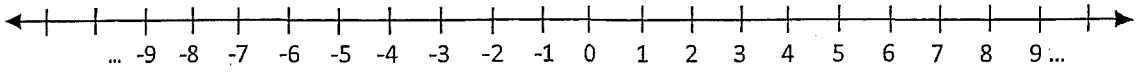
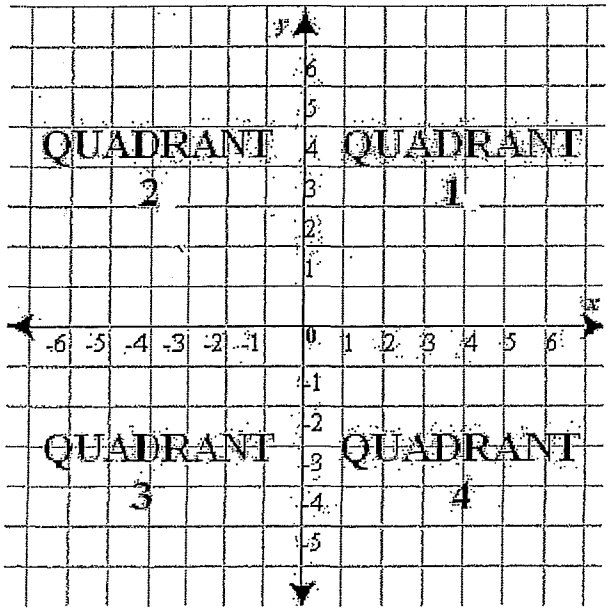
5.1 – The Coordinate Plane

A **Coordinate Plane** is also known as a **Cartesian Plane**, named after French mathematician, Rene Descartes. It is a system for graphing any point (ordered pairs) on a grid by using two numbers that form a **coordinate** (x, y). He came up with the idea while trying to describe the position of a spider crawling across the ceiling.

In Unit 1, we worked with an integer number line.



When a **vertical number line** and a **horizontal number line** intersect at **right angles** and at the point **zero** on each line, they form axes on a ***coordinate plane.***



- The number lines intersect at the origin, which is labelled (0, 0).
- The horizontal axis is labelled x.
- The vertical axis is labelled y.
- The axes divide the plane into four quadrants.
- The numbers on the axes are called the co-ordinates.

Coordinates / Ordered Pairs

Any point on the plane can be described by its ***coordinates***. Coordinates are also known as ordered pair and written in the form (x, y).

The $x - value$ of a coordinate represents the placement along the $x - axis$, and it is always written first.

The $y - value$ of a coordinate represents the placement along the $y - axis$, and it is always written second.

To plot a point (x, y):

- ✓ Always start at the origin (0, 0)
- ✓ Read along the $x - axis$ to identify the $x - coordiante$ (the first coordinate)
  A **positive** $x - value$ means move to the **right**.
  A **negative** $x - value$ means move to the **left**.
- ✓ Read along the $y - axis$ to identify the $y - coordiante$ (the first coordinate)
  A **positive** $y - value$ means move to the **upwards**.
  A **negative** $y - value$ means move to the **downwards**.

Ex. 1: Graph the following points on the given grid. State which quadrant each point is in.

A (3 , 4) Q 1

B (- 1, 4) Q 2

C (4, - 2) Q4

D (- 5, - 4) Q 3

E (2, 5) Q1

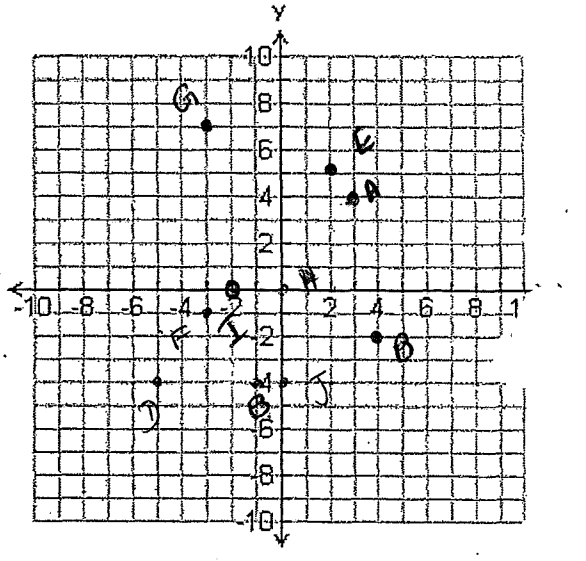
F (- 3, - 1) Q 3

G (- 3, 7) Q2

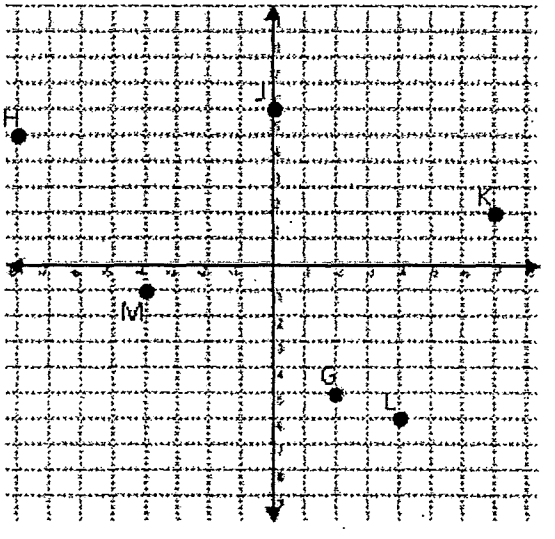
H (0, 0) origin (none)

I (- 2 , 0) none

J (0 , - 4) none



Ex. 2: Using the coordinate plane given, write the ordered pairs for each point.



G (2,5)

H (-8,5)

J (0,6)

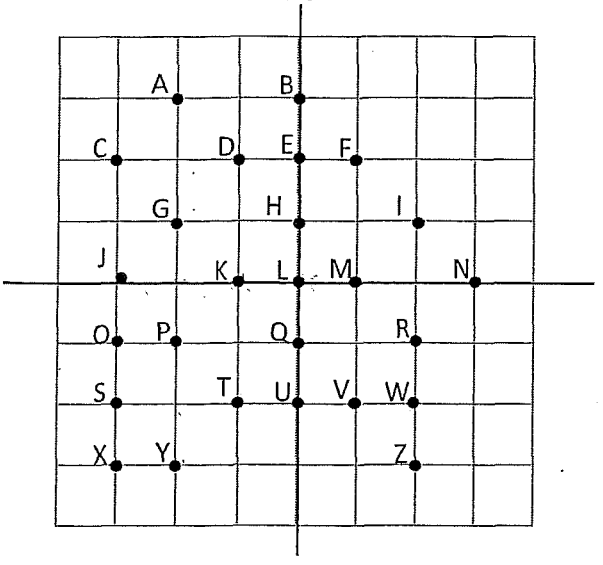
K (7,2)

L (4,-6)

M (-4,-1)

The Coordinate Plane - Practice

Use the following grid to code and decode messages.



1. Write the coordinate positions for the letters in these words:

DRIVE (-1, 2) (2, -1) (2, 1) (1, -2) (0, 2)

PARTY (-2, -1) (-2, 3) (2, -1) (1, -2) (2, -3)

GAME (-2, 1) (-2, 3) (1, 0) (0, 2)

2. Decode this message, using the coordinate plane on the left.

(2, 1) (1, 2) (-2, -3) (-3, -1) (0, -2) (-3, 2) (-2, 3) (3, 0)

IF YOU CAN

(-1, 2) (0, 2) (-3, 2) (-3, -1) (-1, 2) (0, 2)

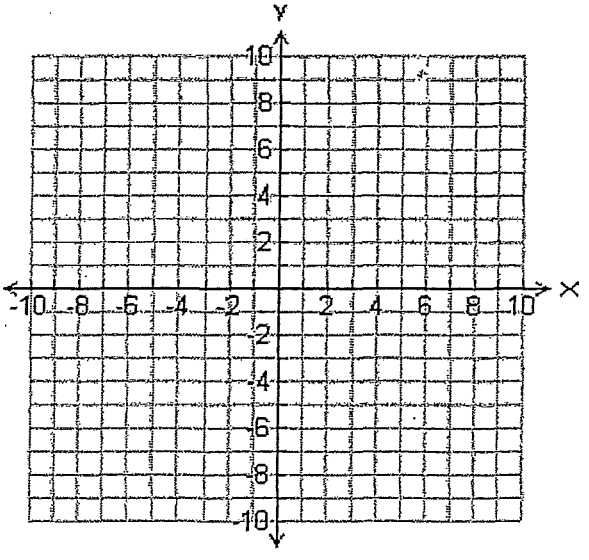
DECODE

(-1, -2) (0, 1) (2, 1) (-3, -2)

THIS

3. On the grid below, plot and label each point.

N(2, 3)	P(2, -3)	Q(1, -3)
R(0, 3)	S(3, 0)	T(-2, 0)
U(0, -1)	V(-1, 2)	W(-3, 1)
X(-1, 3)	Y(-3, -1)	Z(-3, -2)



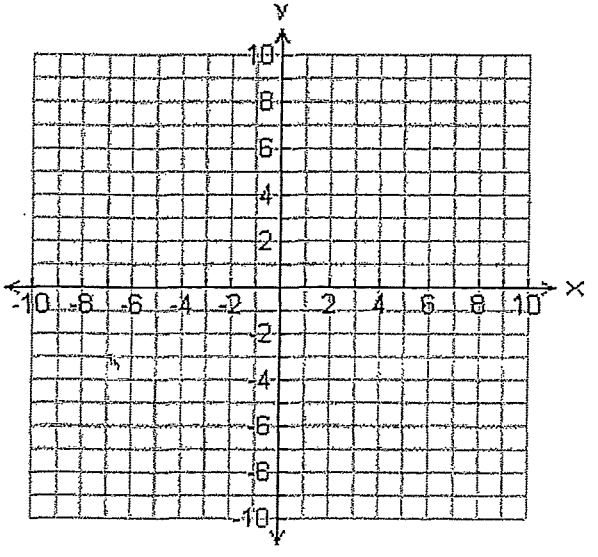
4. For each set of points, plot and join the points in order to form a closed figure.

(a) A(2, 1) B(5, 1) C(5, 3) D(2, 3)

(b) E(-2, 3) F(-5, 3) G(-5, 1)

(c) H(-3, 1) I(-1, 1) J(-1, -1) K(-3, -1)

(d) L(2, 1) M(5, 1) N(4, -3) P(1, -3)



5. Match the words in the box with the most appropriate expression below.

coordinates	origin	scale
y-coordinate	horizontal axis	ordered pair
x-coordinate	vertical axis	coordinate plane

(a) A grid with two perpendicular lines coordinate plane

(b) tells how far the point is along the x-axis x-coordinate

(c) the numbers on the axes scale.

(d) tells how far the point is along the y-axis y-coordinate

(e) also known as the x-axis horizontal axis

(f) the point where the axes cross origin

(g) a point in a plane represented by an ordered pair of numbers coordinates.

(h) two numbers, written in order within a set of brackets and separated by a comma ordered pair

(i) also known as the y-axis vertical axis

6. Exactly where in coordinate plane are the following ordered pairs located?
(**e.g.** Quadrant 1, 2, 3, or 4; origin; x **– axis**; y **– axis**)

1) (27, -89) Q4

2) (0, -19) y-axis

3) (14, 34) Q1

4) (0, 0) origin

5) (-66, -23) Q3

6) (-1,103) Q2

7) (126, -12) Q4

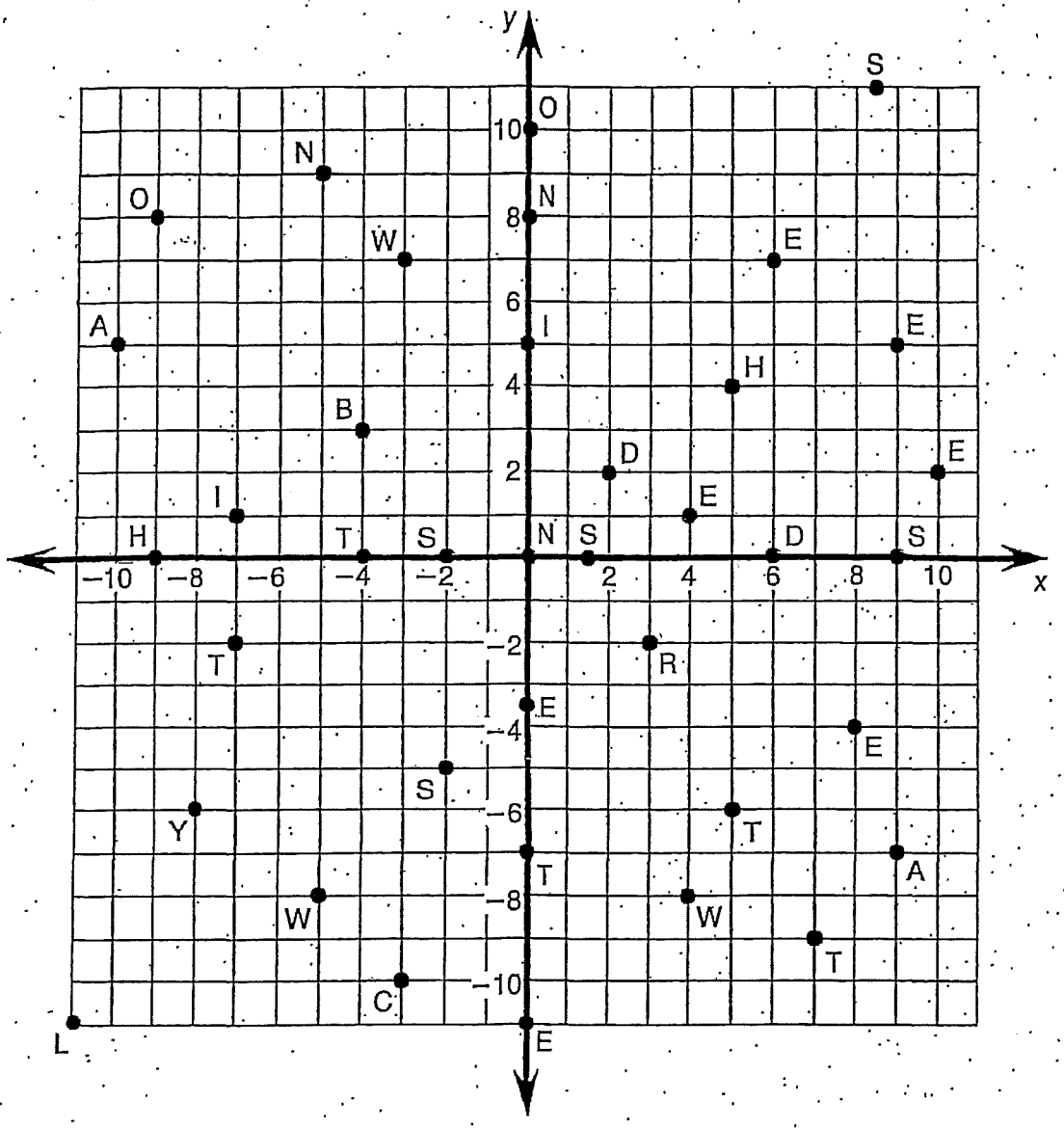
8) (-18, 0) x-axis

9) (352, -353) Q4

5.1

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.



H	E	W	A	S	C	R	E	D	I	T	E	D
(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)

W	I	T	H	T	W	E	N	T	Y	O	N	E
(−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)

S	T	O	L	E	N	B	A	S	S	E	S
(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)

OBJECTIVE 5–a: To locate a point in a coordinate plane given its coordinates.

slope $m = \frac{\text{rise}}{\text{run}}$ (up/down) (right/left)

rate of change
gradient

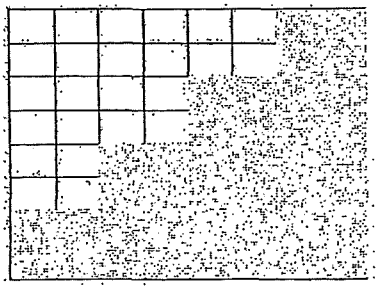
5.2: Slope

Slope

Name: _____

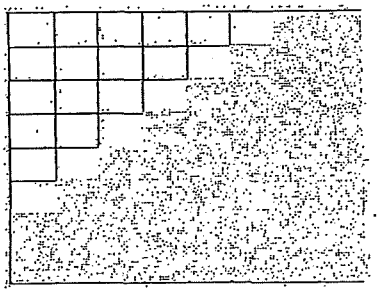
Example 1

These diagrams represent two staircases.



We move 2 blocks right. The run is 2.

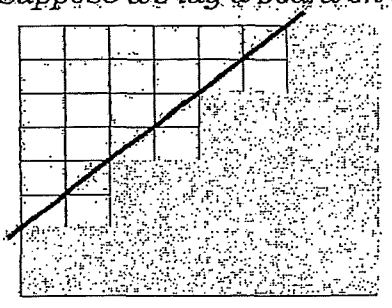
We move up 2 blocks. The rise is 2.

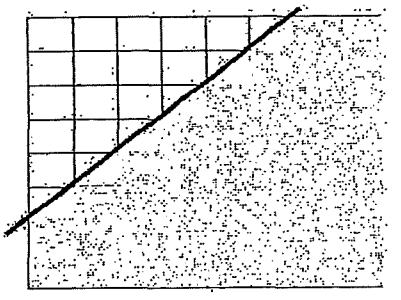


We move 1 block right and 1 block up.

The run is 1 and the rise is 1.

Suppose we lay a board on each staircase.

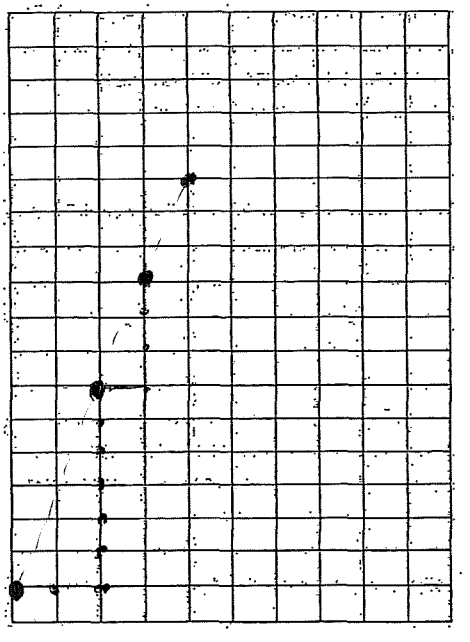




What do you notice about the steepness of each board?

Example 2

- On the following grid draw a staircase where each step has a rise of 6 and a run of 2.
- Without changing the steepness, draw additional blocks so that each horizontal step is only 1 block.
- On the new staircase, as we move 1 block right, we move 3 blocks up. This number is the slope.
- What is the slope of the staircase? $\frac{6}{2} = 3$
- Draw a board that will lie on your staircase.
- Explain why moving 2 units right and 6 units up has the same steepness as moving 1 unit right and 3 units up. Simplify $\frac{6}{2}$ it equals $\frac{3}{1}$
- When the rise is 6 and the run is 2, what is the slope? $m = 3$

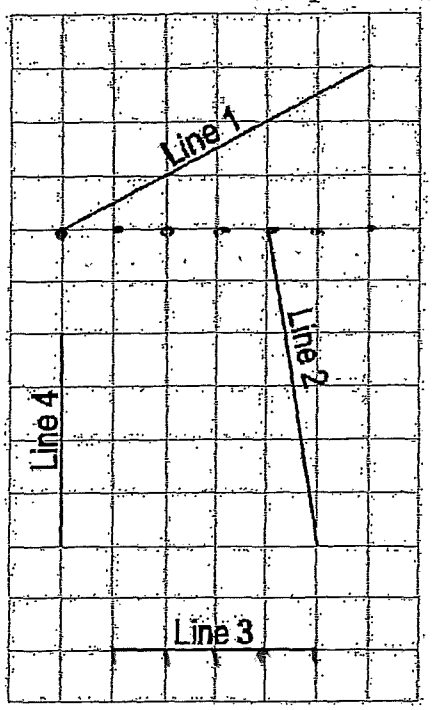


When calculating slope on a grid you need to be careful of positive and negative values.

- On a grid we always count the run from left to right (just like we read!)
  So the run is always positive!!

Example 6

Determine the slope of each line on the following grid.



Line 1 **rises** from left to right, so it has a positive.

Slope = $\frac{\text{rise}}{\text{run}} = \frac{3}{6} = \frac{1}{2}$

Line 2 **drops** from left to right, so it has a negative

Slope = $\frac{\text{rise}}{\text{run}} = -\frac{6}{1} = -6$

Line 3 doesn't rise or fall from left to right so its rise is 0.

Slope = $\frac{0}{4} = 0$ slope of a horizontal line is 0

Line 4 has a rise of 4 and a run of 0. Therefore, the slope is UNDEFINED.

slope of a vertical line is undefined.

Conclusions

Any line **rising** to the right has a positive slope.

Any line **falling** to the right has a negative slope.

Any **horizontal line** has a slope of 0.

Any **vertical line** has an undefined slope.

Slope is calculated using the formula $\text{Slope} = \frac{\text{rise}}{\text{run}}$

Slope measures how steep a line is

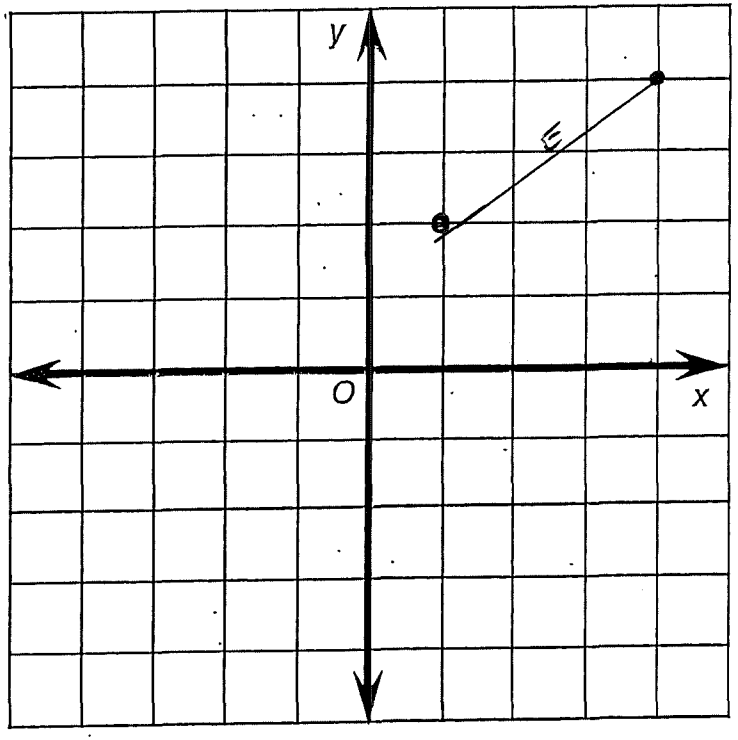
A **higher** value for slope represents a steeper line.

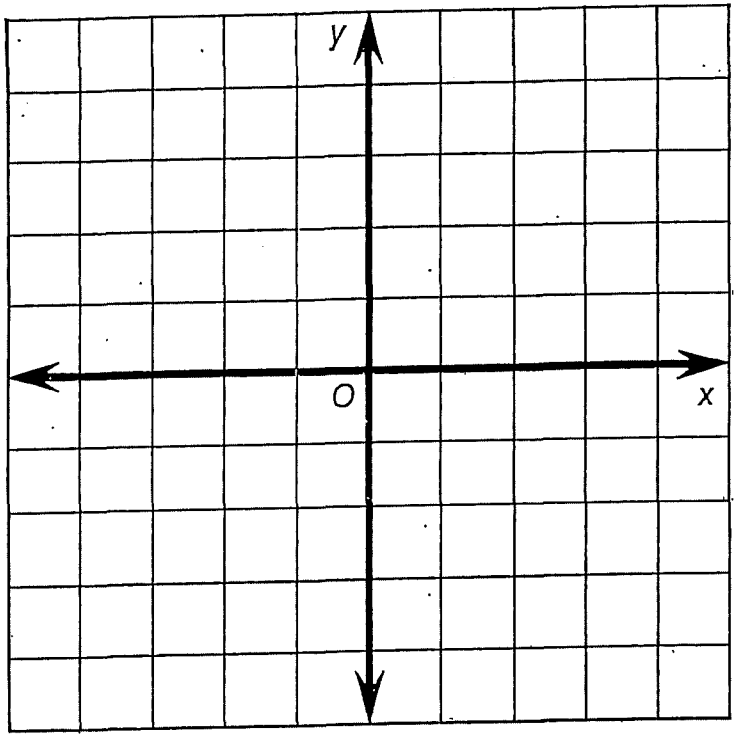
A **lower** value for slope represents a less steeper line.

Pg 1

What Might You Have If You Don't Feel Well ?

For each exercise, draw a line through the two given points. Determine the *slope* of this line. Find your answer at the bottom of the page and write the letter of that exercise above it.





(E) (1, 2) and (4, 4) $\frac{2}{3}$

(G) (−4, −2) and (2, −5) $\frac{-7}{2}$

(O) (3, −3) and (4, 1) $m = 4$

(S) (−2, 4) and (0, −2) $m = -3$

(O) (0, −1) and (4, 3) $m = 1$

(V) (−1, 0) and (−3, 4) $m = -2$

(N) (−5, 2) and (−3, −3) $m = -5/2$

(L) (5, −1) and (−2, −4) $m = \frac{3}{7}$

	G	L	O	V	E	S		O	N	
$-\frac{4}{3}$	$-\frac{1}{2}$	$\frac{3}{7}$	1	−2	$\frac{2}{3}$	−3	$\frac{7}{3}$	4	$-\frac{5}{2}$	0

OBJECTIVE 5–g: To find the slope of a line given

Mathematics 9

The Slope of a Line

skip

Date:

Grid Lines: *The vertical and* _____ *lines which form the grid on graph paper.*

Grid Point: *Any point of* _____ *of two* _____ _____ *on graph paper.*

Slope: *A number which represents the* _____ *or* _____ *of a line.*

AMOUNT OF SLOPE:

Moderate Slope: .....makes an angle of _____ with the horizontal.

Gentle Slope: .....makes an angle between _____ and _____ with the horizontal.

Steep Slope: .....makes an angle between _____ and _____ with the horizontal.

Zero slope: .....makes an angle of _____ with the horizontal.

DIRECTION OF SLOPE: Lines many be ***vertical, horizontal, uphill*** or ***downhill*** in direction.

Uphill: ***Ascending,*** _____ ***or*** _____ ***to the right.***

Downhill: _____ , _____ ***or*** _____ ***to the right.***

Steps For Finding A Numerical Value For Slope:

1. Find two ***grid points*** on the line and mark them with dots.
2. Start at the left grid point.
3. Use a ruler to draw a horizontal line to the right from this point until you are vertically above or below the second grid point. This horizontal line is the ***run***.
4. Now draw a vertical line from the right end of the ***run*** either up or down to connect to the second grid point. This vertical line is the ***rise***.
5. Count the graph squares to determine the length of the ***run*** and the ***rise***.
6. The ***run*** is always positive.
7. The ***rise*** is positive if it is going upwards from the ***run***, or is negative if the ***rise*** is going downwards from the ***run***.
8. $$SLOPE = \frac{rise}{run}$$
9. Reduce the answer for slope to a fraction in lowest terms – avoid decimals or mixed numbers.

SUMMARY:

Uphill Slope: .....corresponds to slope values which are _____ .

Downhill Slope: .....corresponds to slope values which are _____ .

Moderate Slope: .....corresponds to a slope value of _____ or _____ .

Gentle Slope: .....corresponds to slope values which are _____ than _____.

Steep Slope: .....corresponds to slope values which are _____ than _____.

Zero slope: .....corresponds to a slope value of _____ .

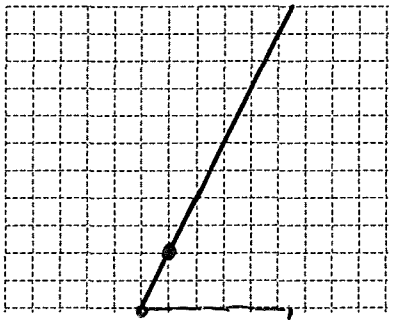
Graph # ____ has the **steepest slope** of all because its slope value is _____.

Graph # ____ has the **gentlest slope** of all because its slope value is _____.

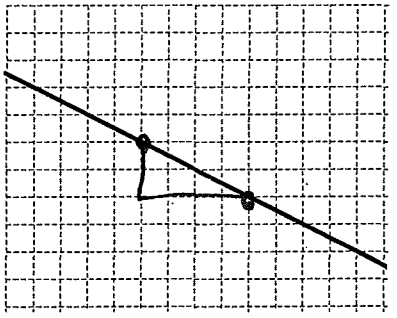
Mathematics 9

The Slope of a Line

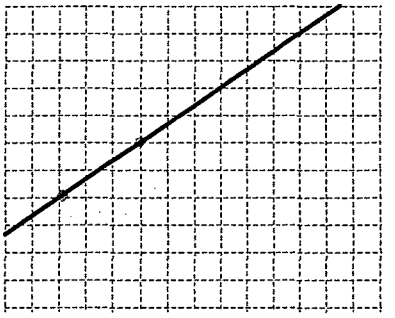
Date:



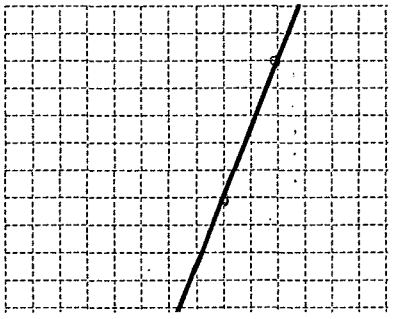
1.	amount of slope:	direction of slope:	slope =
	2	positive.	$\frac{11}{5.5}=2$



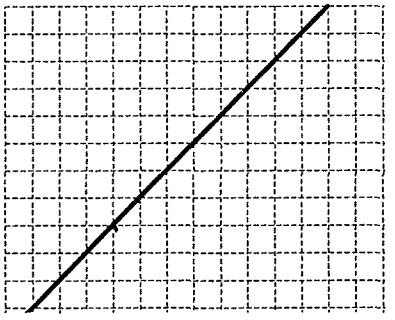
2.	amount of slope:	direction of slope:	slope =
	$-\frac{1}{2}$	negative	$-\frac{2}{4}=\frac{1}{2}$



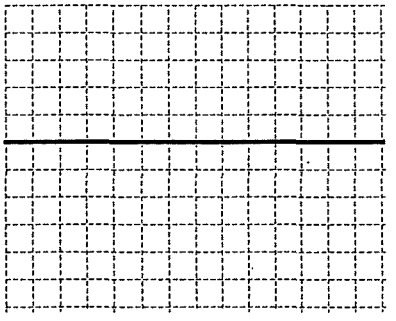
3.	amount of slope:	direction of slope:	slope =
	$\frac{2}{3}$	positive	$\frac{2}{3}$



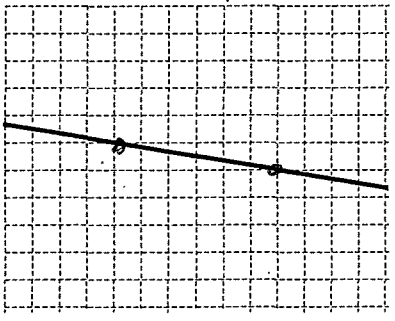
4.	amount of slope:	direction of slope:	slope =
	$5/_2$	+	$5/_2$



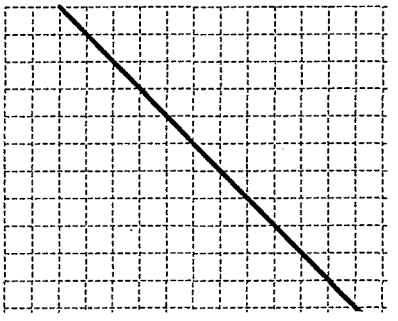
5.	amount of slope:	direction of slope:	slope =
	1	+	1



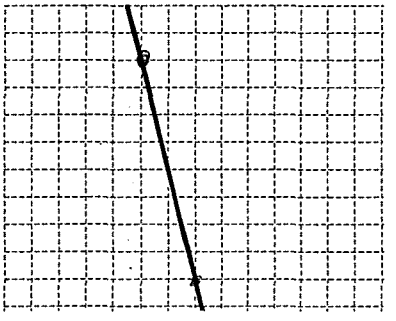
6.	amount of slope:	direction of slope:	slope =
	0	none	0



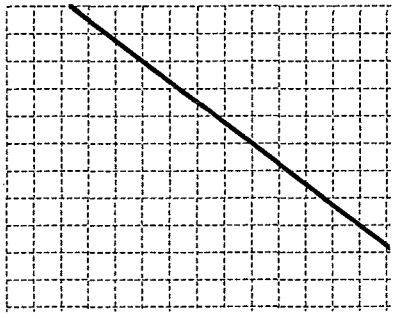
7.	amount of slope:	direction of slope:	slope =
	$-1/_6$	−	$-1/_6$



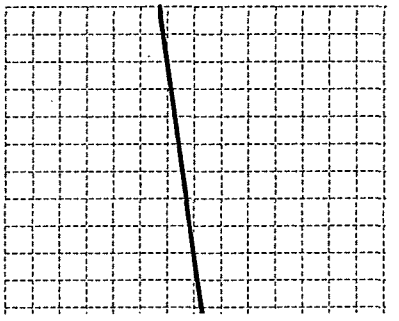
8.	amount of slope:	direction of slope:	slope =
	−1	−	−1



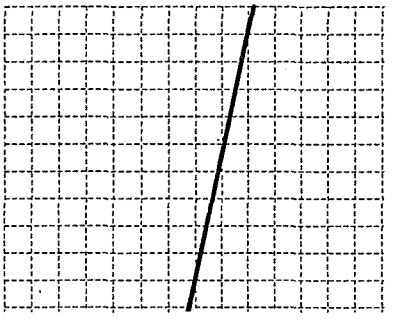
9.	amount of slope:	direction of slope:	slope =
	−4	−	$\frac{-8}{2}=-4$



10.	amount of slope:	direction of slope:	slope =



11.	amount of slope:	direction of slope:	slope =



12.	amount of slope:	direction of slope:	slope =

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Mathematics 9

Point-Slope Graphs

Date:

① For each of the slopes given in the table below:

a) Complete the rows for ***amount of slope*** and ***direction of slope*** in words.

b) Give the ***rise*** and the ***run*** in the spaces provided.

Graph #:	*1*	*2*	*3*	*4*	*5*	*6*
Slope	$\frac{4}{5}$	$\frac{5}{2}$	$-\frac{5}{3}$	$-\frac{1}{3}$	$\frac{4}{1}$	$\frac{-3}{1}$
Direction Of Slope	up	up	down	down	up	down.
Amount Of Slope	4/5	5/2	-5/3.	-1/3	4/1	-3/1
Run *(always positive)*	5	2	3	3	1	1
Rise *(positive or negative)*	4	5	-5	-1	4	-3

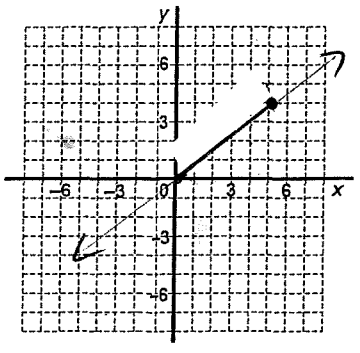
② On the 6 graphs below, plot lines which pass through the origin that have the given slopes.

Steps: i) Place your pencil at the requested starting point.

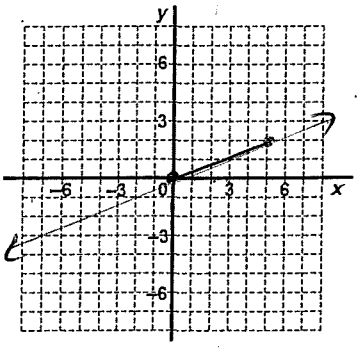
ii) Use a ruler draw the ***run first.*** Since this is always positive, it will always be drawn to the right from the starting point.

iii) Now ***draw the rise*** from the end of the run. (***Up*** if positive, ***down*** if negative.)

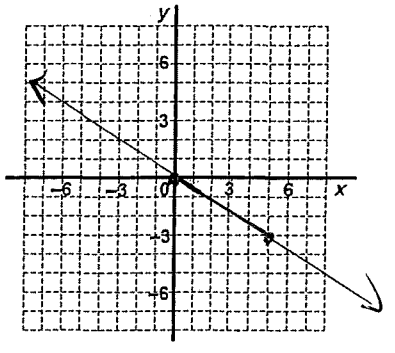
iv) Draw a line through the ends of the rise and run and ***extend the line to the edges of the grid.***



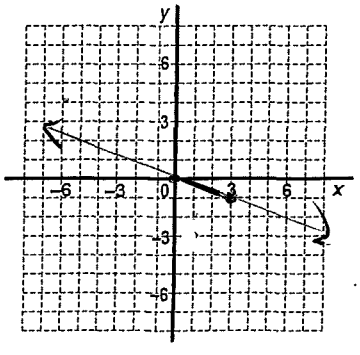
1. slope $=\frac{4}{5}$; start at (0,0)



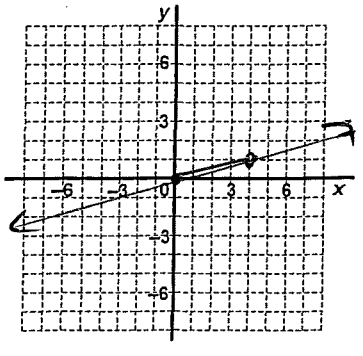
2. slope $=\frac{5}{2}$; start at (0,0)



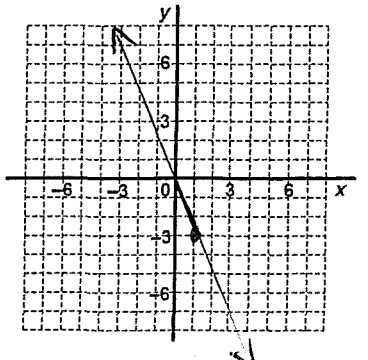
3. slope $=-\frac{5}{3}$; start at (0,0)



4. slope $=-\frac{1}{3}$; start at (0,0)



5. slope $=4$; start at (0,0)



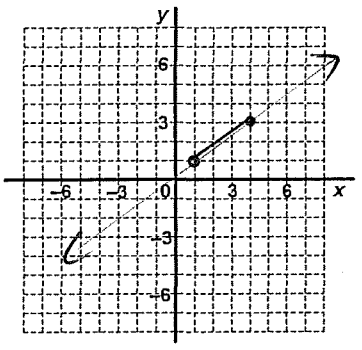
6. slope $=-3$; start at (0,0)

Mathematics 9

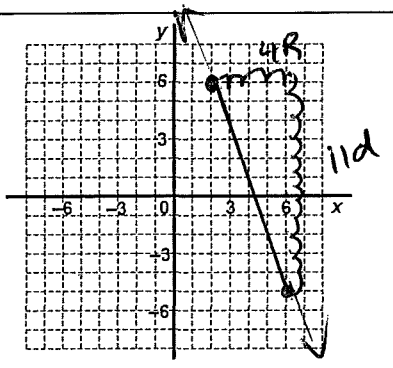
Point-Slope Graphs

Date:

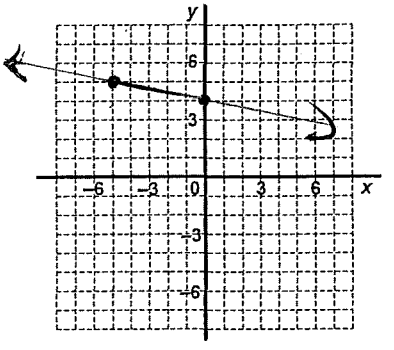
For the remaining graphs notice that the requested start point for the *run* is no longer at the origin.



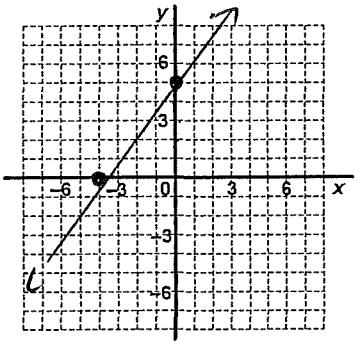
7. slope $= \frac{2}{3}$; start at (1,1)



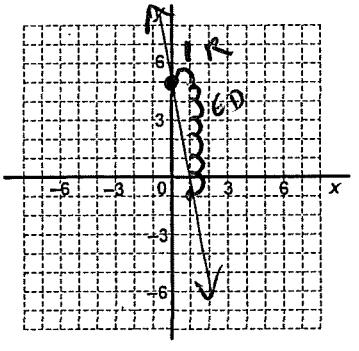
8. slope $= -\frac{11}{4}$; start at (2,6)



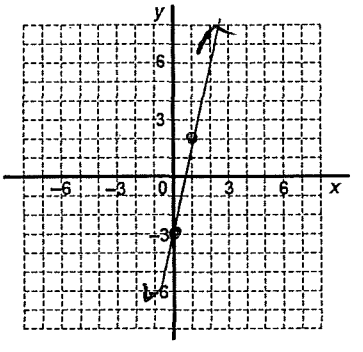
9. slope $= -\frac{1}{5}$; start at (–5,5)



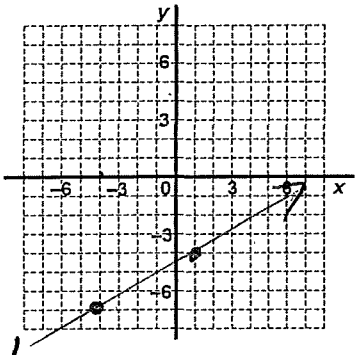
10. slope $= \frac{5}{4}$; start at (–4,0)



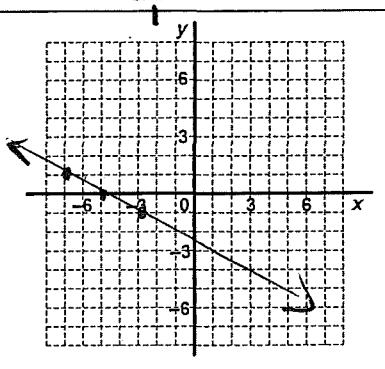
11. slope $= -6$; start at (0,5)



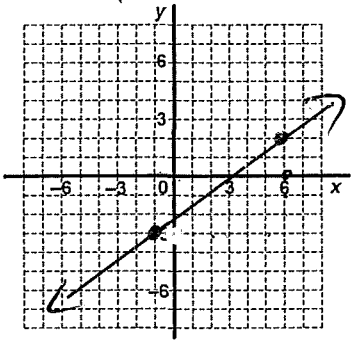
12. slope $= 5$; start at (0,–3)



13. slope $= \frac{3}{5}$; start at (–4,–7)



14. slope $= -\frac{1}{2}$; start at (–7,1)



15. slope $= \frac{5}{7}$; start at (–1,–3)

To Check Answers:

If drawn correctly, your line will also go through the point indicated below. ***(A near miss probably means that you just need to be more careful when lining up your ruler to draw the line—try it!)***

1. (–5,–4)	2. (–2,–5)	3. (–3,5)	4. (–6,2)	5. (2,8)	6. (–1,3)
7. (7,5)	8. (6,–5)	9. (5,3)	10. (–8,–5)	11. (2,–7)	12. (–1,–8)
13. (6,–1)	14. (1,–3)	15. (–8,–8)			