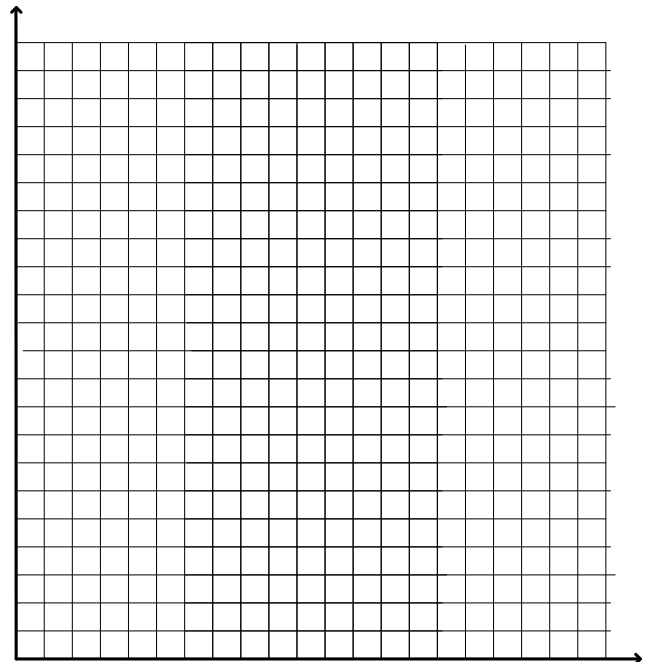
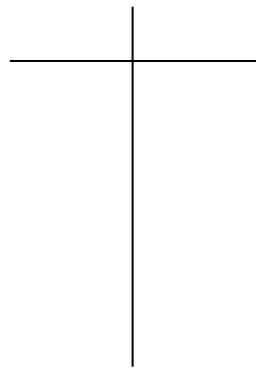
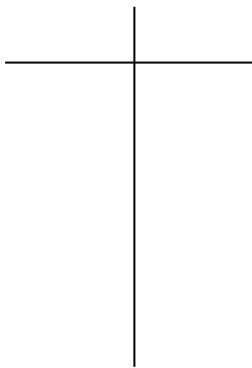
Ex. 1. A fitness club offers two types of monthly memberships:

- **Membership A:** \$4 per visit
- **Membership B:** a flat fee of \$12 plus \$2 per visit

a) Complete a **table of values** for 0 to 10 visits for each relation and then **graph**.

i) **Membership A**

ii) **Membership B**



b) Identify this set of data as **discrete** or **continuous** with reasons.

c) Write an equation relating the cost, C , in \$ and the number of visits, n , for each membership.

d) Use the equations to determine the number of visits for which both monthly costs are the same.

e) Identify each relation as **direct** or **partial variation** with reasons.

Linear Relation: - equation is of the first degree, the graph is a straight line, and in a **table of values** the **first differences are constant**.

Non-linear Relation: - equation is not of the first degree, the graph is not a straight line, and in a **table of values** the **first differences are not constant**.

The **first differences**, Δy , “delta y”, represent the differences between consecutive y - values where the differences between consecutive x - values is constant.

Ex. 2. a) Petri Dish A: Bacteria can double every 30 minutes in a growth medium. Starting with one bacterial cell, set up a table of values for the growth of this bacterial colony over 2 hours and use **first differences** to determine if the relation is linear or non-linear.

b) Petri Dish B: Bacteria are growing more slowly due to an antibiotic in the growth medium. Starting with one bacterial cell, only 5 new cells are generated every 40 minutes. Set up a table of values for the growth of this bacterial colony over 2 hours and use **first differences** to determine if the relation is linear or non-linear.

Let x represent the time in minutes and let y represent the number of bacteria in the colony.

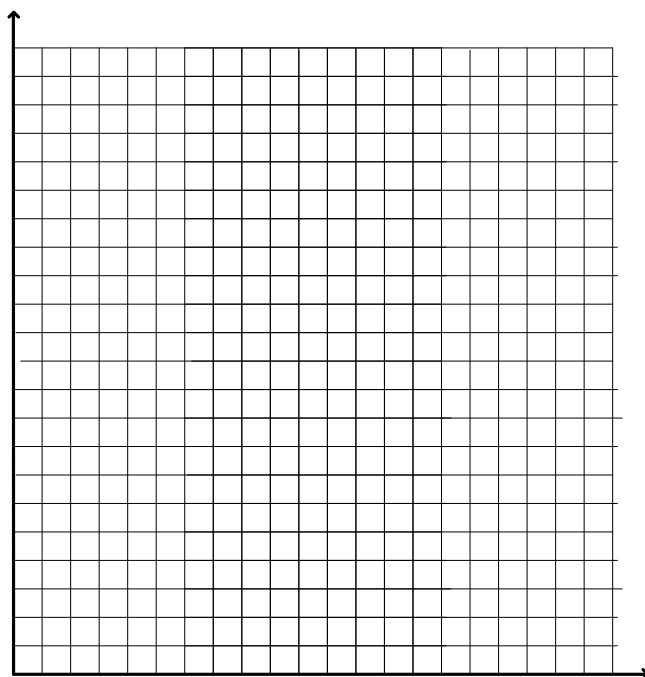
Petri Dish A

Petri Dish B

a)

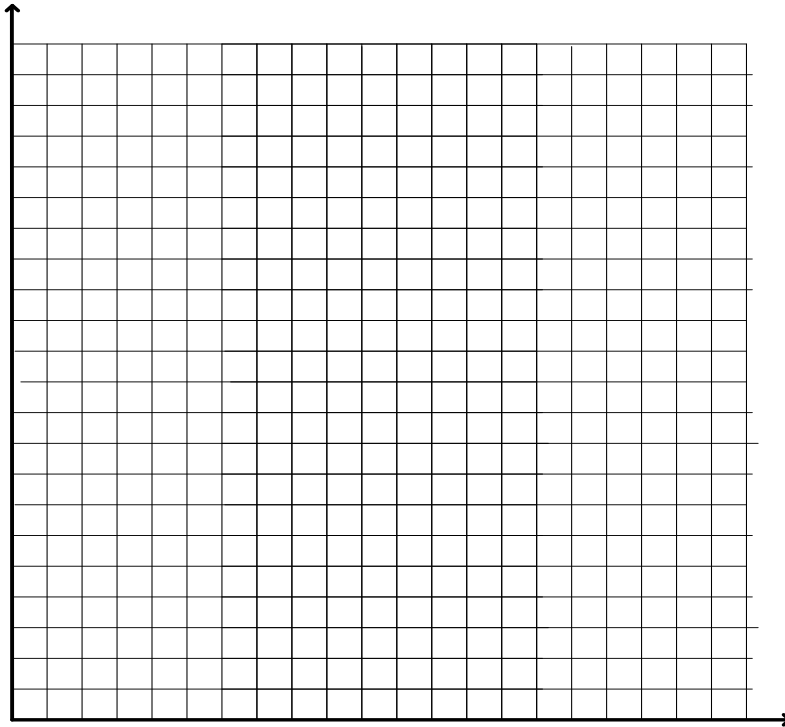
b)

c) **Graph** both relations.

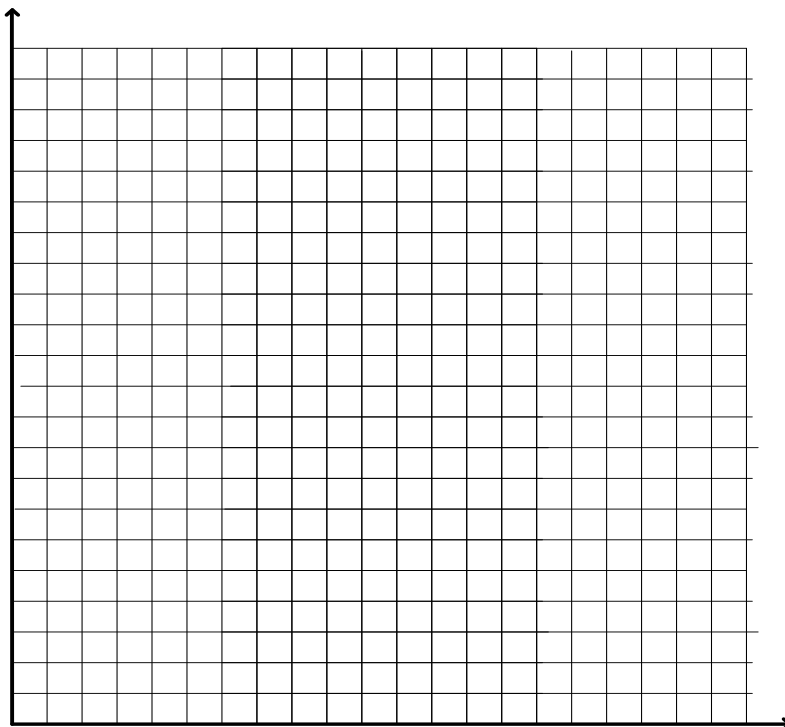


Grids For Homework: p. 151

#2.



#3.



Coordinate Geometry in 4 Quadrants

To describe the location of points on a plane we use the Cartesian Coordinate System.

Definitions:

x-axis - the _____ number line which extends left and right.

y-axis - the _____ number line which extends up and down.

origin - the point _____ where the axes meet

ordered pair - a point of the form _____ located on a Cartesian plane

x-coordinate - the _____ number in an ordered pair describing the _____ position of the point.

y-coordinate - the _____ number in an ordered pair describing the _____ position of the point.

quadrant - the _____ regions created by the _____

Example: Plot the following points on the grid below: A(4,3) B(-5,1) C(-2,-4) D(0,5)
 E(-2,0) F(6,1) G(-1,4) H($1\frac{1}{2}$, -2) I($-3\frac{1}{2}$, $5\frac{1}{2}$) O(0,0)

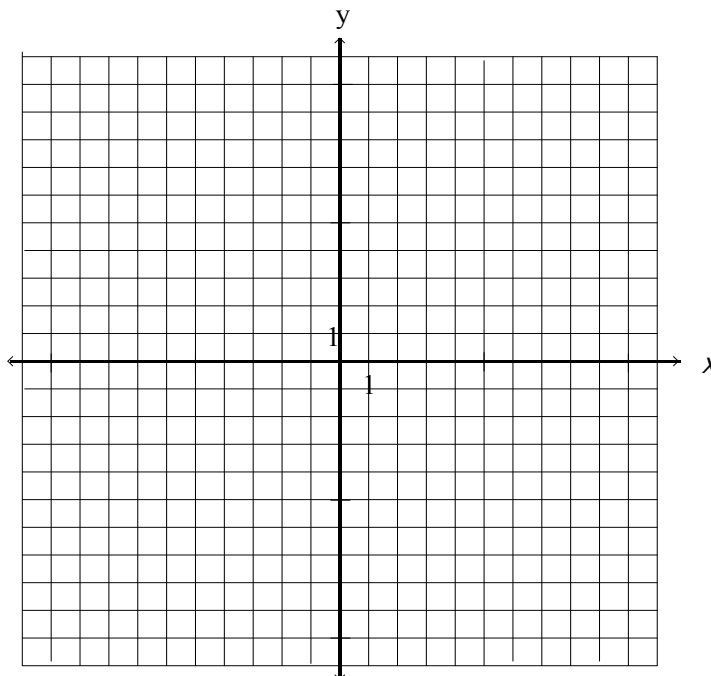
Which points are in:

Quadrant I

Quadrant II

Quadrant III

Quadrant IV



Describe in which quadrant ordered pairs have the following signs.

(+ , +)

(+ , -)

(- , +)

(- , -)

p. 503 #1-4

1.

3. a)

b)

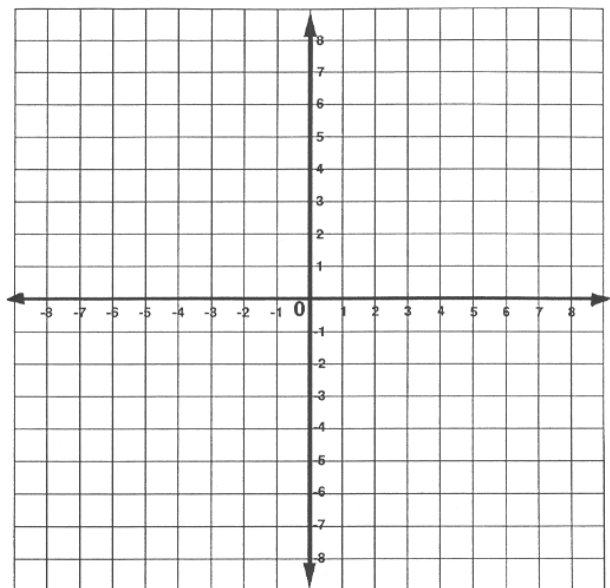
4. a)

b)

c)

d)

2.

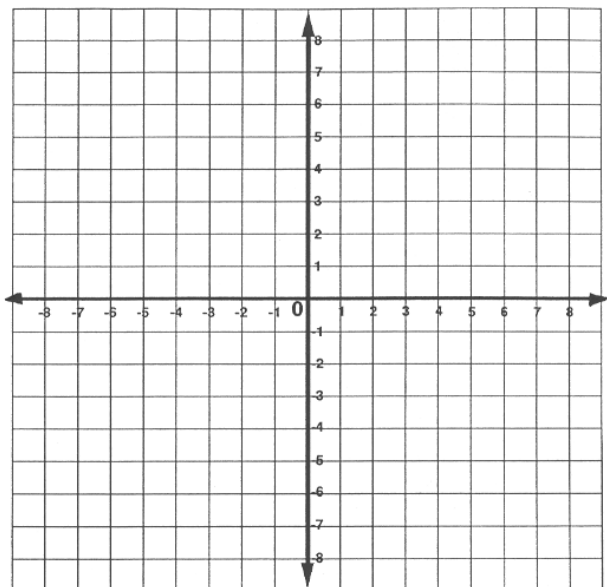


p. 147-148 #3c, 4c, 14

3. c)

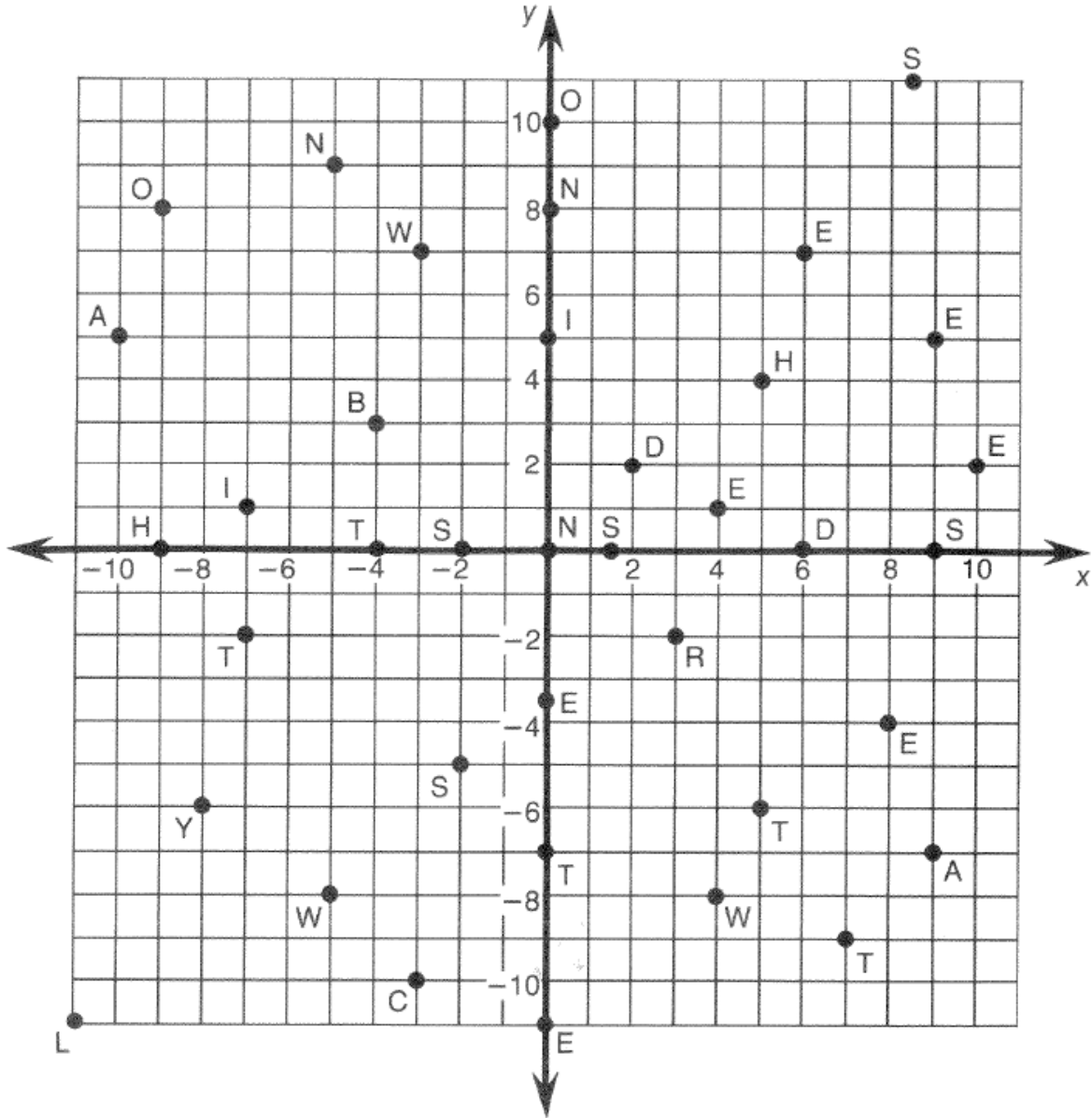
4. c)

14.



What Happened After a Burglar Broke Into a Tuba Factory ?

Each ordered pair at the bottom of the page represents a point on the coordinates below. Above each ordered pair, write the letter that appears at that point.



(5, 4)(10, 2)(-3, 7)(-10, 5)(-2, -5)(-3, -10)(3, -2)(8, -4)(6, 0)(0, 5)(-4, 0)(0, -11)(2, 2)

(-5, -8)(-7, 1)(7, -9)(-9, 0)(-7, -2)(4, -8)(6, 7)(-5, 9)(0, -7)(-8, -6)(0, 10)(0, 0)(9, 5)

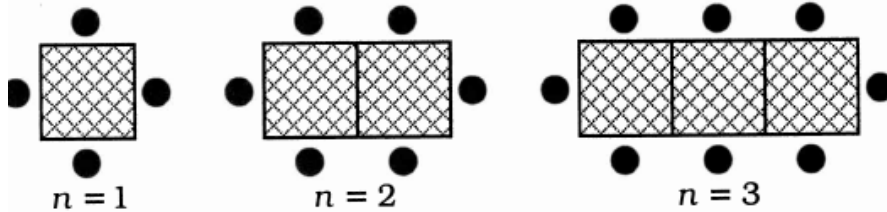
(9, 0)(5, -6)(-9, 8)(-11, -11)(4, 1)(0, 8)(-4, 3)(9, -7)(-2, 0)(8.5, 11) (0, -3.5) (1.5, 0)

How Does a Backward Poet Write?

For each situation, complete the table and graph.
For table cells with letters, write the letter in the corresponding box at right.

23	18	15	6	31	12	7
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Situation #1. Arranging Tables.

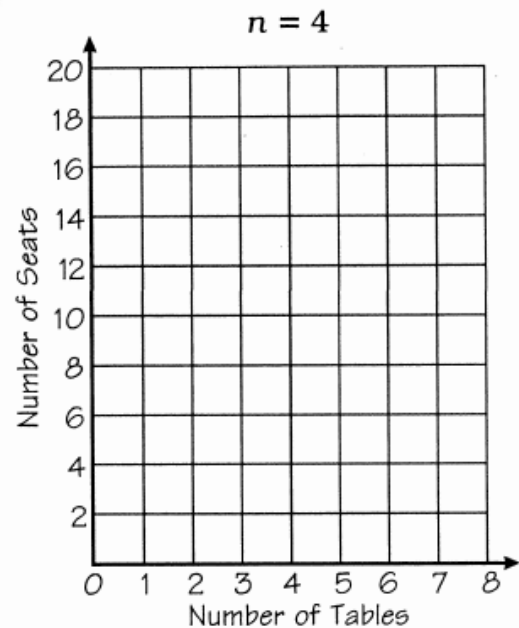


A square table has one seat on each side. Square tables are pushed together to make banquet tables. Draw banquet table #4 in the pattern above. Then complete the table and graph to show how the number of seats varies with the number of tables that are pushed together.

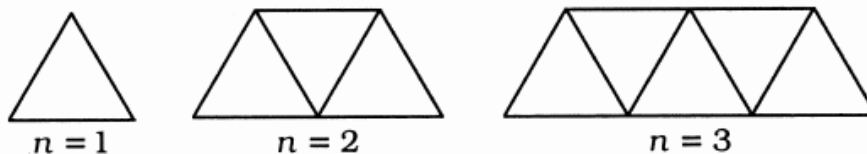
Let n = Number of tables
 S = Number of seats

Equation:
 $S =$

n	S
1	
2	E
3	
4	
5	S
6	
7	
8	N



Situation #2. Building Bridges.

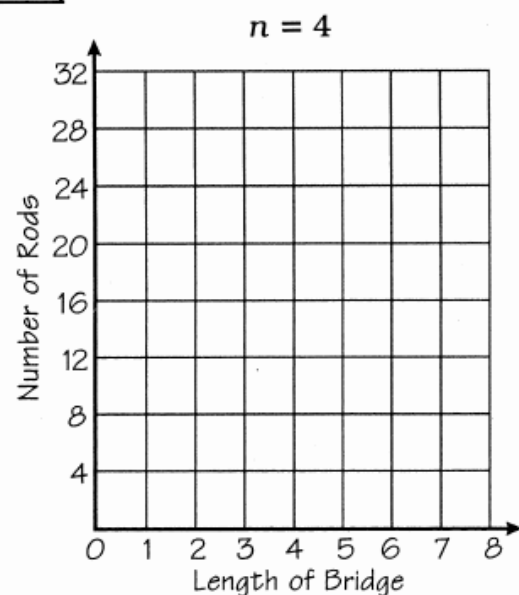


These bridges are constructed using rods to make equilateral triangles. The length of a bridge is the number of rods used to construct the bottom span. Draw bridge #4 in the pattern above. Then complete the table and graph to show how the number of rods used varies with the length of the bridge.

Let n = Length of bridge
 R = Number of rods

Equation:
 $R =$

n	R
1	
2	E
3	
4	V
5	
6	I
7	
8	R



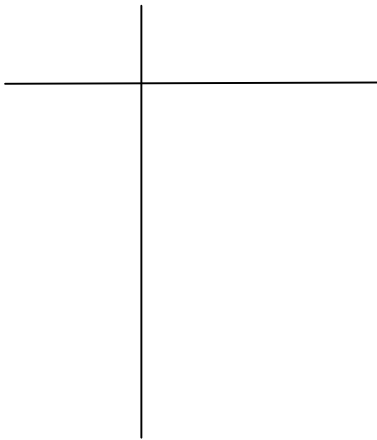
Using a Table of Values to Graph Linear Relations

A linear equation can be written in the form $y = mx + b$ where m and b are numbers.

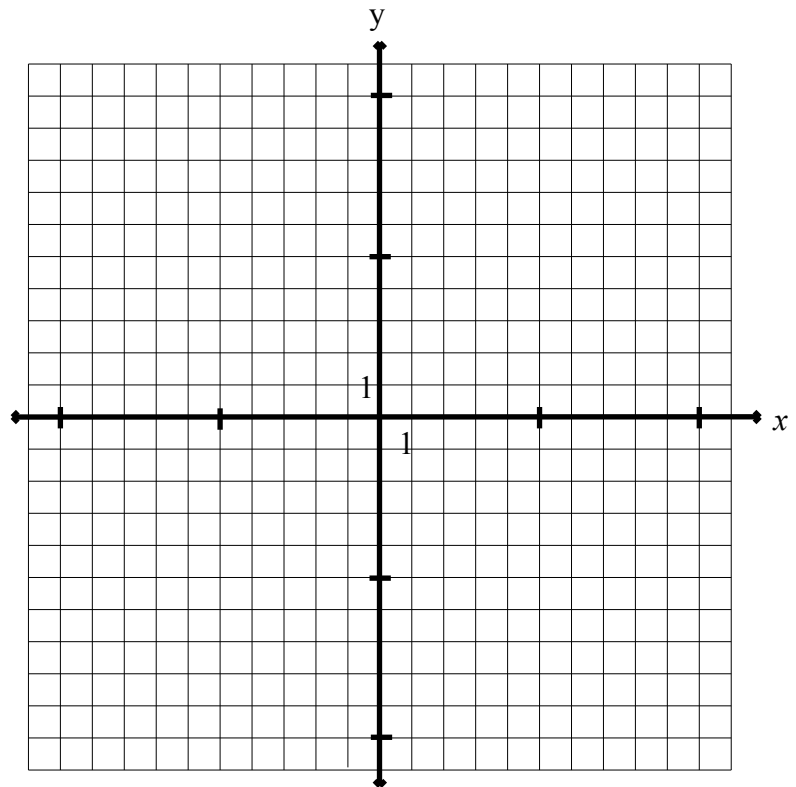
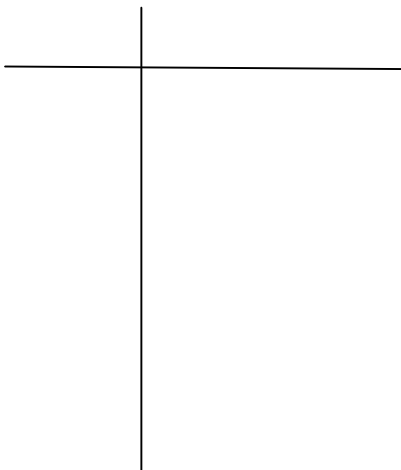
Ex. 1. Determine if the following points are on the line $y = -3x + 7$: **A** (1, 4) **B** (-2, 14)

Ex. 2. Graph each relation by making a **Table of Values** with five entries.

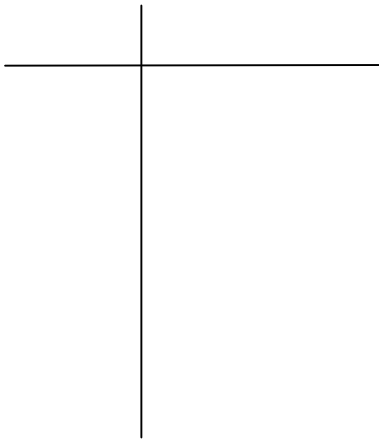
a) $y = 2x$



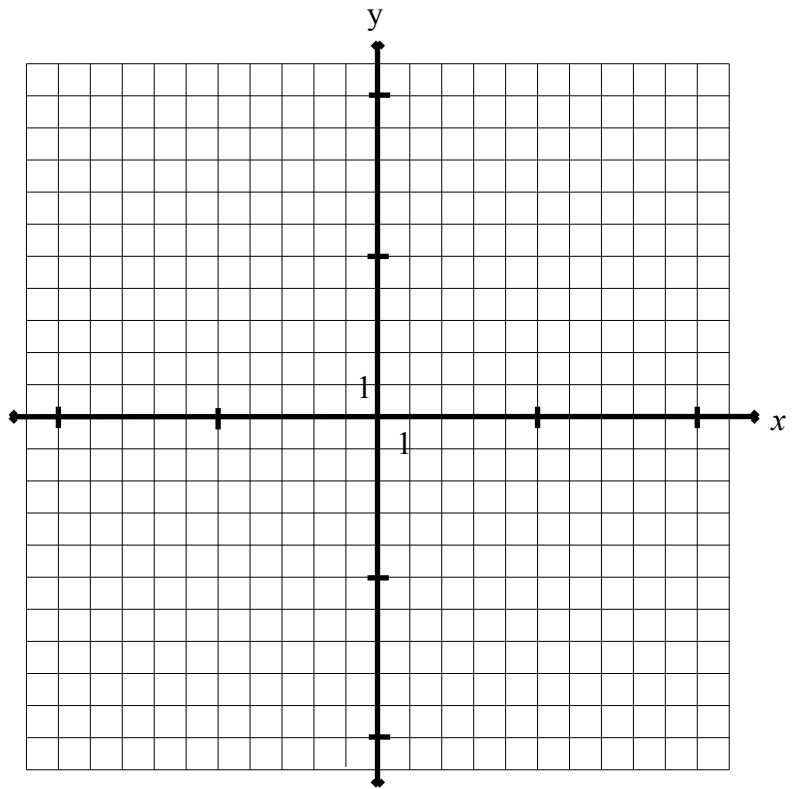
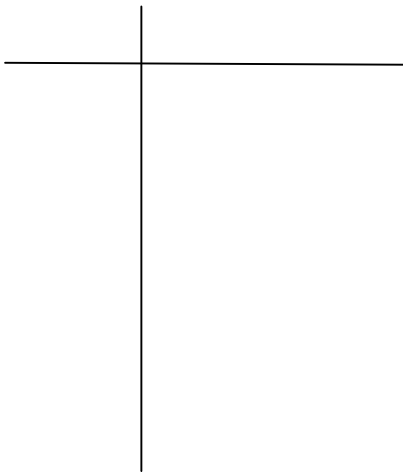
b) $y = -3x + 4$



c) $y = \frac{1}{2}x - 4$

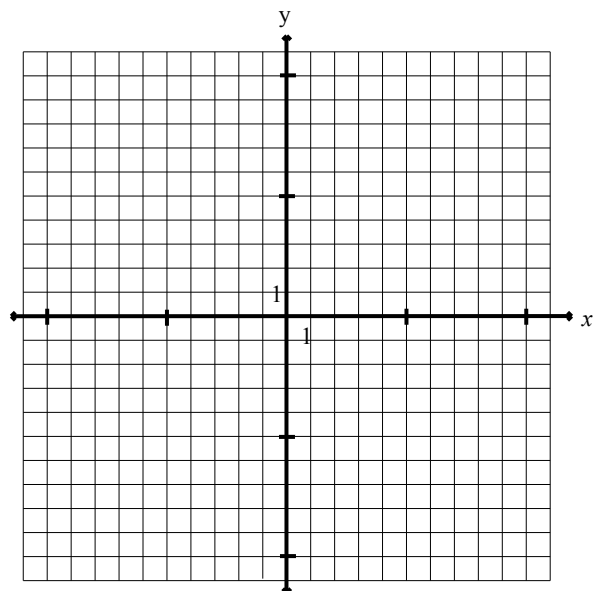


d) $y = -\frac{2}{3}x$



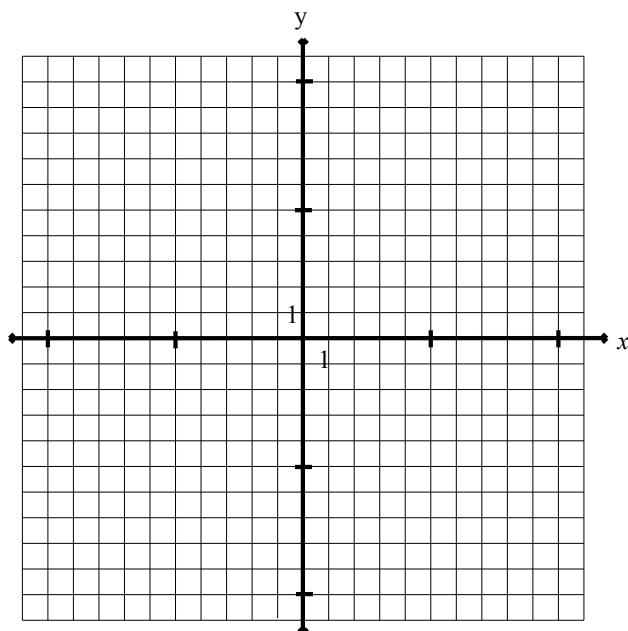
Ex. 3. Complete the following table of values and graph.

$3x - 4y = 12$	
x	y
0	
-2	
	3
6	
	0

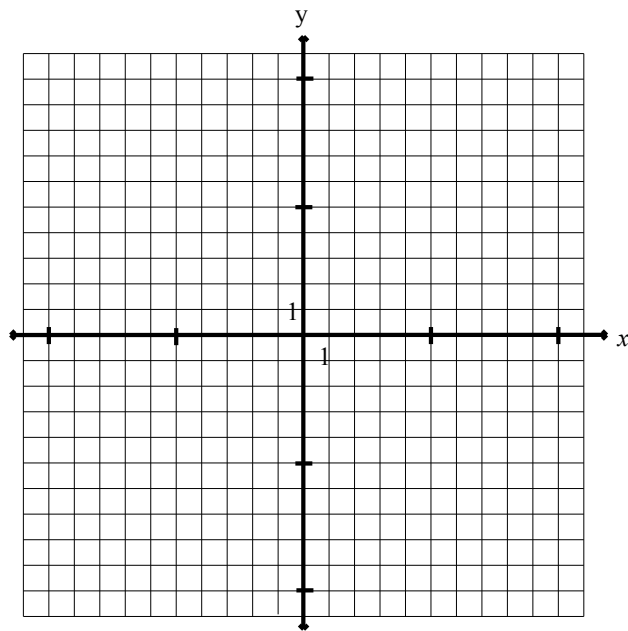


Grids For Homework: p. 148-149

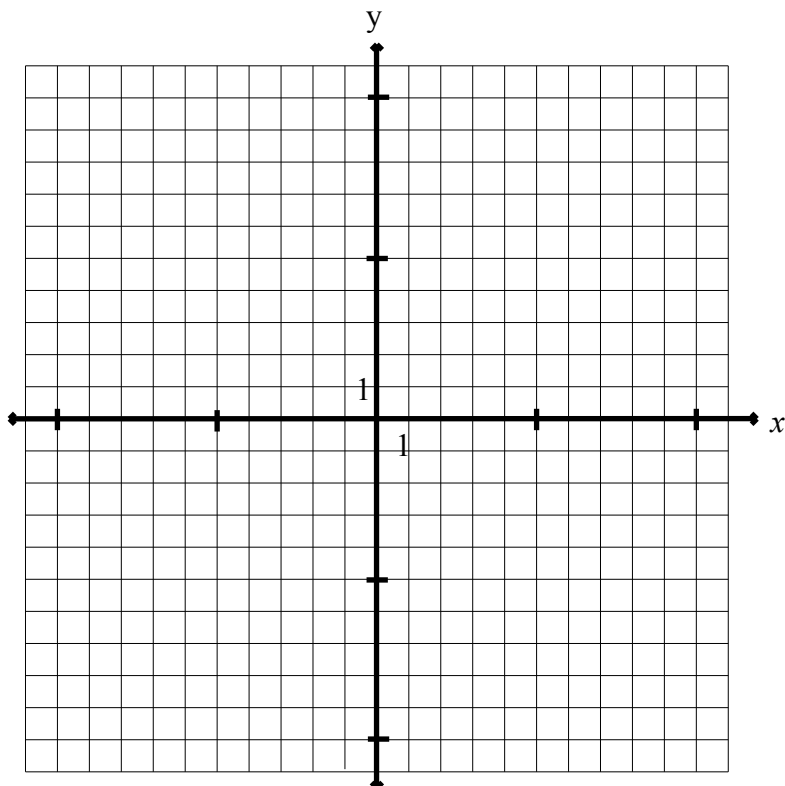
#13. a) and b)



#13. c) and d)



#18.



What Did the Doctor Say After Examining Yunn Yunsberger?



Complete the table for each function. Find each ordered pair at the bottom of the page and write the corresponding letter above it. (Answers for Exercises 1–4 are to the left, and answers for Exercises 5–8 are to the right of the center line.)



1

$2x + y = 1$	
x	y
-1	
-4	
3	

(A) (D) (O)

2

$x - y = 5$	
x	y
7	
1	
-2	

(I) (E) (Y)

5

$-2x + 3y = 6$	
x	y
6	
0	
-3	

(D) (U) (E)

6

$x + 4y = 12$	
x	y
8	
0	
-8	

(T) (N) (E)

3

$3x - y = -4$	
x	y
2	
-1	
-3	

(U) (A) (I)

4

$x - 2y = 2$	
x	y
6	
2	
-4	

(V) (H) (C)

7

$x + y + 6 = 0$	
x	y
-5	
2	
-8	

(Y) (N) (C)

8

$3x = 2y + 8$	
x	y
8	
2	
-4	

(N) (S) (H)

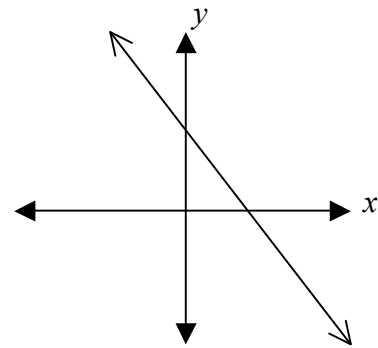
(-2, -7)	
(3, -5)	
(2, 10)	
(7, 8)	
(2, 0)	
(-1, 3)	
(6, 2)	
(1, -4)	
(2, 4)	
(-1, 1)	
(-4, -3)	
(-3, -5)	
(-4, 9)	
(6, 8)	
(7, 2)	
(8, 8)	
(2, 3)	
(6, 6)	
(-8, 5)	
(8, -2)	
(-8, 2)	
(-4, -10)	
(-3, 0)	
(2, -1)	
(8, 1)	
(-5, 3)	
(-5, -1)	
(0, 2)	
(2, -8)	
(0, 3)	

Using Intercepts to Graph Linear Relations

Definitions:

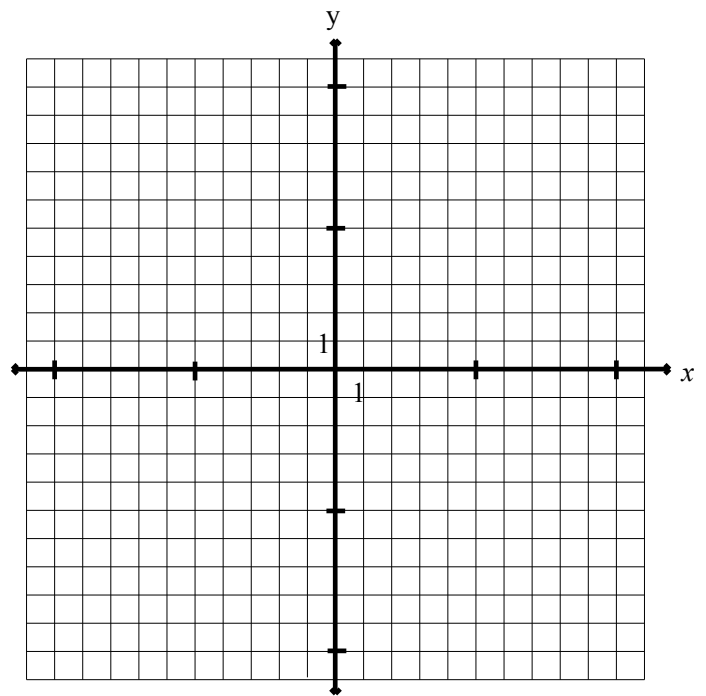
The **x-intercept** is the x value of the point where the line crosses the _____ . To find the **x-intercept**, let _____ and then solve for x .

The **y-intercept** is the y value of the point where the line crosses the _____ . To find the **y-intercept**, let _____ and then solve for y .



Ex. 1. Graph the following linear relations by finding the intercepts.

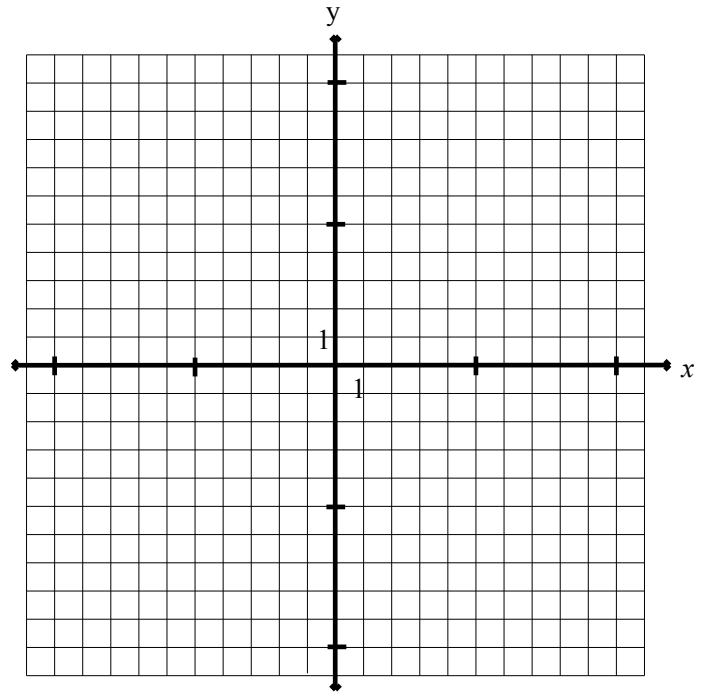
a) $4x - 3y = 12$



b) $y = -3x + 6$

Ex. 2. Graph the following linear relations by finding the intercepts.

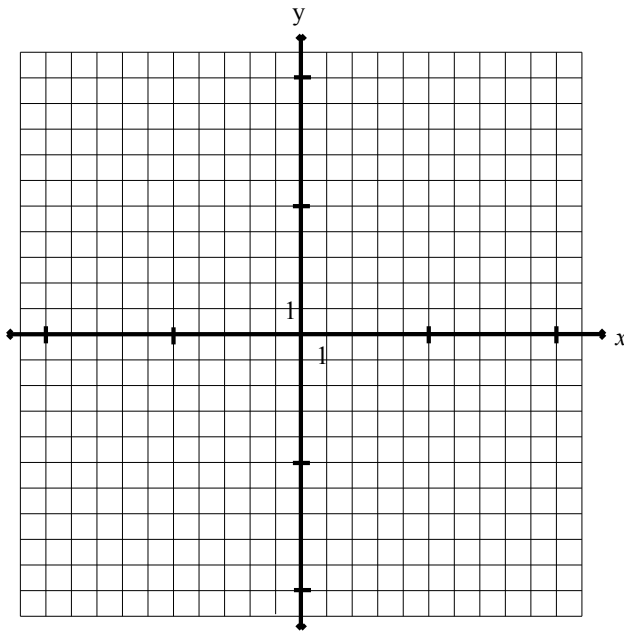
a) $\frac{2}{3}x - \frac{4}{5}y = 2$



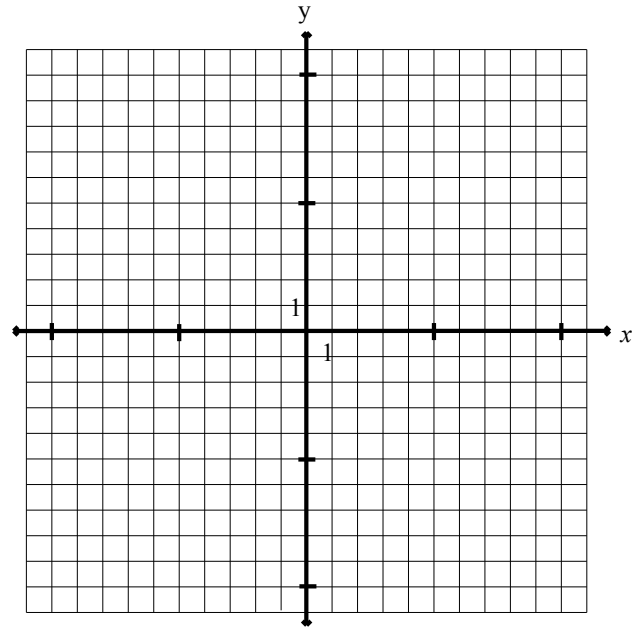
b) $\frac{1}{6}x + y - \frac{2}{3} = 0$

Grids For Homework: p. 169-170

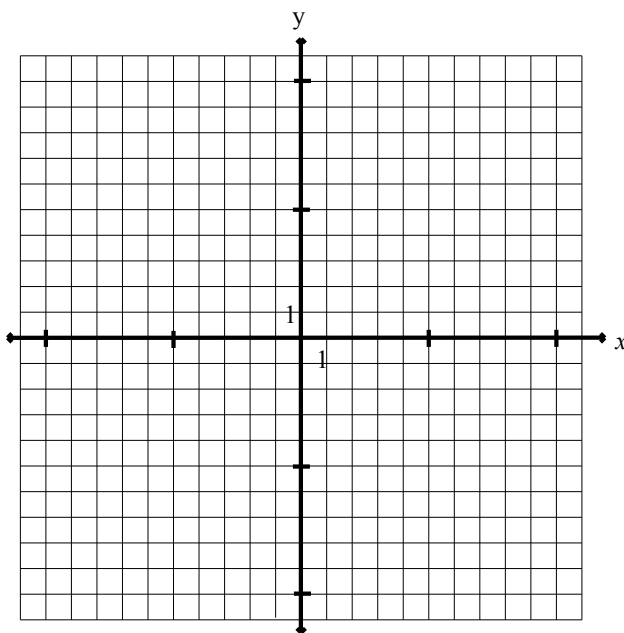
#1. a) and c)



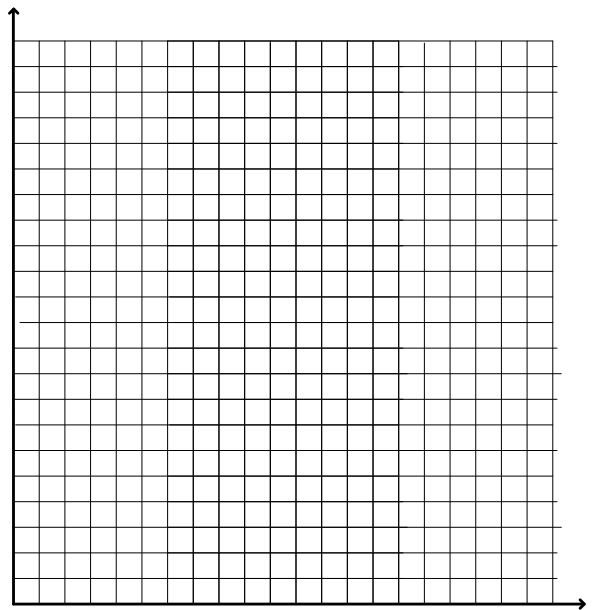
#4. a) and b)



#8. b) and c)



#7. c)



Using the Slope and y -intercept to Graph Linear Relations

WARMUP

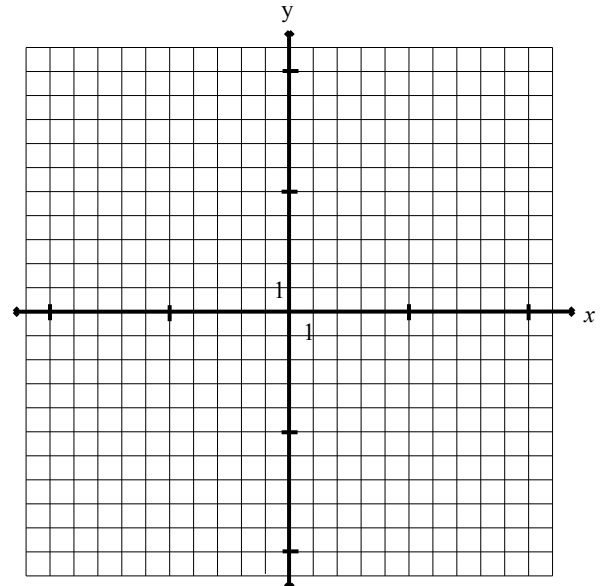
Graph each of the following linear relations using the indicated method.

table of values

$$y = \frac{3}{5}x + 2$$

intercepts

$$3x + y = 0$$



The **rate of change** of the linear relation is called the _____ of the line.

The y value of the point where the line crosses the y -axis is called the _____.

For $y = \frac{3}{5}x + 2$ the slope is _____ and the y -intercept is _____.

For $y = -3x$ the slope is _____ and the y -intercept is _____.

Summary:

The graph of the relation $y = mx + b$ is a straight line with slope _____ and y -intercept _____.

Slope measures _____.

Slope =

The greater the magnitude of slope m (ignoring the sign) _____.

A line with a **positive slope** _____ to the right.

A line with a **negative slope** _____ to the right.

Note: The equation of a line in **slope, y-intercept form** is in the form $y = mx + b$.

Ex. 1. Complete the following table.

Equation	Slope	y-intercept
$y = 2x - 5$		
$y = x + 10$		
$y = -5x$		
$y = \frac{2}{3}x - 1$		
$y = 3$		

Ex. 2. Write the equation of the line in **slope, y-intercept form** with:

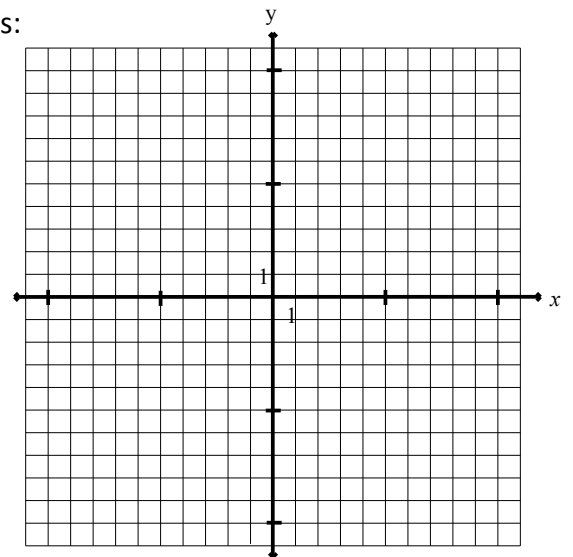
a) $m = \frac{1}{2}$ and $b = -1$

b) $m = 7$ and $b = 0$

Ex. 3. Use the **slope and y-intercept** to graph the following lines:

a) $y = 3x - 5$

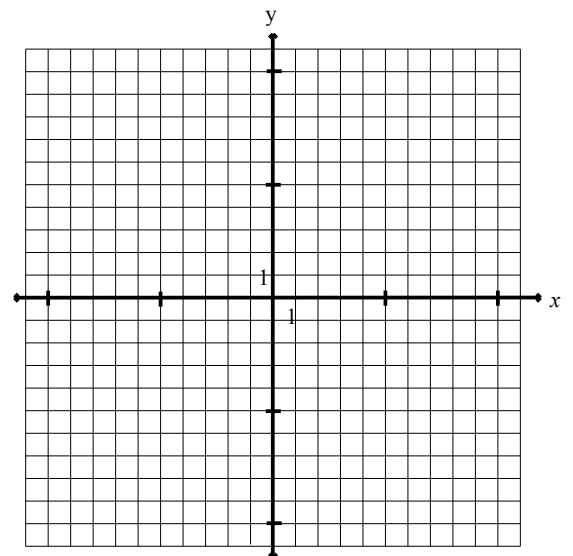
b) $y = -\frac{2}{3}x + 4$



Ex. 4. Rewrite each of the following equations in **slope, y-intercept form** and graph.

a) $5x + 2y = 0$

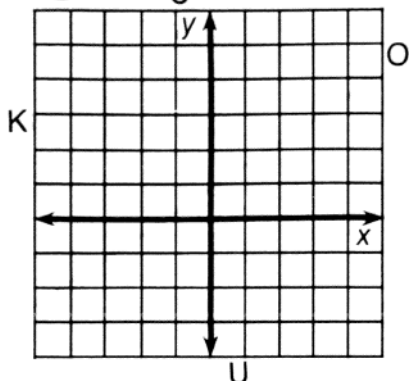
b) $x - 4y - 28 = 0$



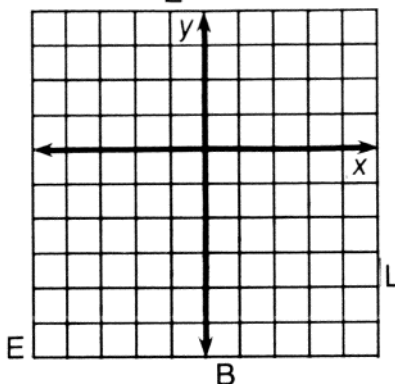
Whom Should You See at the Bank If You Need To Borrow Money?

Use the slope and **y**-intercept to graph each equation below. The graph, if extended, will cross a letter. Print this letter in each box that contains the number of that exercise.

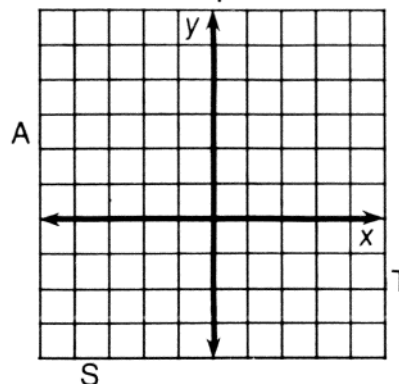
① $y = \frac{2}{3}x + 1$



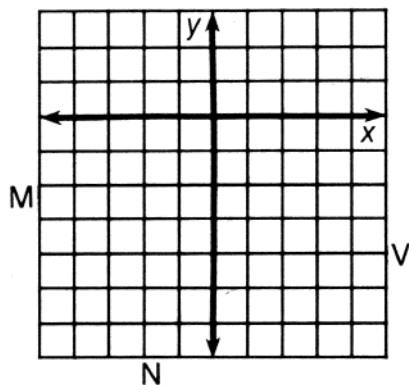
② $y = \frac{1}{2}x - 3$



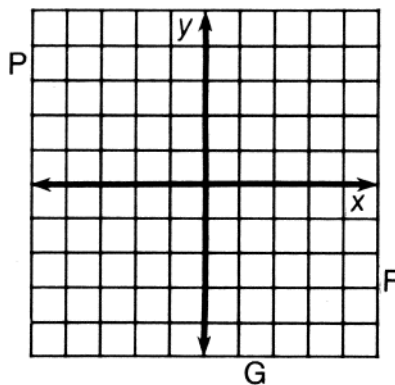
③ $y = -\frac{3}{4}x + 2$



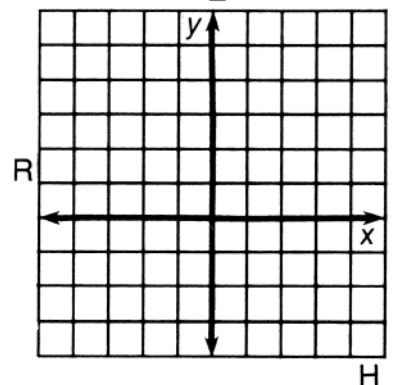
④ $y = 2x - 4$



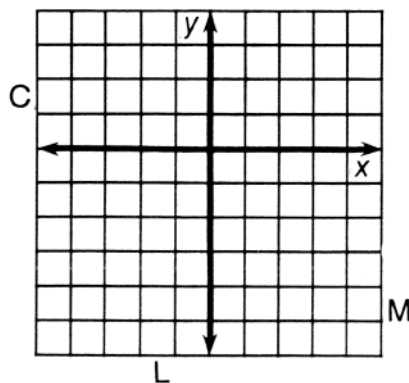
⑤ $y = -3x - 1$



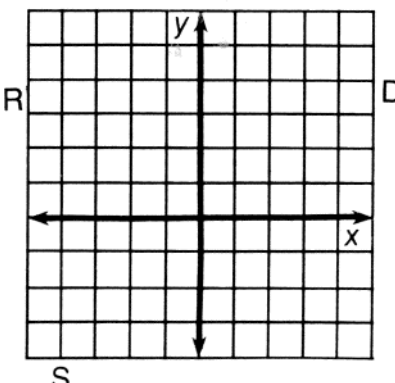
⑥ $y = -\frac{3}{2}x + 3$



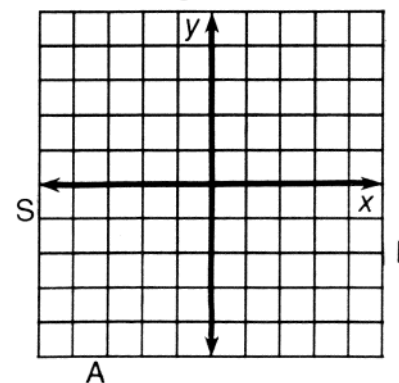
⑦ $y = 4x - 2$



⑧ $y = -\frac{1}{4}x + 2$



⑨ $y = \frac{5}{3}x$

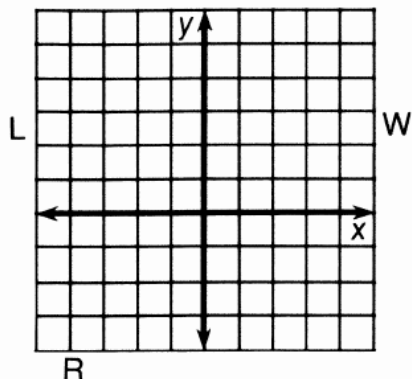


3	6	2	7	1	9	4	9	8	8	9	4	5	2	8
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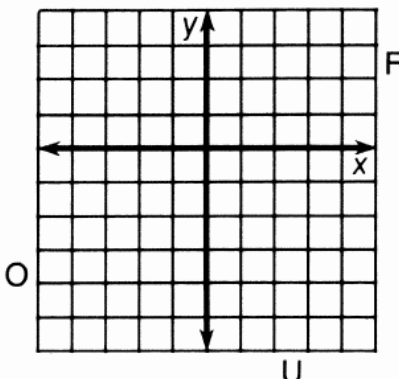
Why Does a Poor Man Drink Coffee ?

Use the slope and y -intercept to graph each equation below. The graph, if extended, will cross a letter. Print this letter in each box that contains the number of that exercise.

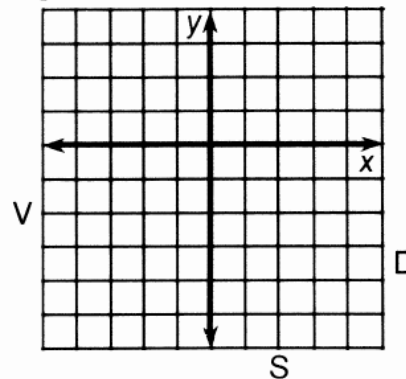
① $-3x + 2y = 2$



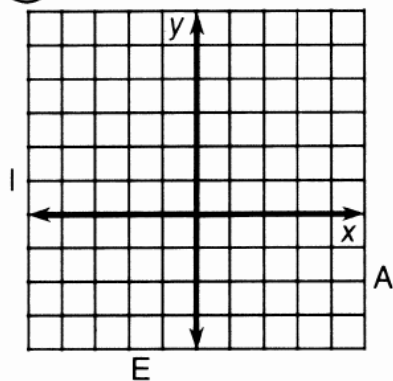
② $x - 4y = 8$



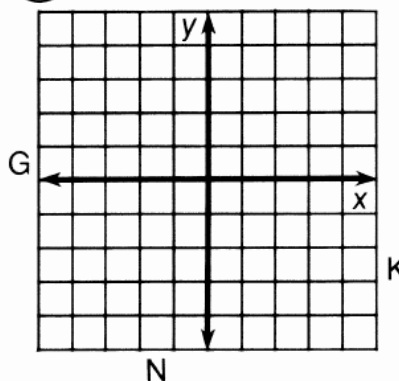
③ $2x + y = -3$



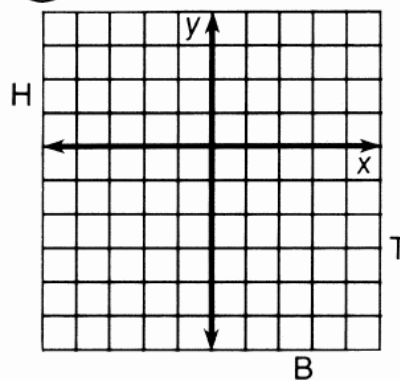
④ $2x + 3y = 6$



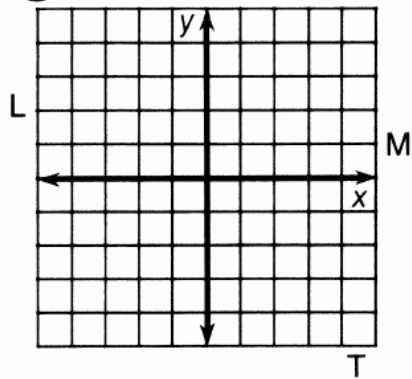
⑤ $3x - y = 1$



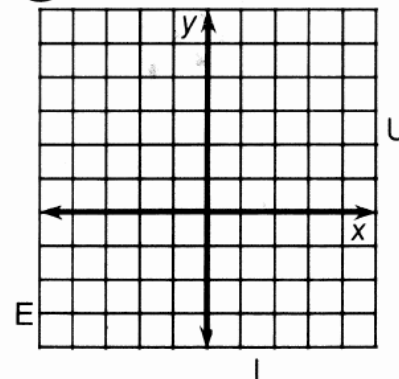
⑥ $-3x - 5y = 10$



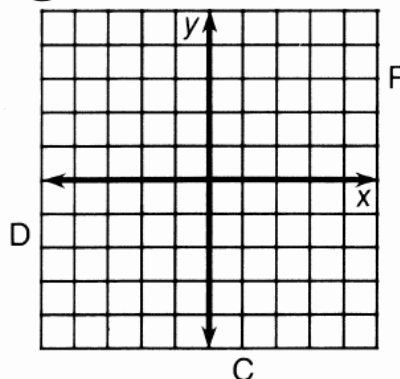
⑦ $4x + 3y = 0$



⑧ $2x - 2y + 5 = 0$



⑨ $y - 3 = 0$



6	8	6	4	3	5	2	9	1	2	9	8	1	7	8	4
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Graphing Assignment

Show all work on lined paper and graph no more than two lines on one grid.

1. Graph the following using the **table of values** method. (5 entries)

a) $y = 2x - 7$

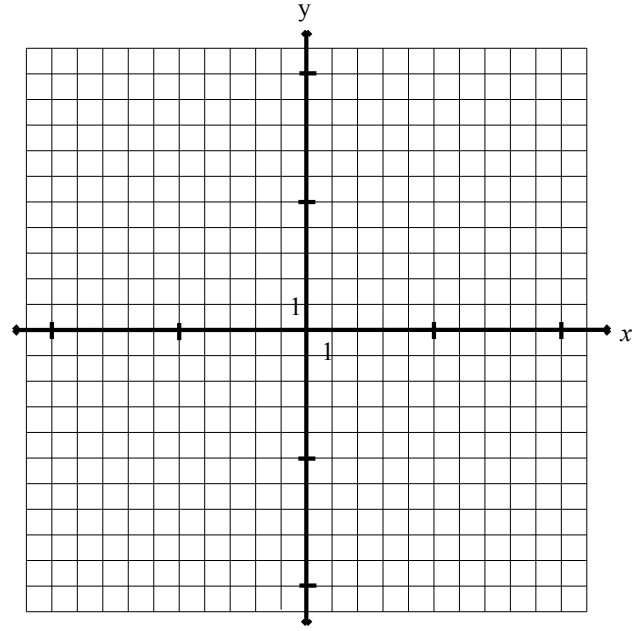
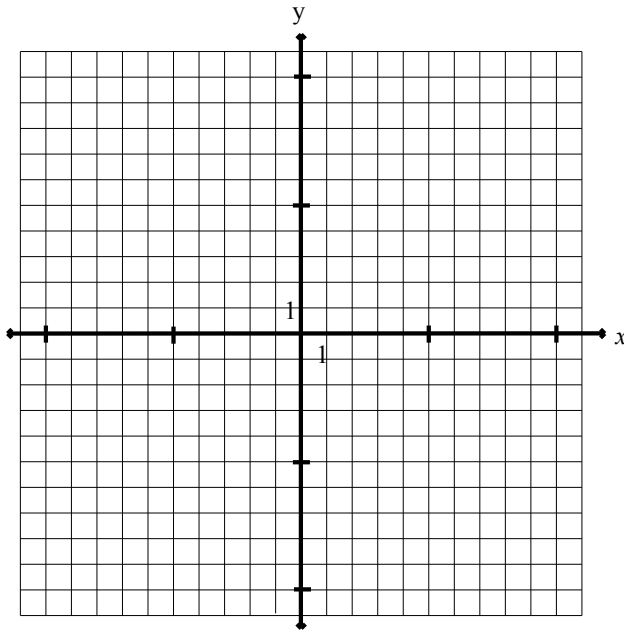
b) $y = -\frac{2}{5}x + 4$

c) $x - y = 0$

d) $2x + 4y = 12$

#1. a) and b)

#1. c) and d)



2. Graph the following using the **intercepts** method.

a) $2x - 3y = 12$

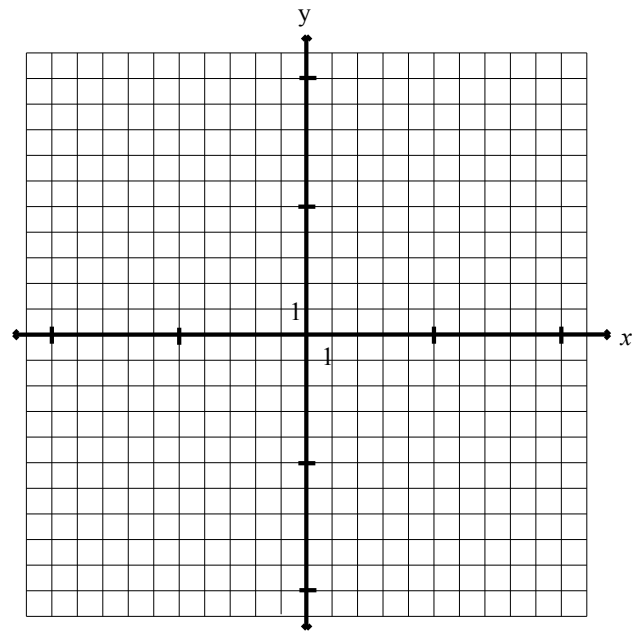
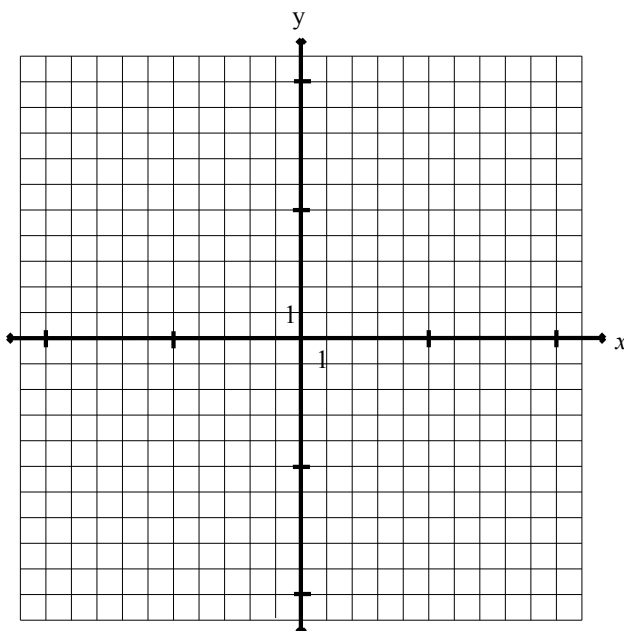
b) $5x + 4y - 10 = 0$

c) $\frac{1}{2}x + \frac{3}{4}y = 3$

d) $\frac{3}{5}x - \frac{2}{3}y + 2 = 0$

#2. a) and b)

#2. c) and d)



3. Graph the following using the **slope, y-intercept** method.

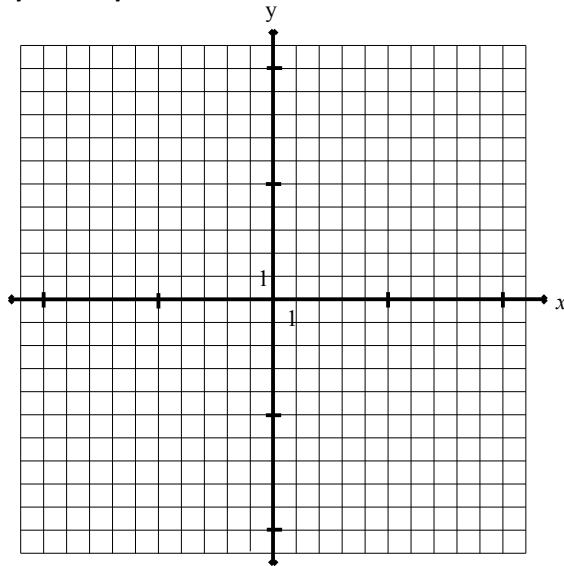
a) $y = \frac{3}{5}x + 1$

b) $y = -2x + 5$

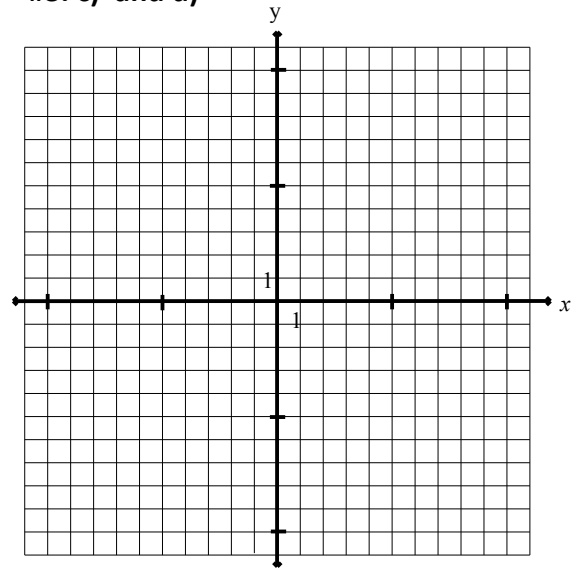
c) $x - y - 4 = 0$

d) $x + 2y = 0$

#3. a) and b)

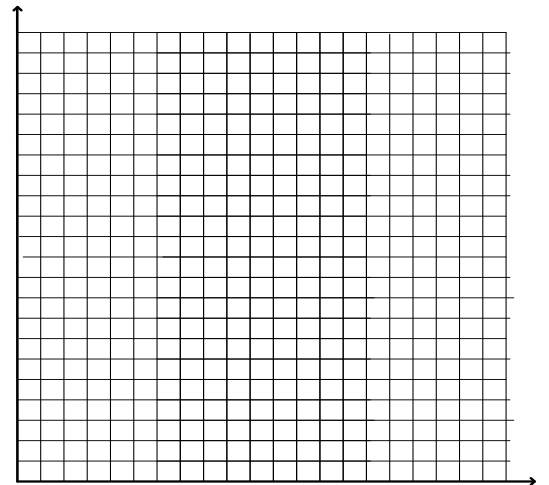


#3. c) and d)



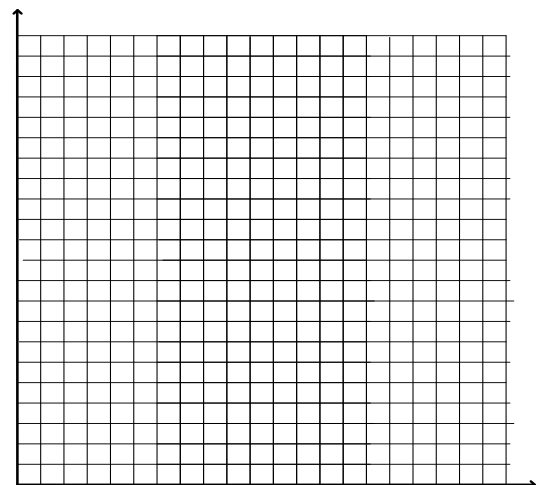
4. An appliance repair person charges \$50 for a service call and \$40 per hour for time spent repairing a kitchen appliance.

- What is the independent variable?
- What is the dependent variable?
- Define the variables with "let statements" and write an equation for the repair person's charges.
- Graph the relation for up to 5 hours using a table of values.



5. The height of a ball when kicked is given by the equation $h = 30t - 5t^2$, where t is the time in seconds and h is the height in metres.

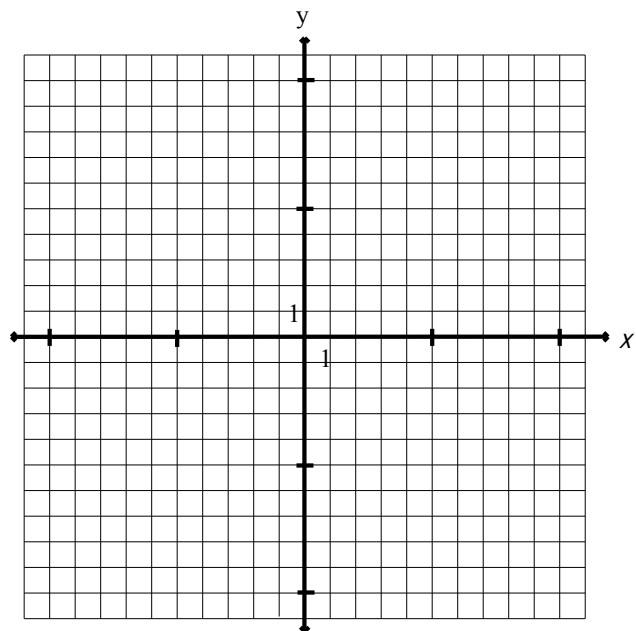
- Graph the relation for $t = 0$ to $t = 6$ using a table of values.
- Using the graph, determine each of the following:
 - the maximum height reached by the ball
 - the time it takes to reach the maximum height
 - the length of time the ball is in the air



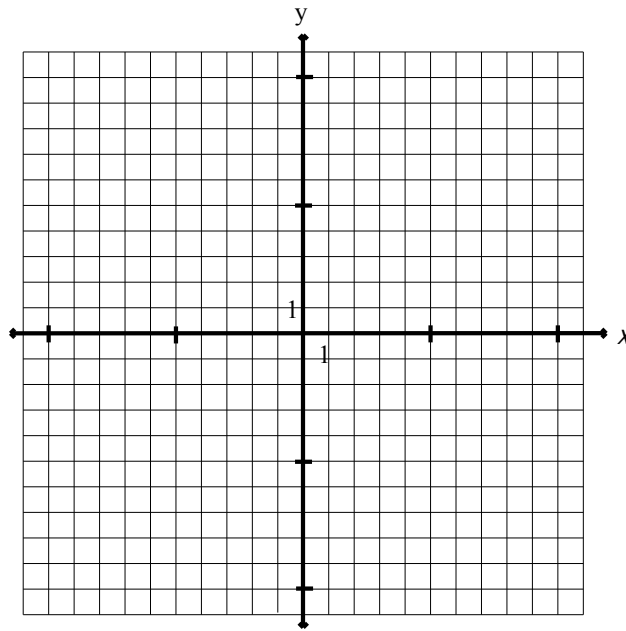
Unit 6A Test Review

- HW: p. 283 #1, 2, 5ac* (graph using slope, y-intercept method) – Lesson 6
p. 263 #2i – Lessons 6
p. 258 #7ab* – Lesson 4
p. 258 #8* – Lesson 5
p. 163 #2 – Lesson 2
p. 183 #2a, 9, 10* – Lesson 2
*grids provided

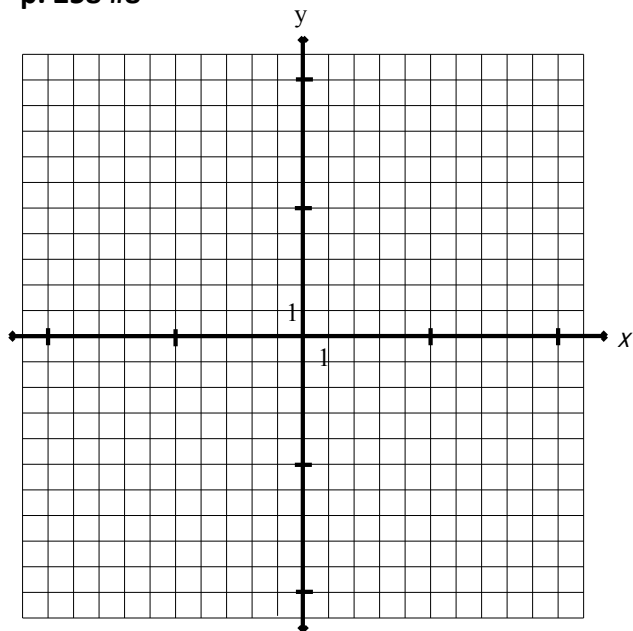
p. 283 #5a) and c)



p. 258 #7 a) and b)



p. 258 #8



p. 183 #10

