Key Terms

	Term	Definition	Example
1	Linear Relation	straight line relationships a change at a constant rate	$E=10h$ Earnings + hours worked.
2	Linear Function	graph of a straight line	$y=mx+b$
3	Ordered pair	a pair of x and y values which satisfy an equation	$y=3x$ $(1,3)$
4	Slope		
5	y-intercept	where line passes through y-axis $(0,y)$ $x=0$	
6	x-intercept	where line passes through x-axis $(x,0)$ $y=0$	
7	Slope-intercept form of a linear equation		
8	Point-slope form of a linear equation		
9	General form of a linear equation		
10	Parallel Lines		
11	Perpendicular Lines		
12	Dependent Variable		
13	Independent Variable		
14	Linear Function		

Introduction to Linear Relations

We have examined relations between two quantities earlier in this course. Now we will narrow our focus to examine only linear relations.

Linear relations are straight line relationships. Each output value is proportionate to the input value. That is, the change occurs at a constant rate.

Eg. An employee that works for an hourly wage ($10 per hour).

This is a linear relationship because the employees earnings increase at a constant rate.
The equation that relates the **Earnings** and the **hours worked** is $E = 10h$.

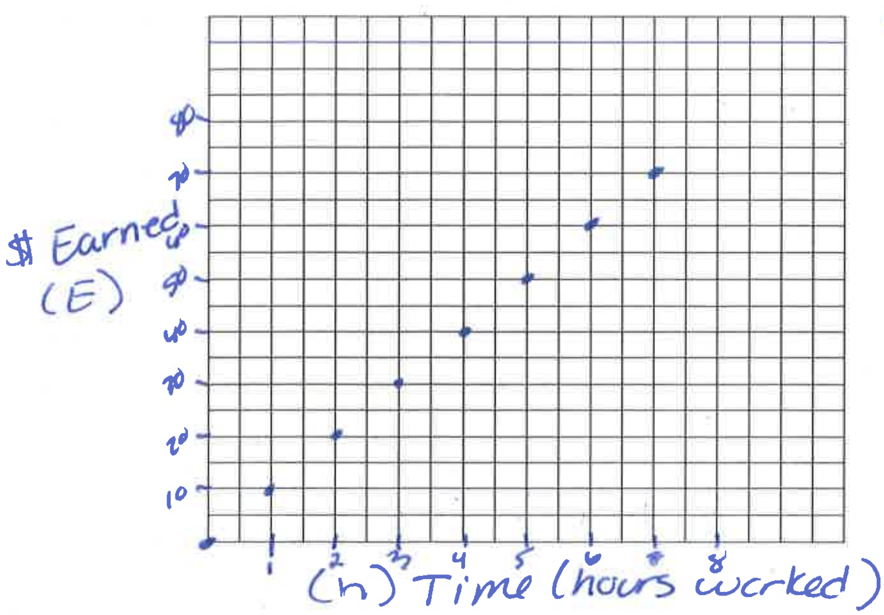
all x values.

step 1

1. Plot the relationship described above if the domain is {0,1,2,3,4,5,6,7}.

E	h
0	0
10	1
20	2
30	3
40	4
50	5
60	6
70	7

step 2



2. What is the shape of the graph you just plotted?

dots form a straight line

3. Is the relation $E = 10h$ a function?

Yes, no input value (h) produces more than one output value (E)

4. Which variable in the relation $E = 10h$ is the dependent variable

the amount you earn depends on how long you work for.
ie: 'E' is the dependant variable

recall Function = for any given x-value, there is only ever 1 y-value.

Hint: Time is always the indep. variable (x-axis)

"Table of Values"
used to find ordered pairs.

5. Challenge #1:

If $y = 3x$, find the missing values of y.

$y = 3x$	
x	y
-2	-6
-1	-3
0	0
1	3
2	6

Use substitution to complete the table of values.

$y = 3(-1) = -3$

$y = 3(0) = 0$

$y = 3(1) = 3$

$y = 3(2) = 6$

6. What name do we give the pairs of numbers in each row?

ordered pairs

7. Does $(-8, -24)$ satisfy the equation above.

x, y ① sub. ② check

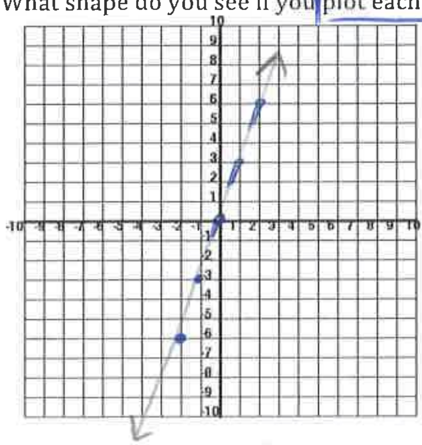
$y = 3x$
$y = 3(-8)$
$y = -24$

yes.

8. How many pairs of numbers are there that satisfy that equation?

an infinite number.

9. What shape do you see if you plot each of the pairs of numbers in the table above?



straight line.

Finding coordinates from an equation:

A **Table of Values** is a tool used to find ordered pairs from an equation.

$y = 3x$	
x	y

This is a table of values set up to find 5 ordered pairs for the equation $y = 3x$.

Step1: Select 5 *input* values of **x** and write them in the *x* column. Eg. -2,-1,0,1,2

Step2: Substitute them into the equation and solve to find the **y** value.

This is the completed table from above.

This gives us 5 ordered pairs:
$(-2,-6),(-1,-3)(0,0)(1,3)(2,6)$

$y = 3x$	
x	y
-2	-6
-1	-3
0	0
1	3
2	6

**I chose to input values of *x*, but I could have selected values of *y* and solved for *x (although I find that more difficult in this case).*

HW Q's. 10. Challenge #2: Using the *table of values*, graph the equation $y = 3x$ on the graph provided.

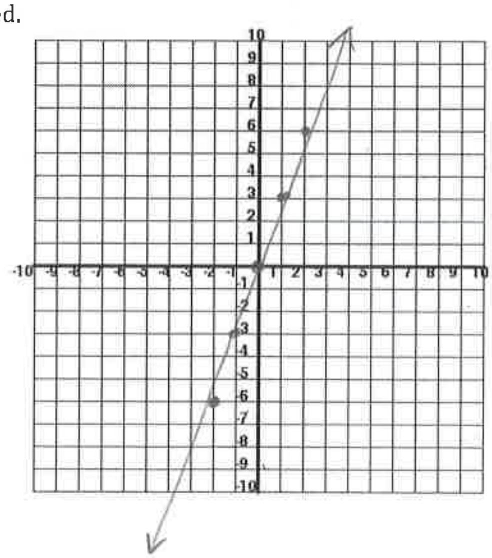
$y = 3x$	
x	y
-2	-6
-1	-3
0	0
1	3
2	6

$y = 3(-1) = -3$

$y = 3(0) = 0$

$y = 3(1) = 3$

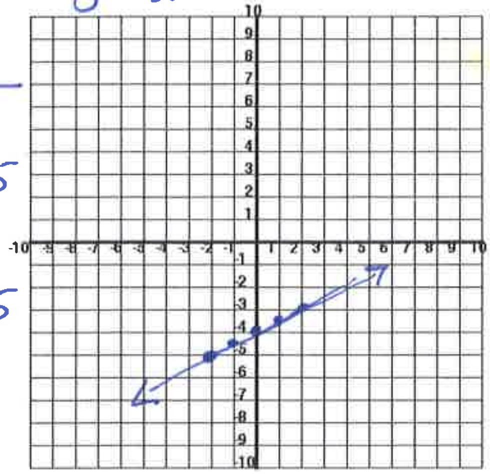
$y = 3(2) = 6$



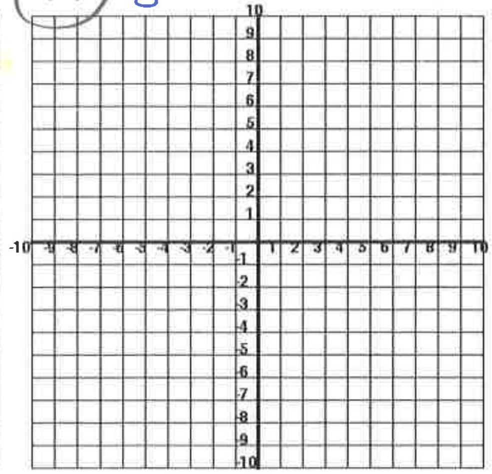
Use this page to graph Q's # 11–16.

11. $y = \frac{1}{2}x - 4.$

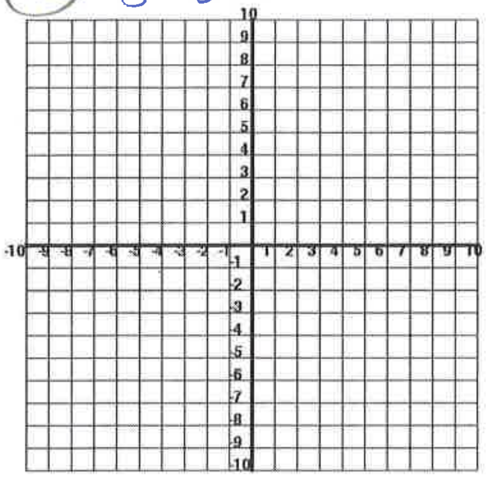
x	y
-2	-5
-1	-4.5
0	-4
1	-3.5
2	



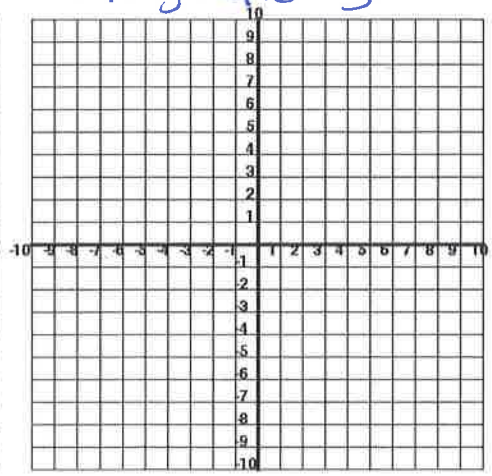
12. $y = 2x - 3$



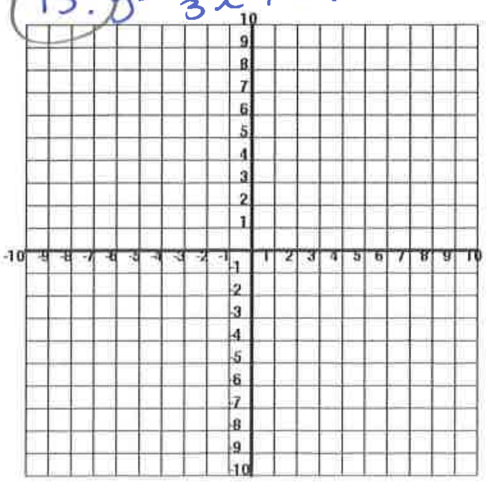
13. $y = \frac{3}{5}x + 4$



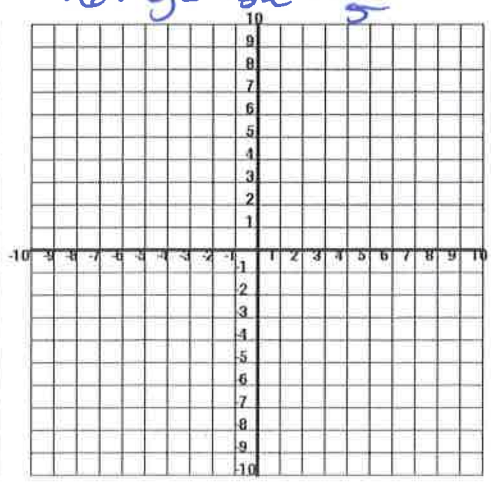
14. $y = \frac{2}{9}x - \frac{2}{3}$



15. $y = \frac{4}{3}x + 12$



16. $y = \frac{-4}{3}x + \frac{16}{5}$



Some Algebra Review:

When working with a table of values and linear equations, it is most useful to have 'y' isolated on the left.

Example:

$$2x + 3y = 12$$
$$3y = -2x + 12$$
$$y = -\frac{2}{3}x + 4$$

Plus graph #11 on prev. page as an example.

11. Isolate y.
$\cancel{2x} - 4y = 16$
$-\cancel{2x} \quad = -2x$
$\frac{-4y}{-4} = \frac{16 - 2x}{-4}$
$y = -4 + \frac{2}{4}x$
Simplify $\left(\frac{2}{4} = \frac{1}{2}\right)$
$\boxed{\therefore y = \frac{1}{2}x - 4}$

12. Isolate y.
$4y - 8x + 12 = 0$
$+8x \quad +8x$
$4y + \cancel{12} = 8x$
$-\cancel{12} \quad -12$
$\frac{4y}{4} = \frac{8x - 12}{4}$
$\boxed{y = 2x - 3}$

13. Isolate y.
$20 + 3x = 5y$
$\frac{5y}{5} = \frac{20 + 3x}{5}$
$y = 4 + \frac{3}{5}x$
or
$\boxed{y = \frac{3}{5}x + 4}$

14. Isolate y.
*multiply by a common denominator (LCM)
$6\left(\frac{1}{3}x - \frac{3}{2}y = 1\right)$
$\frac{6}{3}x - \frac{18}{2}y = 6$
$2\cancel{x} - 9y = 6$
$-2\cancel{x} \quad -2x$
$\frac{-9y}{-9} = \frac{6 - 2x}{-9}$
$y = \frac{-6}{9} + \frac{2}{9}x$
$\boxed{y = \frac{2}{9}x - \frac{2}{3}}$

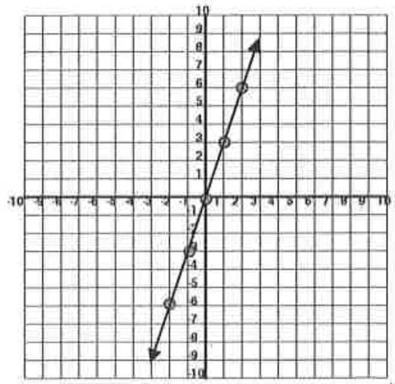
15. Isolate y.
$4\left(x - \frac{3y}{4} + 9 = 0\right)$
$4x - 3y + 3\cancel{6} = 0$
$-3\cancel{6} \quad -36$
$4\cancel{x} - 3y = -36$
$-4\cancel{x} \quad -4x$
$\frac{-3y}{-3} = \frac{-36 - 4x}{-3}$
$y = -12 + \frac{4}{3}x$
or
$\boxed{y = \frac{4}{3}x - 12}$

16. Isolate y.
$30 \times \left(\frac{2x}{3} + \frac{y}{2} - \frac{3}{5} = 1\right)$
$\frac{60x}{3} + \frac{30y}{2} - \frac{90}{5} = 30$
$20x + 15y - 1\cancel{8} = 30$
$+1\cancel{8} \quad +18$
$20\cancel{x} + 15y = 48$
$-20\cancel{x} \quad -20x$
$\frac{15y}{15} = \frac{48 - 20x}{15}$
$y = \frac{48}{15} - \frac{20x}{15}$
$\boxed{y = \frac{-4}{3}x + \frac{16}{5}}$

Graphing from a Table of Values.

Using the *table of values*, graph the equation $y = 3x$ on the graph provided.

$y = 3x$	
x	y
-2	-6
-1	-3
0	0
1	3
2	6



Step1: From the table of values we get the following ordered pairs.
$(-2,-6), (-1,-3), (0,0), (1,3), (2,6)$

Step2: Plot each of the ordered pairs.

Step3: Draw a line through the points with arrows on each end.

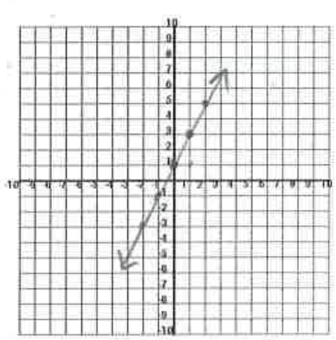
(examples done previously #11).

Use the table of values, if necessary, to graph each of the following equations.

complete

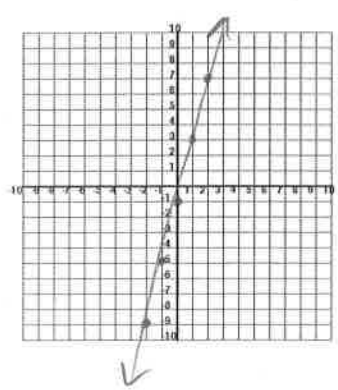
17. $y = 2x + 1$

$y = 2x + 1$		
x	y	
-2	-3	2(-2)+1
-1	-1	2(-1)+1
0	1	2(0)+1
1	3	2(1)+1
2	5	2(2)+1



18. $y = 4x - 1$

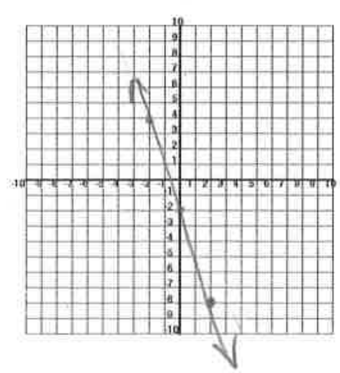
$y = 4x - 1$		
x		
-2	-9	4(-2)-1
-1	-5	4(-1)-1
0	-1	
1	3	4(1)-1
2	7	4(2)-1



19. $3x + y = -2$

$y = -3x - 2$

$3x + y = -2$		
x	y	
-2	4	-3(-2)-2
-1		
0	-2	
1		
2	-8	-3(2)-2



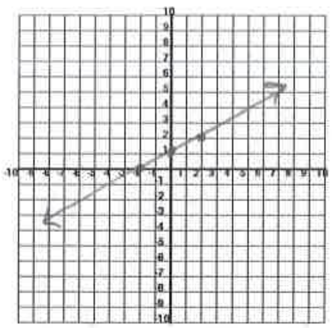
Use the table of values, **if necessary**, to graph each of the following equations.

20. $y = \frac{x}{2} + 1$

$y = \frac{x}{2} + 1$		
x	y	
-2	0	$-\frac{2}{2}+1$
-1	-1.5	$-\frac{1}{2}+1$
0	1	$\frac{0}{2}+1$
1	1.5	$\frac{1}{2}+1$
2	2	$\frac{2}{2}+1$

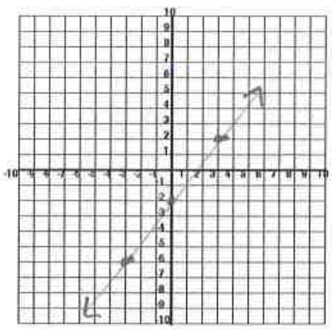
*all (+) slope

↑ L to R



21. $y = \frac{4}{3}x - 2$

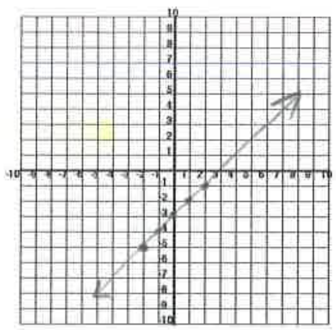
$y = \frac{4}{3}x - 2$		
x	y	
-3 $\cancel{-2}$	-6	$\frac{4}{3}(-3)-2$
-1		
0	-2	
1		
3 $\cancel{2}$	2	$\frac{4}{3}(3)-2$



22. $y + 3 = x$

$y = x - 3$

$y + 3 = x$		
x	y	
-2	-5	-2-3
-1	-4	-1-3
0	-3	0-3
1	-2	1-3
2	-1	2-3



23. $2x + 3y = 12$

$3y = 12 - 2x$

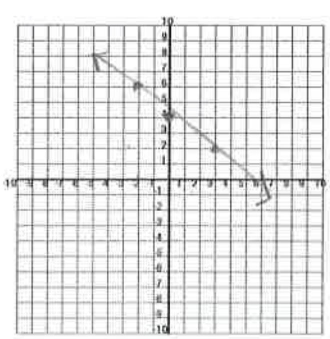
$y = 4 - \frac{2}{3}x$

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

neg. (−) slope

↓ L to R.

$2x + 3y = 12$		
x	y	
-3	6	$-\frac{2}{3}(-3)+4$
0	4	(intercept)
3	2	

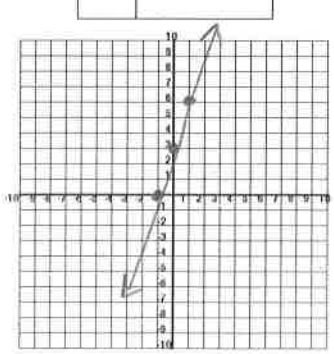


24. $3\left(\frac{1}{3}y - x = 1\right)$

$y - 3x = 3$

$y = 3x + 3$

$y =$	
x	y
-1	0
0	3
1	6



25. $5\left(\frac{2y}{5} - 2 = x\right)$

$2y - 10 = 5x$

$\frac{2y}{2} = \frac{5x + 10}{2}$

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

$y =$	
x	y
-2	0
0	5
2	10