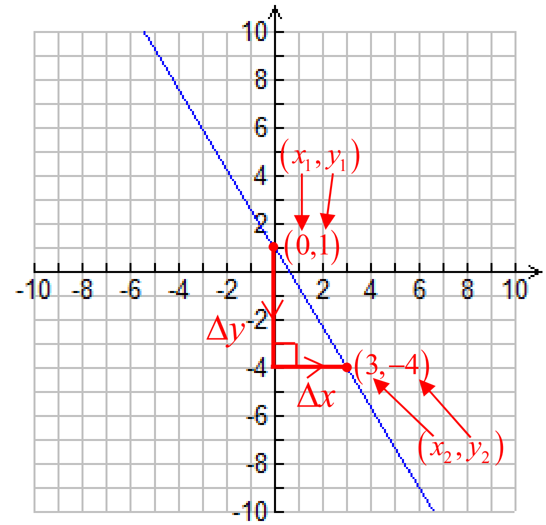
MPM1D9 Unit 4 – Linear Relations

Introduction – What you Should Already Know

Slopes, Intercepts and their MEANINGS



1. The ***slope*** of a line is a measure of the line's ______________________.

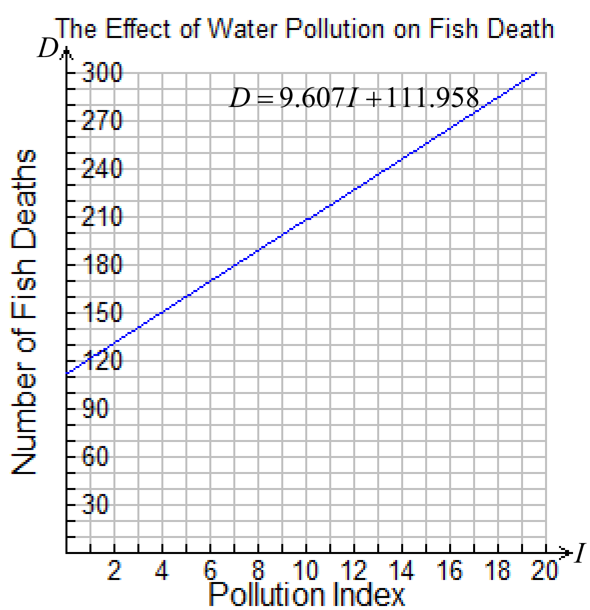
Slope also measures the ____________________________________ of the __________________________ variable ***with respect to*** the __________________________ variable. For example, in the graph shown at the right, slope $= m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-1}{3-0} = \frac{-5}{3}$. This ***means*** that for every ***increase*** in the independent variable ("x value") by ______ units, the dependent variable ("y value") ________________ by ______ units.

2. The ***y-intercept*** or ***vertical intercept*** is the y-co-ordinate of the point at which the graph _________________ the y-axis.

The ***meaning*** of the ***y-intercept*** is ____.

In the graph shown above, the line intersects the y-axis at the point with co-ordinates ________________ , which means that the ***y-intercept*** must be __________. The x-co-ordinate of the point at which the graph intersects the y-axis must be zero because ____.

Applications of Slopes and Intercepts



1. Fisherman in the Finger Lakes Region have been recording the dead fish they encounter while fishing in the region. The Department of Environmental Conservation monitors the pollution index for the Finger Lakes Region. The mathematical model for the number of fish deaths "D" for a given pollution index "I" is $D = 9.607I + 111.958$.

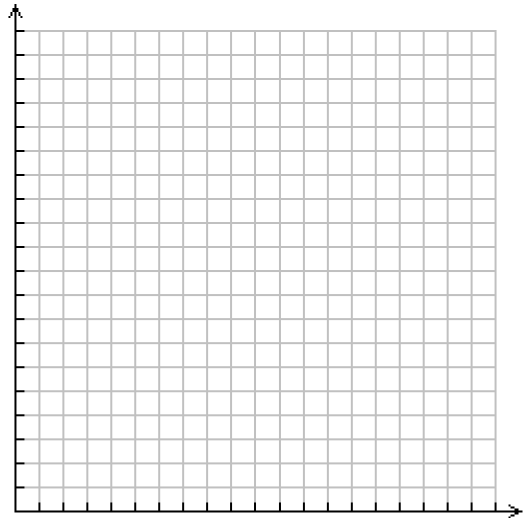
(a) Use the equation to identify the slope and the y-intercept of the given linear relation.

slope $= m =$ ___________ y-intercept $= b =$ ___________

(b) Mark the y-intercept on the graph. In addition, draw a right triangle that shows rise and run of the given line.

(c) What is the ***meaning*** of the y-intercept?

(d) What is the ***meaning*** of the slope? (**Hint:** slope = rate of change)



2. The *WeTalkALot* long distance company charges \$5.00 each month for its special \$0.05 per minute rate on long distance.

(a) Let C represent the total monthly long distance cost and let t represent the total number of minutes used for long distance calls. Write an equation that expresses C in terms of t.

(b) State the slope, y-intercept and their meanings.

slope = m = ________ **Meaning:** _________________________

y-intercept = b = ____ **Meaning:** _________________________

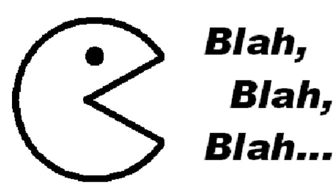
(c) Use the provided grid to sketch a graph of C versus t. Use a scale of 0 to 200 minutes for the horizontal axis and scale of 0 to 20 dollars for the vertical axis. Don't forget to label the axes!

(d) The *WeTalkEvenMore* long distance company charges \$7.00 per month for its special \$0.03 per minute rate on long distance. Using the same grid given above, sketch a graph of C versus t for *WeTalkEvenMore*.

(e) If you have sketched both graphs correctly, you should find that they intersect (cross) at approximately the point with co-ordinates $(100,10)$. Explain the ***meaning*** of this point of intersection.

(f) Under what circumstances is the *WeTalkALot* long distance plan a better deal? Under what circumstances is the *WeTalkEvenMore* plan a better deal?

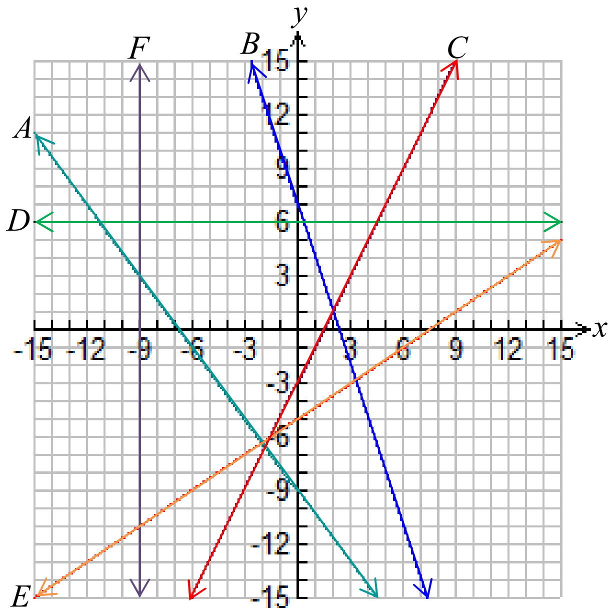
(g) The *BlahBlahBlah* long distance company offers a unique plan. Each month, the first 20 minutes are free but thereafter, the calls cost \$0.10 per minute. Using the same grid given above, sketch a graph of C versus t for *BlahBlahBlah*.



(h) If you have sketched the graph for *BlahBlahBlah* correctly, you will see that it has an ***x-intercept*** of 20. What is the meaning of the x-intercept?

(i) Under what circumstances is the *BlahBlahBlah* plan a better deal than either of the others?

EQUATIONS OF LINES – DISCOVERY ACTIVITY



1. Which of the lines shown at the left…

(a) …have ***positive*** slope? ______________________________

(b) …have ***negative*** slope? ______________________________

(c) …have ***zero*** slope? ______________________________

(d) …have ***undefined*** slope? ______________________________

2. Which line is steeper, …

(a) A or B? ______________________________

(b) E or C? ______________________________

(c) D or F? ______________________________

(d) A or C? ______________________________

(e) B or E? ______________________________

3. For each of the lines shown above, ***carefully select two points that lie on the line***. Then use those two points to calculate the slope of the line.
Important Note: Make sure that the points that you choose lie ***where two grid lines intersect***.

A. slope $= m = \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} =$ ______________ $=$

B. slope $= m = \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} =$ ______________ $=$

C. slope $= m = \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} =$ ______________ $=$

D. slope $= m = \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} =$ ______________ $=$

E. slope $= m = \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} =$ ______________ $=$

F. slope $= m = \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} =$ ______________ $=$

4. For each of the lines shown above, ***identify the y-intercept***.

A. y-intercept $= b =$ _______

B. y-intercept $= b =$ _______

C. y-intercept $= b =$ _______

D. y-intercept $= b =$ _______

E. y-intercept $= b =$ _______

F. y-intercept $= b =$ _______

5. For each of the lines shown above, ***write an equation in the form y = mx + b*** (i.e. slope-y-intercept form).

A. ________________________

B. ________________________

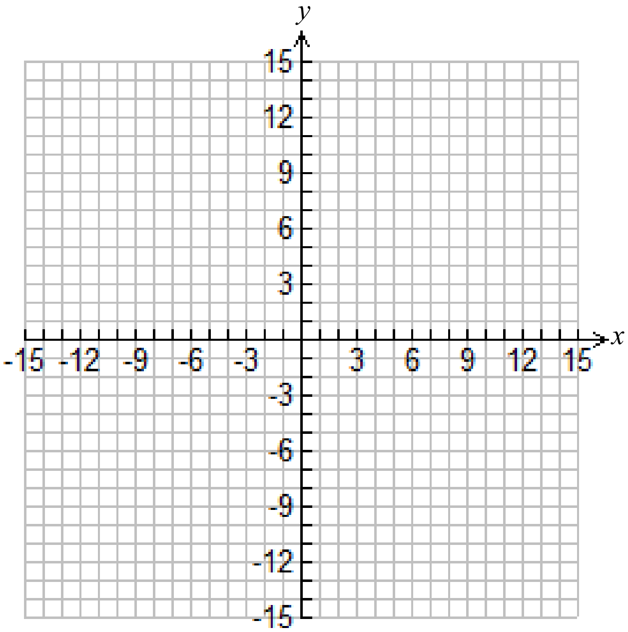
C. ________________________

D. ________________________

E. ________________________

F. ________________________

6. For each of the lines shown above, ***sketch a diagram showing both the rise and the run***. In each case, indicate the signs of Δx and Δy (i.e. whether the rise and run are positive or negative).



7. Use the provided grid to sketch lines passing through the point $(-3,4)$ and having…

(a) …a slope of $-\frac{2}{5}$. Label this line *A*.

(b) …a slope of $-\frac{5}{2}$. Label this line *B*.

(c) …a slope of $\frac{3}{7}$. Label this line *C*.

(d) …a slope of $\frac{7}{3}$. Label this line *D*.

8. Using your sketches, ***estimate*** the *y*-intercepts of each of the lines that you sketched in question 7.

A. $b \doteq$ __________ ***B.*** $b \doteq$ __________ ***C.*** $b \doteq$ __________ ***D.*** $b \doteq$ __________

9. Using the example given below for line *A* as a model, calculate the *y*-intercepts of each of the lines in question 7. Then write an equation of each line in the form $y = mx + b$. (This is called the **slope-*y*-intercept equation** of a line.)

A. Since the slope of this line is known to be $-\frac{2}{5}$, the equation of the line must be of the form $y = -\frac{2}{5}x + b$. It's also given that the point $(-3,4)$ ***lies on the line***. Therefore, ***the co-ordinates of this point must satisfy the equation***. This means that when the values of *x* and *y* are substituted into the equation, the left-hand side ***must agree with*** the right-hand side.

$$4 = -\frac{2}{5}\left(\frac{-3}{1}\right) + b$$

$$\therefore 4 = \frac{6}{5} + b$$

$$\therefore \frac{4}{1} - \frac{6}{5} = \frac{6}{5} + b - \frac{6}{5}$$

$$\therefore \frac{20}{5} - \frac{6}{5} = b$$

$$\therefore \frac{14}{5} = b$$

The slope-*y*-intercept equation of line *A* must be $y = -\frac{2}{5}x + \frac{14}{5}$.

B.

C.

D.

10. Carefully check your answers to questions 8 and 9. Summarize your results in the following table. If your answers to question 8 ***do not agree*** with your answers to question 9, then find out what went wrong and correct your mistakes!

$8A.\ b \doteq$ ____________	$8B.\ b \doteq$ ____________	$8C.\ b \doteq$ ____________	$8D.\ b \doteq$ ____________
$9A.\ b =$ ____________	$9B.\ b =$ ____________	$9C.\ b =$ ____________	$9D.\ b =$ ____________
Answers Agree? (Yes / No)	Answers Agree? (Yes / No)	Answers Agree? (Yes / No)	Answers Agree? (Yes / No)

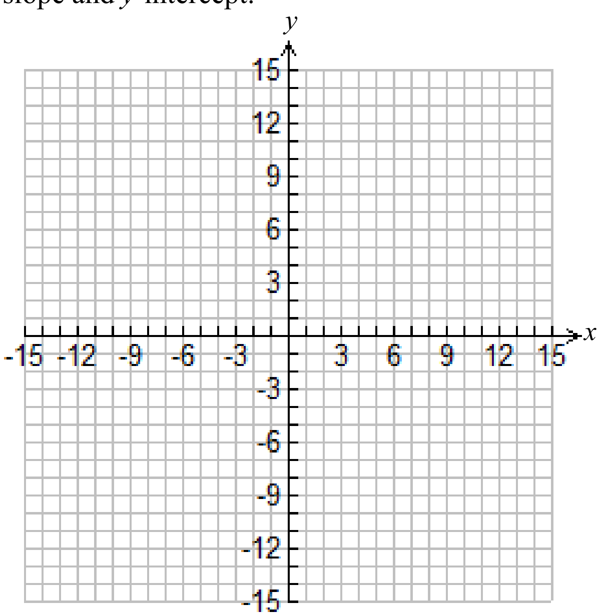
11. Consider the linear relation with slope-y-intercept equation $y = -\frac{3}{2}x - \frac{7}{2}$.

(a) Describe the relation in words. Specifically, what does the equation tell you about the ***relationship*** between the x-co-ordinate and the y-co-ordinate of any point that lies on the line?

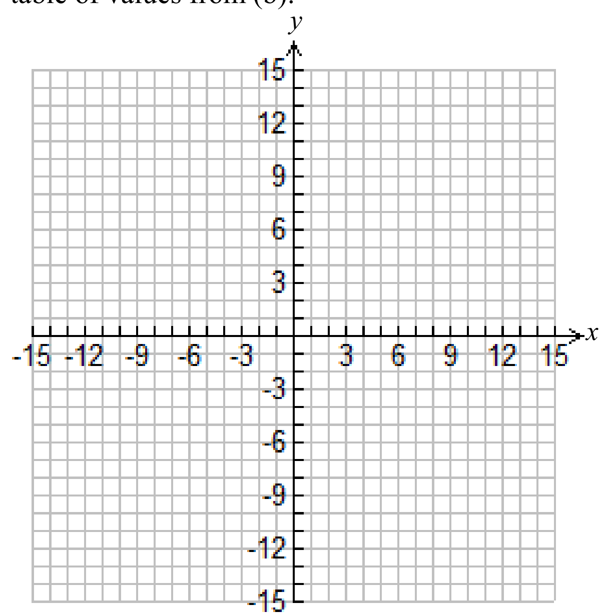
(b) Complete the following table of values:

x	$y = -\frac{3}{2}x - \frac{7}{2}$
-5	
-3	
-1	
0	
1	
3	
5	

(c) Sketch the graph of $y = -\frac{3}{2}x - \frac{7}{2}$ using ***only*** the slope and y-intercept.



(d) Sketch the graph of $y = -\frac{3}{2}x - \frac{7}{2}$ using ***only*** the table of values from (b).



(e) Check carefully to ensure that the graphs in (c) and (d) are identical. If they are, then check with some classmates to see if your graphs agree.

If all the graphs agree, then they are probably correct. If any do not agree, then check your work and correct any mistakes.

(f) Summarize what you have learned from exercises 7 to 11.

12. In this question you will explore various forms of equations for linear relations. The forms that you need to know are summarized in the table given below.

Slope-y-intercept Form	***Standard Form***	***"Modified" Standard Form***
$y = mx + b$ m and b are ***constants*** representing the ***slope*** and ***y-intercept*** respectively **e.g.** $y = -3x - 5$ slope $= m = -3$, y-intercept $= b = -5$	$Ax + By + C = 0$ ($A > 0$, no fractions) A, B and C are ***constants*** that ***do not by themselves*** represent geometric features of the graph **e.g.** $2x - 5y - 3 = 0$ $A = 2, B = -5, C = -3$	$Ax + By = C$ ($A > 0$, no fractions) A, B and C are ***constants*** that ***do not by themselves*** represent geometric features of the graph **e.g.** $2x - 5y = 3$ $A = 2, B = -5, C = 3$
Advantage Very easy to sketch the graph. **Disadvantage** Cannot be used with lines that have an undefined slope.	**Advantage** Can be used even if slope is undefined. **Disadvantage** More difficult to sketch the graph.	**Advantage** Can be used even if slope is undefined. **Disadvantage** More difficult to sketch the graph.

(a) Use your knowledge of rearranging equations to write $y = -\frac{3}{2}x - \frac{7}{2}$ in standard form. (**Hint:** Eliminate the fractions first!)

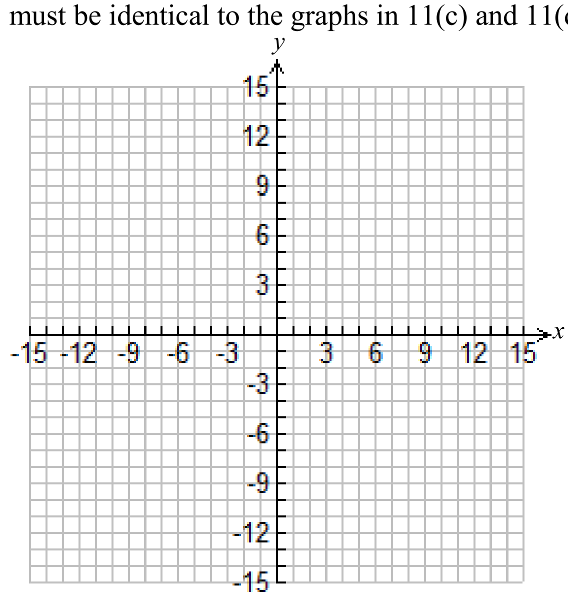
(b) Check your answer to (a) by completing the following table of values.

x	y (Calculated using $y = -\frac{3}{2}x - \frac{7}{2}$)	y (Calculated using the equation in standard form obtained in (a))
−4	5/2	
−2	−1/2	
0	−7/2	
2	−13/2	
4	−19/2	

(c) By now you should have the correct answer to (b). Rewrite the equation in the form $Ax + By = C$. Then use the equation to complete the following table. Show all your work!

x	y
0	
	0

(d) Use the table in (c) to sketch the graph. Your graph must be identical to the graphs in 11(c) and 11(d).



(e) Use the first two columns of the table in (b) to explain why the relation ***must be*** linear.

Writing Equations of Lines in Standard Form and Slope-Intercept Form

Definitions

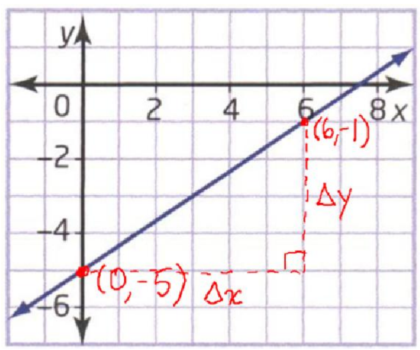
Slope-y-intercept Form	*Standard Form*
$y = mx + b$ m and b represent the ***slope*** and ***y-intercept*** respectively. **e.g.** $y = -3x - 5$ slope $= m = -3 = \frac{-3}{1}$, y-intercept $= b = -5$ **Meaning of the Slope:** The y-co-ordinate (dependent variable) decreases by 3 units for every increase of 1 unit in the x-co-ordinate (independent variable). **Meaning of the y-intercept:** The y-co-ordinate is −5 when the x-co-ordinate is zero.	$Ax + By + C = 0$ • $A > 0$ • If possible, A, B and C should be integers (i.e. no fractions) A, B and C are ***constants*** that ***do not by themselves*** represent geometric features of the graph. However, A, B and C are related to m and b. **e.g.** $2x - 5y - 3 = 0$ $A = 2, B = -5, C = -3$

Note: "Slope-y -Intercept Form" is also called "Slope-Intercept Form"

Examples

1. Write the equation of each line in both ***slope-y-intercept*** form and ***standard*** form.

(a)



Solution

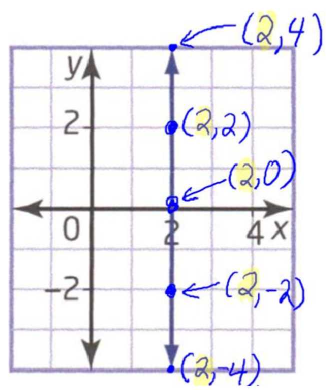
Since $(0,-5)$ lies on the line, $b = -5$

Since $(6,-1)$ also lies on the line,

$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-(-5)}{6-0} = \frac{4}{6} = \frac{2}{3}$$

Therefore, the ***slope-y-intercept form*** of the equation is $y = \frac{2}{3}x - 5$.

(b)



Solution

Since both m and b are undefined, it is not possible to write the equation of a vertical line in slope-y-intercept form.

However, it is possible to write the equation of this line in standard form. Observe that any point on the line has x-co-ordinate 2 but there is no restriction at all on the y-co-ordinate. Therefore, the equation turns out to be extremely simple:

$$x = 2$$

This equation simply means that the *x*-co-ordinate must be 2. Since y does not appear in the equation, it is understood that *y* can have any value.

To make this equation conform to the format of the standard form in can be written as follows:

$$1x + 0y - 2 = 0$$

Continuation of Example 1(a)

To write $y=\frac{2}{3}x-5$ in ***standard form***, use the same techniques that you used to rearrange (manipulate) formulas:

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

$$\therefore 3y=\frac{3}{1}\left(\frac{2}{3}x\right)-3(5) \quad \text{(Multiply both sides by 3.)}$$

$$\therefore 3y=2x-15$$

$$\therefore 3y-2x+15=2x-15-2x+15$$

$$\therefore -2x+3y+15=0$$

$$\therefore -1(-2x)+(-1)(3y)+(-1)(15)=-1(0)$$

$$\therefore 2x-3y-15=0$$

This is ***almost*** in standard form. The only problem is that the coefficient of x is negative.

To write the equation with a positive coefficient of x, simply multiply both sides by -1.

The standard form of the equation is $2x-3y-15=0$.

2. Write the equation $5x-7y+3=0$ in slope-y-intercept form.

Solution

The goal is to isolate y. Once again, use the techniques that you learned to rearrange equations.

$$5x-7y+3=0$$

$$\therefore 5x-7y+3-5x-3=0-5x-3$$

$$\therefore -7y=-5x-3$$

$$\therefore \frac{-7y}{-7}=\frac{-5x}{-7}-\left(\frac{3}{-7}\right) \quad \text{(Divide both sides by } -7\text{.)}$$

$$\therefore y=\frac{5}{7}x+\frac{3}{7}$$

Homework

pp. 312 – 314 # 1, 3, 4, 5, 6, 8, 10, 11

Artwork by *Daniel Dhillon*

PRACTICE is the key to success in mathematics and just about anything else that is meaningful and worthwhile. So do your homework every day, ask questions about anything that you do not understand and do your best to ***understand the meaning*** of all the concepts that you learn.

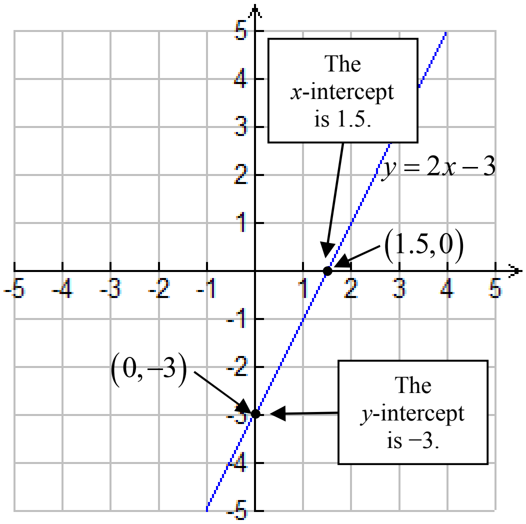
If you choose to do otherwise, the consequences are too frightening to contemplate!

MUHAHAHAHAHAHAHAHAHAHAHAHA!

Using Intercepts to Sketch the Graphs of Linear Relations

Example 1

Determine the ***intercepts*** of the linear relation with equation $y = 2x - 3$.



Solution

Because the equation is given in the form $y = mx + b$, we can immediately conclude the following:

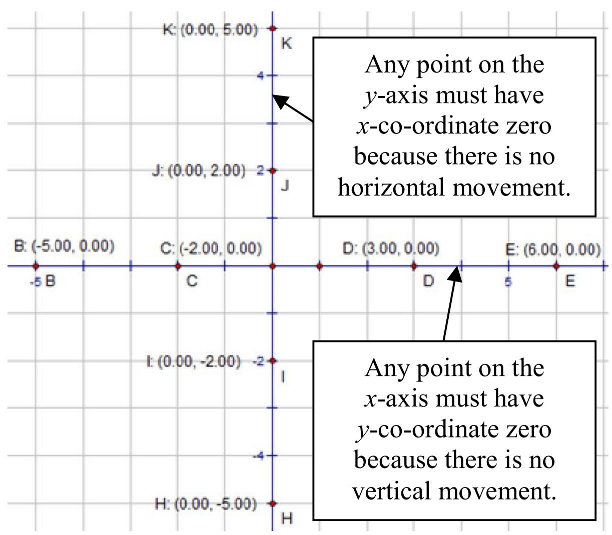
slope $= m = 2$ **y-intercept** $= b = -3$

However, the $y = mx + b$ form of the equation does not directly tell us what the x-intercept is. From the graph, it ***appears*** that the x-intercept is 1.5 but this is only an estimate.

The equation can be used to calculate the ***exact value*** of the x-intercept but first, it is necessary to understand the following important principle:

Any point lying on the x-axis must have a y-co-ordinate of zero!

(In addition, any point lying on the y-axis must have an x-co-ordinate of zero. We don't need this at the moment to calculate the x-intercept but we will need it later to calculate the y-intercept when the equation is given in a form other than the slope-y-intercept form.)



Therefore, to find the x-intercept, we simply set $y = 0$ and solve for x:

If $y = 0$ then

$$0 = 2x - 3$$
$$\therefore 3 = 2x$$
$$\therefore \frac{3}{2} = \frac{2x}{2}$$
$$\therefore x = \frac{3}{2}$$

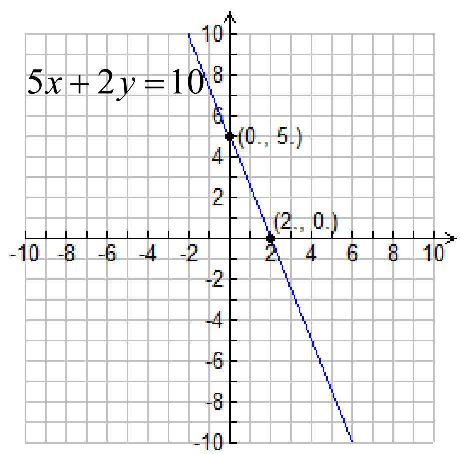
Therefore, the x-intercept is $\frac{3}{2} = 1.5$ (agrees with estimate) and the y-intercept is -3. (Of course, this means that the line intersects the x-axis at the point with co-ordinates $\left(\frac{3}{2}, 0\right)$ and the y-axis at the point with co-ordinates $(0, -3)$.)

Example 2

Use the intercepts of the linear relation $5x + 2y = 10$ to sketch its graph.

Solution

The graph of $5x + 2y = 10$ could be sketched by first rewriting the equation in slope-y-intercept form. However, there is a much faster approach!



x-intercept $\rightarrow y = 0$	y-intercept $\rightarrow x = 0$
$5x + 2y = 10$ $\therefore 5x + 2(0) = 10$ $\therefore 5x = 10$ $\therefore x = 2$ $\therefore (2, 0)$ lies on the graph	$5x + 2y = 10$ $\therefore 5(0) + 2y = 10$ $\therefore 2y = 10$ $\therefore y = 5$ $\therefore (0, 5)$ lies on the graph

Summary – Equations of Linear Relations

As shown below, equations of lines can be written in various forms. Regardless of the form, however, the equation must be satisfied by the co-ordinates of any point that lies on the line. That is, if (x, y) lies on the line, when the values of the x and y co-ordinates are substituted into the equation, the left and right sides of the equation must agree!

(a) Slope-*y*-intercept Form:	$y = mx + b$	m = slope = rate of change of y with respect to x = steepness b = y-intercept = vertical intercept = initial value = value of y when x = 0
(b) Standard Form:	$Ax + By + C = 0$	A, B and C do not directly represent any geometric features of the graph. However, m and b are related to A, B and C.
(c) "Modified" Standard Form:	$Ax + By = C$	

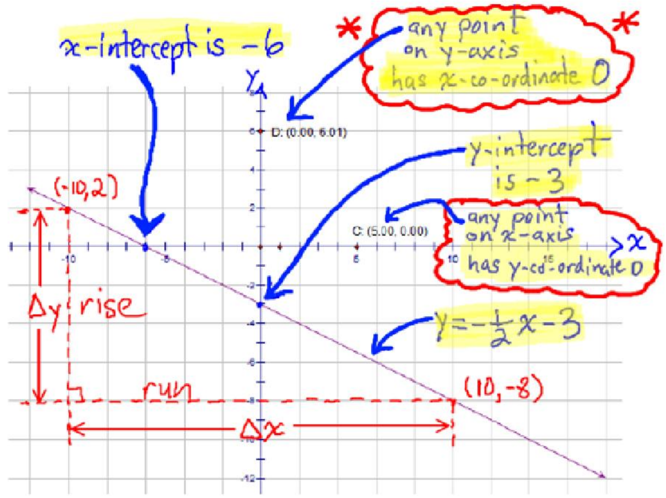
Homework

pp. 319 – 322 # C1, C2, C3, 3, 4, 5, 6, 7, 8, 9, 11, 13, 15

Mid-Unit Summary

Various Forms of Equations of Linear Relations

- $y = mx + b$ (slope-intercept)
  - slope: m; y-intercept: b
- $Ax + By + C = 0$ (standard form)
- $Ax + By = C$ (modified version of standard form)
  - useful for finding intercepts quickly



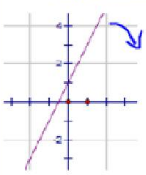
- $\text{slope} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-8-2}{10-(-10)} = \frac{-10}{20} = -\frac{1}{2}$
- the slope is readily seen from the equation: $y = -\frac{1}{2}x - 3$ (slope)
- the y-intercept is readily seen from the equation: y-intercept is -3
- the x-intercept can be calculated from the equation by noting that any point on the x-axis must have y-co-ordinate equal to zero

If $y = 0$ then $0 = -\frac{1}{2}x + 3$ (Multiply B.S. by -2)

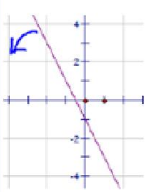
$\therefore 0 = x + 6$

$\therefore -6 = x$.

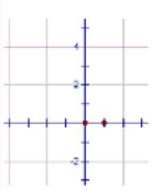
- Slope = rate of change



- positive slope
- positive rate of change → quantity increases as x increases (y-value or dep. var.)



- negative slope
- negative rate of change → quantity decreases as x increases



- zero slope
- zero rate of change → quantity does not change

Converting between Standard Form and Slope-Intercept Form

① Write $3x-5y+7=0$ in slope intercept form.

$3x-5y+7=0$ (subtract $3x$ from B.S.)

$\therefore -5y+7=-3x$ (subtract 7 from B.S.)

$\therefore -5y=-3x-7$

$\therefore \frac{-5y}{-5}=\frac{-3x}{-5}-\left(\frac{7}{-5}\right)$

$\therefore y=\frac{3}{5}x+\frac{7}{5}$

$\therefore$ in slope-intercept form, **the** equation is $y=\frac{3}{5}x+\frac{7}{5}$

② Write $y=-\frac{2}{3}x-\frac{5}{6}$ in standard form.

$y=-\frac{2}{3}x-\frac{5}{6}$

$\therefore 6(y)=\frac{6}{1}\left(-\frac{2}{3}x\right)-\frac{6}{1}\left(\frac{5}{6}\right)$

$\therefore 6y=-\frac{12}{3}x-\frac{30}{6}$

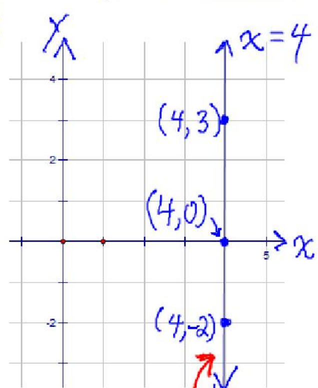
$\therefore 6y=-4x-5$ (add $4x$ and 5 to B.S.)

$\therefore 4x+6y+5=0$

$\therefore$ in standard form, **the** equation of the linear relation is $4x+6y+5=0$

Special Cases

①



All points on this line have the same x-co-ordinate (4)

$\therefore x=4$ is the equation of this line

In standard form this equation can be written

$1x+0y-4=0$

The equation cannot be written in the form $y=mx+b$.

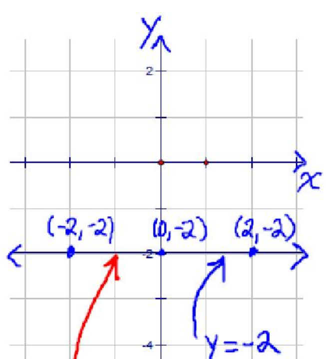
Vertical Lines

(a) Slope is undefined because $\Delta x=0$ regardless of points chosen on line

(b) Since slope = rate of change, rate of change is also undefined

(c) Equation CANNOT be written in the form $y=mx+b$ because m is undefined

②



All points on this line have the same y-co-ordinate (-2)

Horizontal Lines

(a) Slope = 0 since $\Delta y=0$ regardless of points chosen on line

(b) $\therefore$ rate of change = 0

(c) Equation can be written in the form $y=mx+b$

ie. $y=0x+b$

Practice: Consolodating your Skills

Why did Zorna Pour Ketchup on her Brother's Hand?

Why Did Zorna Pour Ketchup on Her Brother's Hand?

Complete the table for each equation. Find each answer in the code key and notice the letter next to it. Write this letter in the box at the bottom of the page that contains the circled number in that row of the table.

1 $y = -2x$

x	y	
1		1
4		2
−5		3
3		4

2 $y = 4 + 2x$

x	y	
3		5
−7		6
1		7
−3		8

3 $y = -3x + 1$

x	y	
3		9
−3		10
4		11
−2		12

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

x	y	
10		13
−2		14
4		15
−8		16

5 $y = -x + 6$

x	y	
4		17
−1		18
6		19
0		20

6 $y = -\frac{3}{2}x - 2$

x	y	
4		21
2		22
0		23
−2		24

7 $y = 7 - 3x$

x	y	
6		25
1		26
0		27
−2		28

8 $y = 1 - x$

x	y	
−2		29
−9		30
9		31
6		32

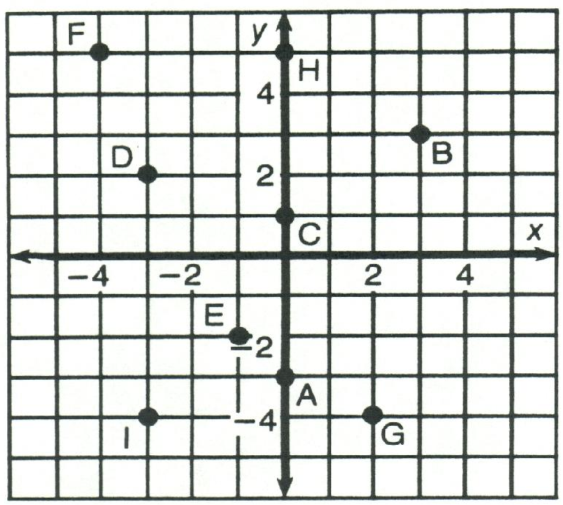
CODE KEY	
13	L
10	R
7	A
6	T
4	P
3	M
2	W
1	I
0	N
−2	H
−5	D
−6	B
−8	E
−10	O
−11	S

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

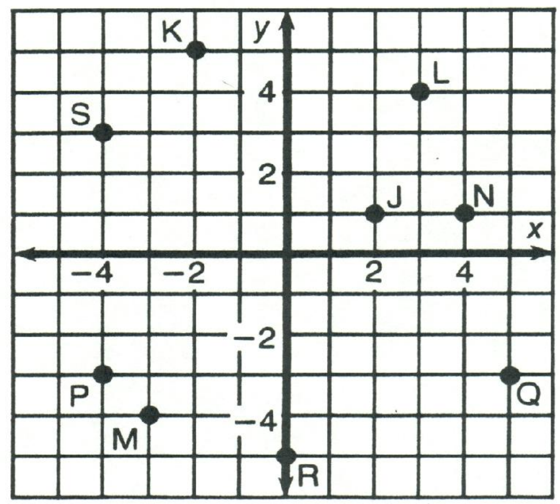
OBJECTIVE 5–c: To find ordered pairs that satisfy a linear equation and use them to graph the equation (equations are solved for *y*).

What Did the Ape Think of the Grape's House?

For each exercise, draw the line indicated and write its equation. Find your answer in the answer section and notice the two letters next to it. Print these letters in the two boxes at the bottom of the page that contain the number of that exercise.



1. Equation of $\overleftrightarrow{AB}$ __________
2. Equation of $\overleftrightarrow{CB}$ __________
3. Equation of $\overleftrightarrow{DE}$ __________
4. Equation of $\overleftrightarrow{FG}$ __________
5. Equation of $\overleftrightarrow{HI}$ __________



6. Equation of $\overleftrightarrow{JK}$ __________
7. Equation of $\overleftrightarrow{LM}$ __________
8. Equation of $\overleftrightarrow{NS}$ __________
9. Equation of $\overleftrightarrow{PQ}$ __________
10. Equation of $\overleftrightarrow{RQ}$ __________

Answers:

DE	$y = -\frac{1}{4}x + 2$	TT	$y = \frac{2}{5}x$	EA	$y = -2x + 3$
SA	$y = \frac{4}{3}x - 1$	NE	$y = \frac{2}{3}x + 1$	VI	$y = \frac{2}{5}x - 5$
TH	$y = -\frac{3}{2}x + 2$	OU	$y = -x + 3$	TH	$y = -2x - 4$
AS	$y = 2x - 3$	GH	$y = -\frac{3}{2}x - 1$	TI	$y = \frac{4}{3}x$
HE	$y = 3x + 5$	TW	$y = -3$	SH	$y = \frac{2}{3}x + 5$

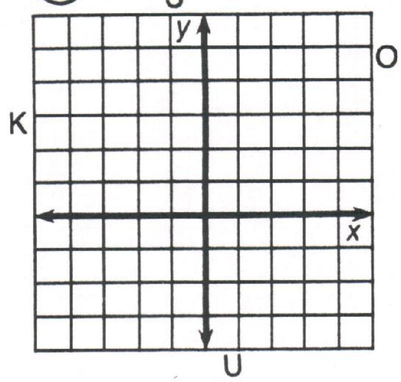
5	5	3	3	6	6	4	4	7	7	9	9	1	1	8	8	10	10	2	2

OBJECTIVE 5–i: To find an equation of a line given two points on the line (using the graph).

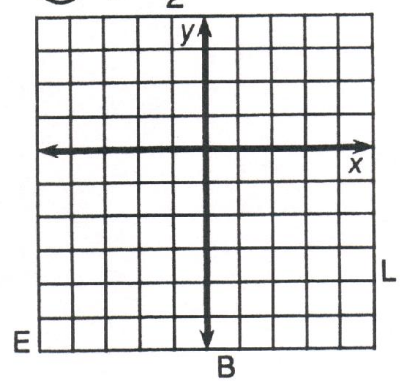
Whom Should You See at the Bank If You Need To Borrow Money?

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.

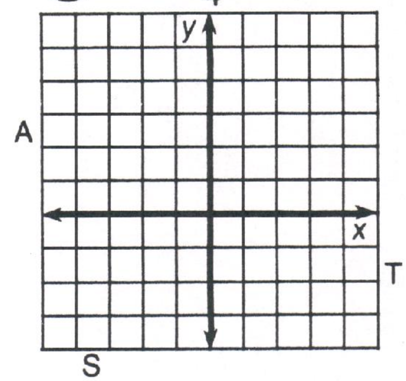
(1) $y = \frac{2}{3}x + 1$



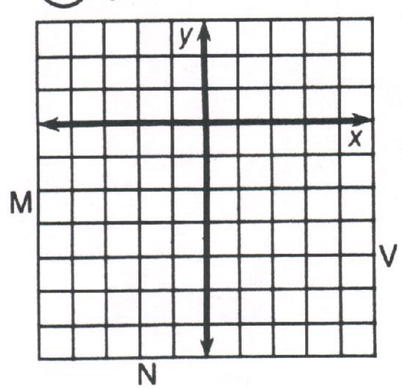
(2) $y = \frac{1}{2}x - 3$



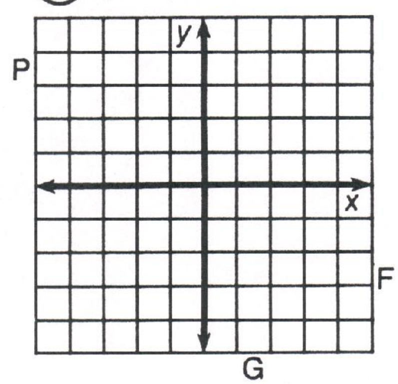
(3) $y = -\frac{3}{4}x + 2$



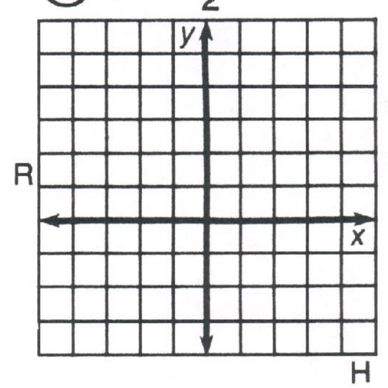
(4) $y = 2x - 4$



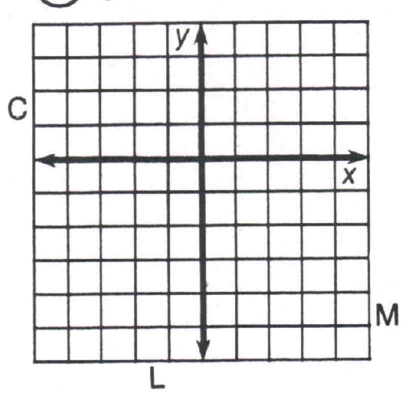
(5) $y = -3x - 1$



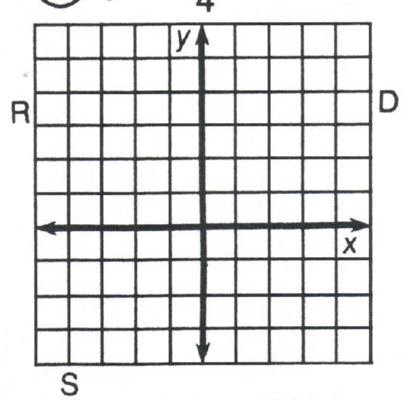
(6) $y = -\frac{3}{2}x + 3$



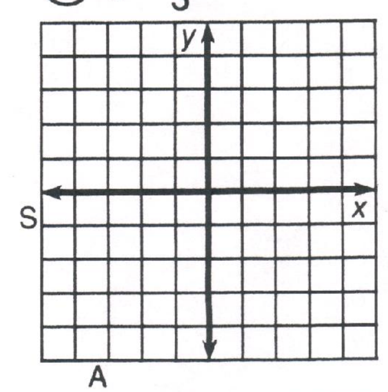
(7) $y = 4x - 2$



(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

OBJECTIVE 5–j: To graph a line given its equation in slope-intercept form.

Did You Hear About…

A	B	C	D	E	F
G	H	I	J	K	L ?

Answers for A–F:

$(2, 0); (0, -6)$	COW
$(2, 0); (0, 3)$	THE
$(4, 0); (0, -2)$	HIS
$(-3, 0); (0, 5)$	WHO
$(4, 0); (0, -3)$	DECIDED
$(2, 0); (0, -4)$	PET
$(2, 0); (0, -3)$	FARMER
$(-3, 0); (0, -5)$	NAMED

Find the *x*-intercept and the *y*-intercept of the graph of each equation below. Then find your answer in the answer column nearest the exercise and notice the word under it. Write this word in the box containing the letter of that exercise. Keep working and you will hear about a novel name.

A. $3x + 2y = 6$

B. $3x - 2y = 6$

C. $-5x + 3y = 15$

D. $5x + 3y = -15$

E. $x - 2y = 4$

F. $-2x + y = -4$

G. $2x + y = 5$

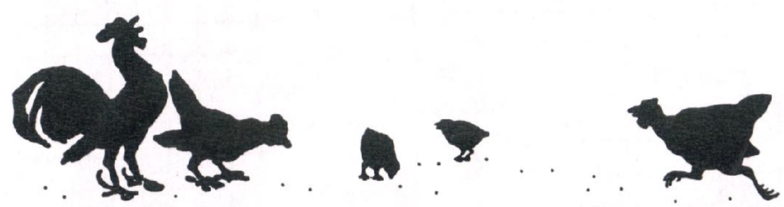
H. $-3x + 2y = 9$

I. $-x - 4y = 6$

J. $4x - 3y - 12 = 0$

K. $5y = 2x - 10$

L. $x = 2y - 3$



Answers for G–L:

$(-6, 0); (0, -\frac{3}{2})$	BECAUSE
$(-3, 0); (0, \frac{3}{2})$	SO
$(\frac{5}{2}, 0); (0, 5)$	ROOSTER
$(3, 0); (0, -4)$	IT
$(-3, 0); (0, \frac{9}{2})$	ROBINSON
$(-3, 0); (0, 3)$	CRACKED
$(5, 0); (0, -2)$	CREW
$(-6, 0); (0, -2)$	UP

OBJECTIVE 5–f: To find the *x*-intercept and the *y*-intercept of the graph of a linear equation and use them to graph the equation.

Review of Analytic Geometry and Relations

1. For a taxi ride, a Toronto taxi company charges $5.00 plus $1.50 per kilometre travelled.

(a) Complete the following table of values:

d = distance (km), C = cost ($)

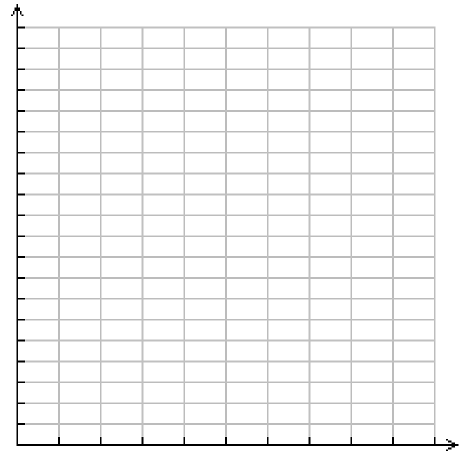
d	C	ΔC (1st differences)
0		–
10		
20		
30		
40		
50		

(b) Is this relation an example of direct variation or partial variation? Explain.

(c) Explain why the relation between C and d must be linear. In addition, state the slope and the y-intercept.

(d) Which variable is the dependent variable? Explain.

(e) Graph the relation.



(f) Write an equation, in the form $y = mx + b$, that relates C to d.

(g) Interpret the slope as a rate of change.

(h) Interpret the y-intercept as an initial value.

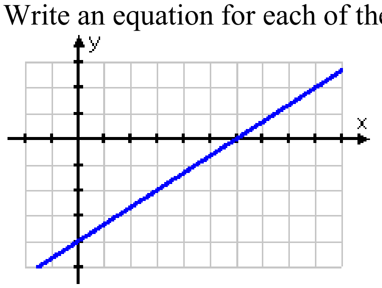
(i) Describe the relation between C and d in words.

(j) How much would it cost to take a 100 km taxi ride?

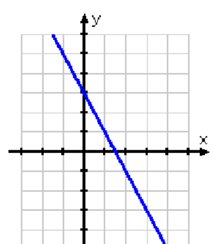
(k) Convert the equation that you obtained in (f) to standard form.

(l) Is there an easy way to determine the slope and y-intercept from the standard form of a linear relation?

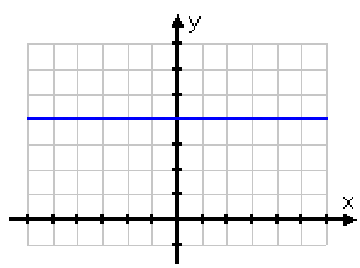
2. Write an equation for each of the following.



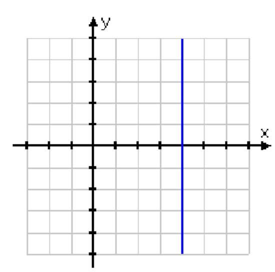
Positive Slope
Positive Rate of Change
As x increases, y increases.



Negative Slope
Negative Rate of Change
As x increases, y decreases.



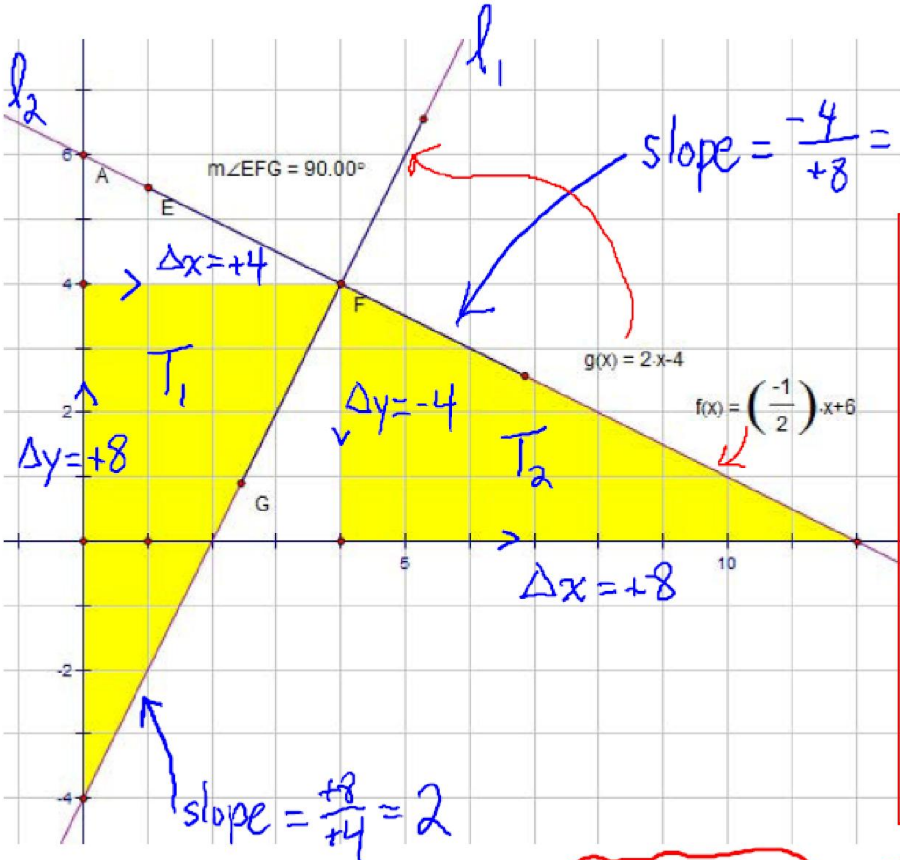
Zero Slope
Zero Rate of Change
As x increases, y is constant.



Undefined Slope
Undefined Rate of Change
x is constant, y varies freely.

Slopes of Parallel and Perpendicular Lines

How the Slopes of Perpendicular Lines are Related



Observations

① Lines are perpendicular

② slope of $l_1 = 2 = \frac{2}{1}$

slope of $l_2 = -\frac{1}{2}$

③ by rotating T_2 90° clockwise about F, T_1 is obtained

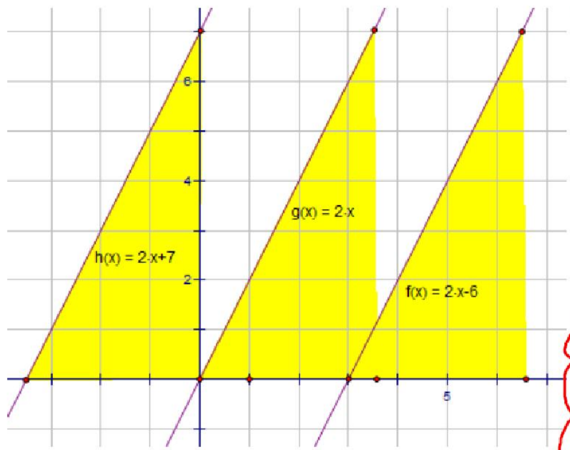
Conjecture (Hypothesis, Educated Guess)

The slopes of perpendicular lines are negative reciprocals of each other.

i.e. If $l_1 \perp l_2$ and the slope of l_1 is $\frac{a}{b}$ then the slope of l_2 must be $-\frac{b}{a}$

In fact, this conjecture is correct but its proof is a little beyond the scope of this course.

How the Slopes of Parallel Lines are Related



Observations

① The lines are parallel to each other

② The lines have the same slope

Conjecture

Parallel lines have the SAME slope

Example 1

The lines with equations $y=-\frac{2}{3}x+8$ and $y=kx-7$ are perpendicular to each other. Find the value of k.

Solution

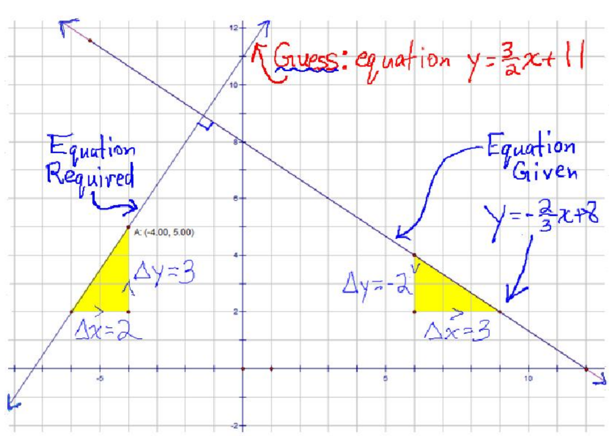
Since perpendicular lines have negative reciprocal slopes,

$$k = -\left(-\frac{3}{2}\right) = \frac{3}{2}$$

negative reciprocal

Example 2

Find an equation of the line passing through the point $(-4,5)$ and perpendicular to the line with equation $y=-\frac{2}{3}x+8$.



Solution

Required Line: $m=?$, $b=?$, passes through $(-4,5)$

From the result of the previous example, we can conclude that $m=\frac{3}{2}$. Thus, the equation of the line must be of the form $y=\frac{3}{2}x+b$. Since $(-4,5)$ ***lies on the required line, the co-ordinates of this point must satisfy the equation***. Therefore,

$$5=\frac{3}{2}\left(\frac{-4}{1}\right)+b$$
$$\therefore 5=-6+b$$
$$\therefore 5+6=-6+b+6$$
$$\therefore 11=b$$

The slope-y-intercept equation of the line must be $y=\frac{3}{2}x+11$.

Homework

pp. 328 – 329 # 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14

Introduction

To find the equation of a line, you need to know

(a) its slope

(b) co-ordinates of ANY point on the line

If you are given two points and you are not given the slope,

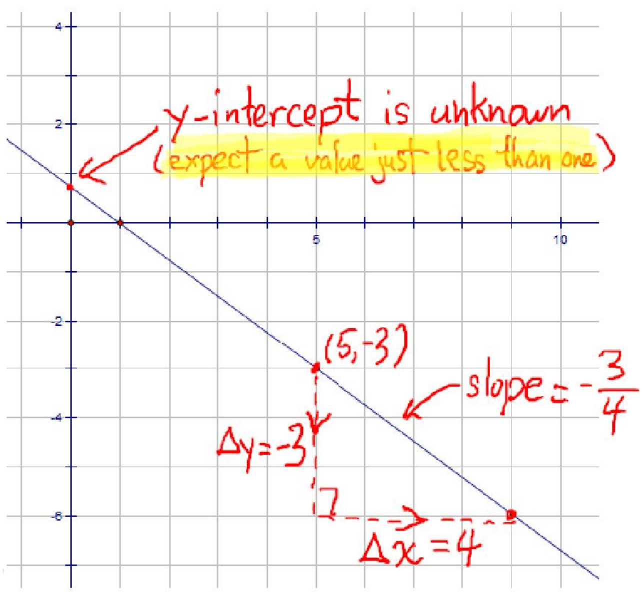
(a) use the two points to calculate the slope

i.e. slope $= \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$

(b) use either of the two given points

Examples

① Find an equation of the line with slope $-\frac{3}{4}$ and passing through the point $(5, -3)$



Solution $m = -\frac{3}{4}$, $b = ?$

The slope-intercept equation of the line must be of the form

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

Since $(5,-3)$ lies on the line, it must satisfy the equation

$\therefore\ -3 = -\frac{3}{4}\left(\frac{5}{1}\right) + b$

$\therefore\ -3 = -\frac{15}{4} + b$

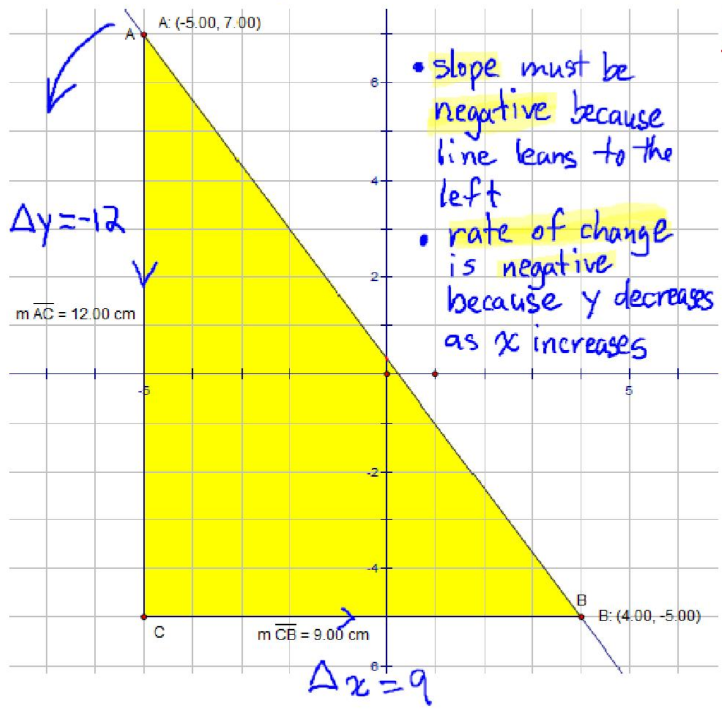
$\therefore\ \frac{-3}{1} + \frac{15}{4} = -\frac{15}{4} + b + \frac{15}{4}$

$\therefore\ -\frac{12}{4} + \frac{15}{4} = b$

$\therefore\ b = \frac{3}{4}$ (agrees with expected value)

$\therefore$ the slope-intercept equation of the given line is $y = -\frac{3}{4}x + \frac{3}{4}$

② Find an equation of the line passing through (-5, 7) and (4, -5).



- slope must be negative because line leans to the left
- rate of change is negative because y decreases as x increases

Solution $m = ?,\ b = ?$

$$\text{slope} = m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5-7}{4-(-5)} = \frac{-12}{9} = -\frac{4}{3}$$

$\therefore$ the slope-intercept equation of the line must be of the form

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

Since (4, -5) lies on the line, it must satisfy the equation.

$$\therefore\ -5 = -\frac{4}{3}\left(\frac{4}{1}\right) + b$$

$$\therefore\ -5 = -\frac{16}{3} + b \quad \left(\text{add } \frac{16}{3} \text{ to B.S.}\right)$$

$$\therefore\ b = \frac{-5}{1} + \frac{16}{3}$$

$$\therefore\ b = \frac{-15}{3} + \frac{16}{3} = \frac{1}{3} \quad \text{(agrees with graph)}$$

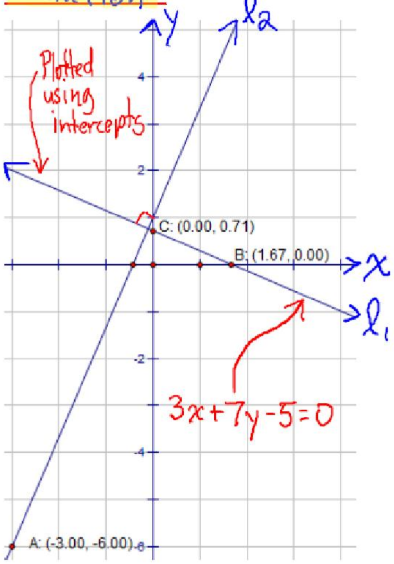
$$\therefore\ y = -\frac{4}{3}x + \frac{1}{3}$$

The slope-intercept equation of the line is $y = -\frac{4}{3}x + \frac{1}{3}$.

③ Find the equation of the line passing through $(-3,-6)$ and perpendicular to the line with equation $3x+7y-5=0$.

ℓ_1 – given line, ℓ_2 – required line

Solution



(a) Slope of Given Line

$$3x+7y-5=0$$
$$\therefore 7y = -3x+5$$
$$\therefore \frac{7y}{7} \quad \frac{-3x}{7} + \frac{5}{7}$$
$$\therefore y = -\frac{3}{7}x + \frac{5}{7}$$

Rough Work

x-int: $y=0$

$3x+7(0)-5=0$

$\therefore 3x=5$

$\therefore x=\frac{5}{3}$

y-int: $x=0$

$3(0)+7y-5=0$

$\therefore 7y=5$

$\therefore y=\frac{5}{7}$

(b) Slope of Required Line

Since $\ell_1 \perp \ell_2$ and slope of $\ell_1 = -\frac{3}{7}$, slope of $\ell_2 = \frac{7}{3}$ (slopes of perpendicular lines are negative reciprocals)

(c) Equation of Required Line

$m=\frac{7}{3}$, $b=?$

$\therefore$ the equation of the required line is of the form

$$y=\frac{7}{3}x+b$$

$\because$ $(-3,-6)$ lies on the required line, it must satisfy the equation

$$\therefore -6 = \frac{7}{\cancel{3}}\left(\frac{-\cancel{3}}{1}\right)+b$$
$$\therefore -6 = -7+b$$
$$\therefore b=1 \quad \text{(agrees with graph)}$$

$\therefore y=\frac{7}{3}x+1$ is the equation of the required line

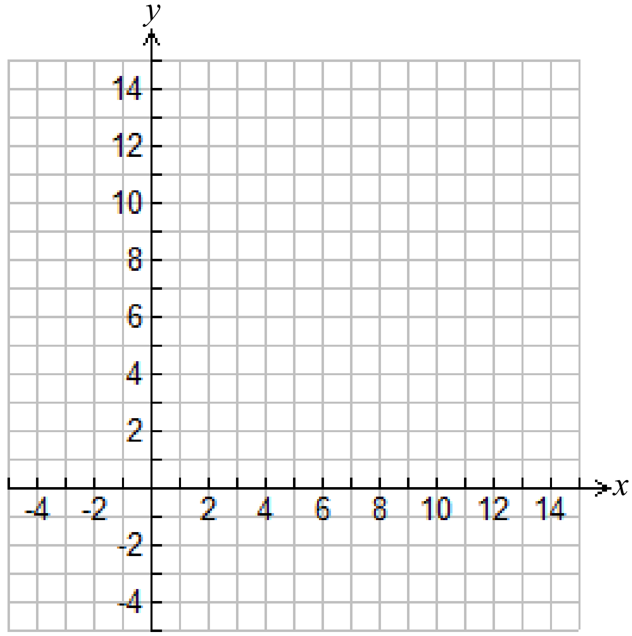
Homework

pp. 335 – 337 # C1, C2, 1, 2, 3, 4, 5, 6, 8, 11

pp. 342 – 343 # 1cd, 2, 3, 5, 6, 7, 9

IMPORTANT PROBLEM SET

1. Line A passes through the point $(9,9)$ and is ***perpendicular*** to the line with equation $9x+11y-99=0$.



(a) Using the provided set of axes, sketch the graph of $9x+11y-99=0$. The fastest approach is to use the intercepts method.

(b) On the same set of axes, carefully sketch the graph of line A. Make sure that line A passes through $(9,9)$ and that it is perpendicular to $9x+11y-99=0$.

(c) Use your sketch of line A to estimate its slope and y-intercept.

$m \doteq$ ______________ $b \doteq$ ______________

(d) Determine the ***exact*** slope of the line $9x+11y-99=0$. Show your work and state a conclusion.

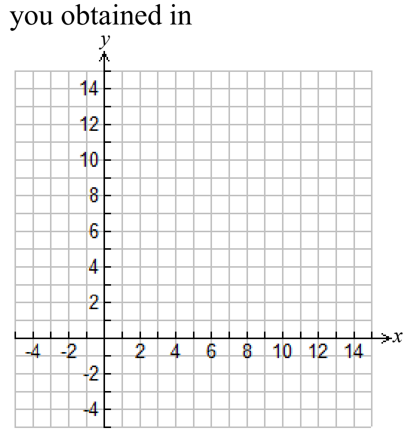
Therefore, the slope of $9x+11y-99=0$ is __________.

(e) Use your answer from (d) to determine the slope of line A.

For line A, $m =$ ______________ because ____.

(f) Use your answer from (e) and the fact that line A passes through the point $(9,9)$ to determine the equation of line A.

(g) Now check your answer to (f) by using the equation that you obtained in (f) to sketch the graph of line A. Does it agree with the graph that you obtained in



(h) Now summarize your results.

Estimates from (c)	***Actual Values from (f)***	***Conclusion(s): Is your equation for line A correct?***
$m \doteq$ ______________ $b \doteq$ ______________	$m =$ ______________ $b =$ ______________	

2. Line A passes through the point $(9,9)$ and is ***parallel*** to the line with equation $9x+11y-99=0$. Determine an equation of line A.

3. The equation $n-E+15=0$ describes the amount earned per hour in a certain factory. In this equation, E represents the amount earned per hour in dollars and n represents the number of years of experience.

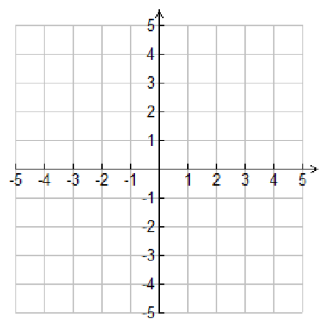
Calculate the hourly earnings of a beginning factory worker as well as one with five years of experience.

4. The equation $9C-5F+160=0$ describes the relationship between temperature, C, in degrees Celsius and temperature, F, in degrees Fahrenheit.

(a) Express the equation in the form $C=mF+b$.

(b) Explain the ***meaning*** of the slope and the vertical intercept.

5. Plot the points $A(1,1)$, $B(-2,-5)$ and $C(3,-2)$ to form ΔABC. Is ΔABC a right triangle? Justify your answer using ***mathematical reasoning***.



6. Given that A and k are one-digit numbers, determine the numbers of pairs of values for which the lines $Ax-3y+15=0$ and $y=kx+7$ are

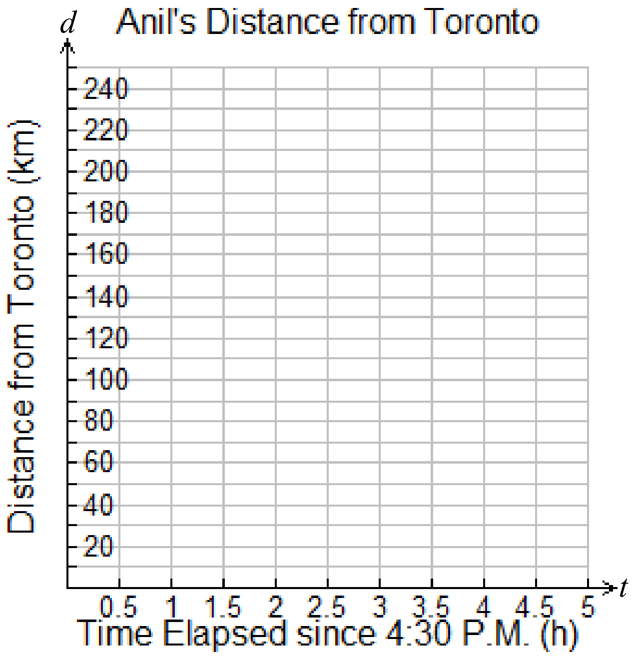
(a) parallel

(b) perpendicular

(c) coincident (the same line)

7. Anil is driving to his home in Toronto at a ***constant speed***. At 4:30 P.M., he spots a sign indicating that Toronto is 240 km away. At 7:00 P.M., he notices another sign indicating that Toronto is 40 km away.

(a) Plot a graph showing Anil's distance from Toronto versus time elapsed since 4:30 P.M.



(b) Do you expect the relation between distance from Toronto and time to be linear? Explain.

(c) Let t represent time in hours and d represent distance from Toronto in km. Write an equation relating d to t. Show all work!

(d) How fast is Anil travelling? Explain.

(e) Explain the ***meaning*** of the y-intercept of the graph in (a).

(f) Explain the ***meaning*** of the x-intercept of the graph in (a).

(g) At 5:45 P.M., ***how far*** from Toronto was Anil? Determine this by using both the graph and the equation. Make sure that your answers agree!

Estimate from Graph: ________________________

Exact Distance using Equation (Show all Work)

(h) ***At what time*** did Anil arrive in Toronto? Determine this by using both the graph and the equation. Make sure that your answers agree!

Estimate from Graph: ________________________

Exact Time using Equation (Show all Work)

(i) Anil was rushing home to Toronto because he did not want to miss watching the Maple Leafs lose yet another game. If the opening faceoff was to take place at 7:45 P.M., did Anil make it home in time? Explain.

Definition

Definition

A system of two linear equations in two unknowns must satisfy the following conditions

(a) there are two linear equations in two unknowns (say x and y)

(b) the solution of the system must satisfy BOTH equations

Example 1

Solve the following system of linear equations

$$\begin{cases} x+2y=7 & ① \\ y=4x-10 & ② \end{cases}$$

Solution

Graph each line and find point of intersection

① Find intercepts

x-int: $y=0$

$x+2(0)=7$

$\therefore x=7$

y-int: $x=0$

$\therefore 0+2y=7$

$\therefore 2y=7$

$\therefore y=\frac{7}{2}$

② $y=4x-10$ Use slope and y-int

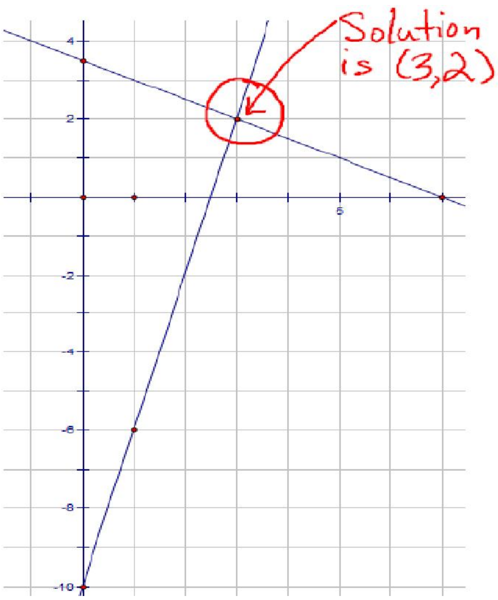
slope $=4$

y-int $=-10$

Plot point $(0,-10)$

slope $=\frac{\text{rise}}{\text{run}}=\frac{4}{1}$

Use this to find another point. (up 4, right 1)



From the graph, we can see that the point of intersection is $(3,2)$. Therefore, the solution is $x=3$, $y=2$

Check:

① $x+2y=7$

L.S. $=3+2(2)$
$=3+4$
$=7$
$=$ R.S.

$\therefore$ L.S. $=$ R.S.

② $y=4x-10$

L.S. $=2$

R.S. $=4(3)-10$
$=12-10$
$=2$

$\therefore$ L.S. $=$ R.S.

$\therefore$ solution is correct

Example 2

Company A charges \$0.10/minute for cell phone service. Company B charges \$0.05/minute plus a flat rate of \$20 for cell phone service. Let C represent total cost, t represent airtime

a) Write an equation that represents the cost of purchasing cell phone service from Company A.

$C = 0.10t$ slope = 0.10 = rate in \$/min (\$0.10/min)
y-int = 0 = initial cost

b) Write and equation that represents the cost of purchasing cell phone service from Company B.

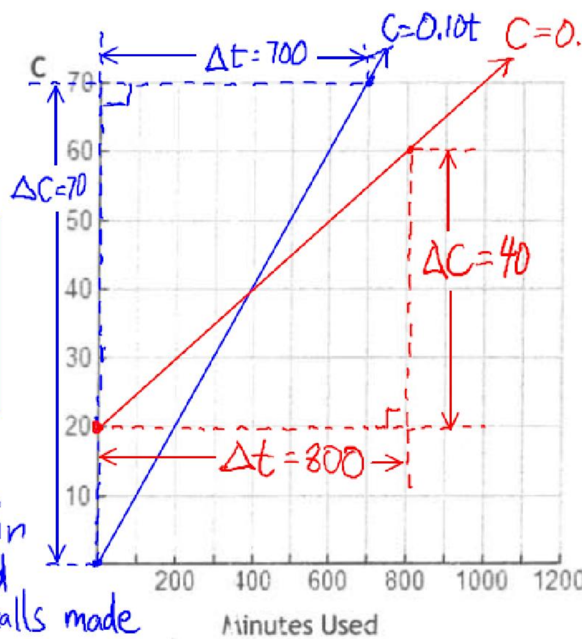
$C = 0.05t + 20$ slope = 0.05 = rate in \$/min (\$0.05/min)
y-int = 20 = initial cost

c) Graph both equations from part a) and b) on the same set of axis below.

Company A
- slope = 0.10
- y-intercept = 0

Company B
- slope = 0.05
- y-intercept = 20

Meaning
- slope = rate in \$/min
- y-int = amount paid if no phone calls made



	Company *A*	Company *B*
t	$C = 0.10t$	$C = 0.05t + 20$
0	0	20
100	10	25
200	20	30
300	30	35
400	40	40
500	50	45
600	60	50
700	70	55
800	80	60

d) State the point of intersection of the two lines.

(400, 40)

e) What does the point of intersection mean in this situation?

The point of intersection represents the point at which both plans have the same cost. Specifically, for either plan if 400 minutes of airtime are used, the cost is \$40. If fewer than 400 minutes of airtime are used, Company A's plan is a better deal. If more than 400 minutes of airtime are used, Company B's plan is a better deal.

Solving Systems of Two Linear Equations in Two Unknowns – Applications

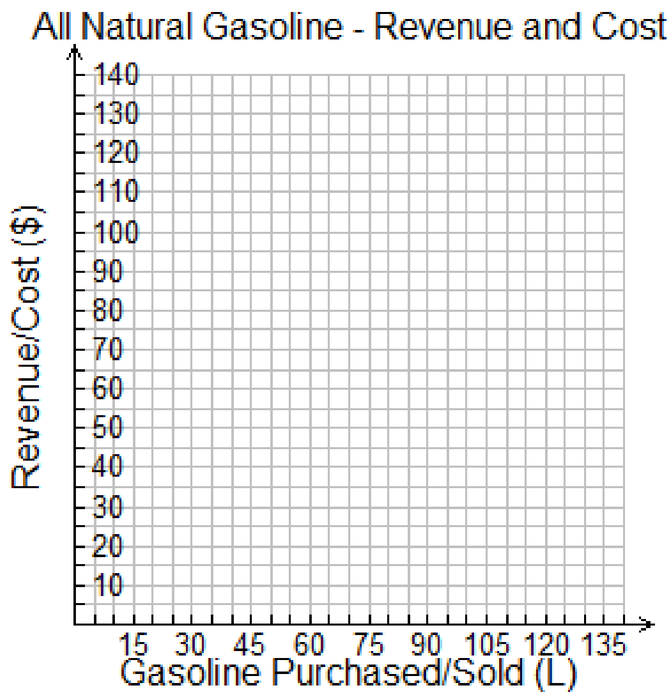
Problem 1

All Natural is a gas station that charges customers $1.00 per litre of gas. It costs All Natural $0.50 per litre plus a flat fee of $20 to obtain gas from their oil supplier.

a) Write an equation that represents the cost for All Natural to obtain gas from the supplier.

b) Write an equation that represents the revenue All Natural earns from selling gas to customers.

c) Graph both equations from part a) and b) on the same set of axes below.



d) State the point of intersection of the two lines.

e) What does the point of intersection ***mean*** in this situation?

f) By looking at the graph, determine if All Natural will make money or lose money if 100 L of gas are sold. What is the profit/loss?

g) By using the equations in part a) and b), determine if All Natural will make money or lose money if 60 litres of gas are sold.

h) Will All Natural make money or lose money if 20 litres of gas are sold? You may use the graph or the equations to find your answer.

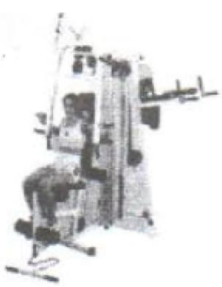
i) **Conclusions:**

If fewer than ________ litres of gas are sold, All Natural will have a ________________.

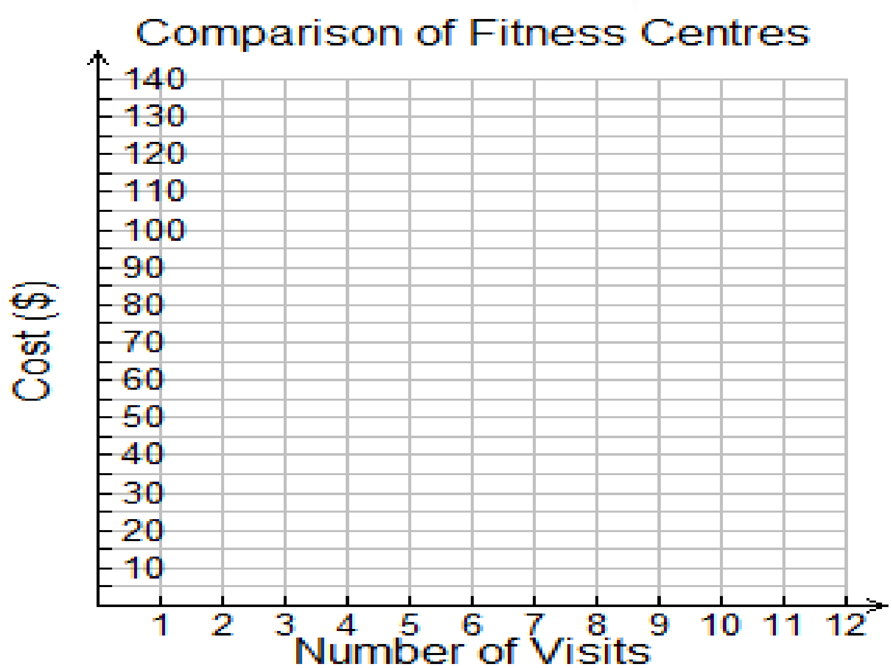
If exactly ___________ litres of gas are sold, All Natural will ________________.

If more than ___________ litres of gas are sold, All Natural will have a ________________.

Problem 2

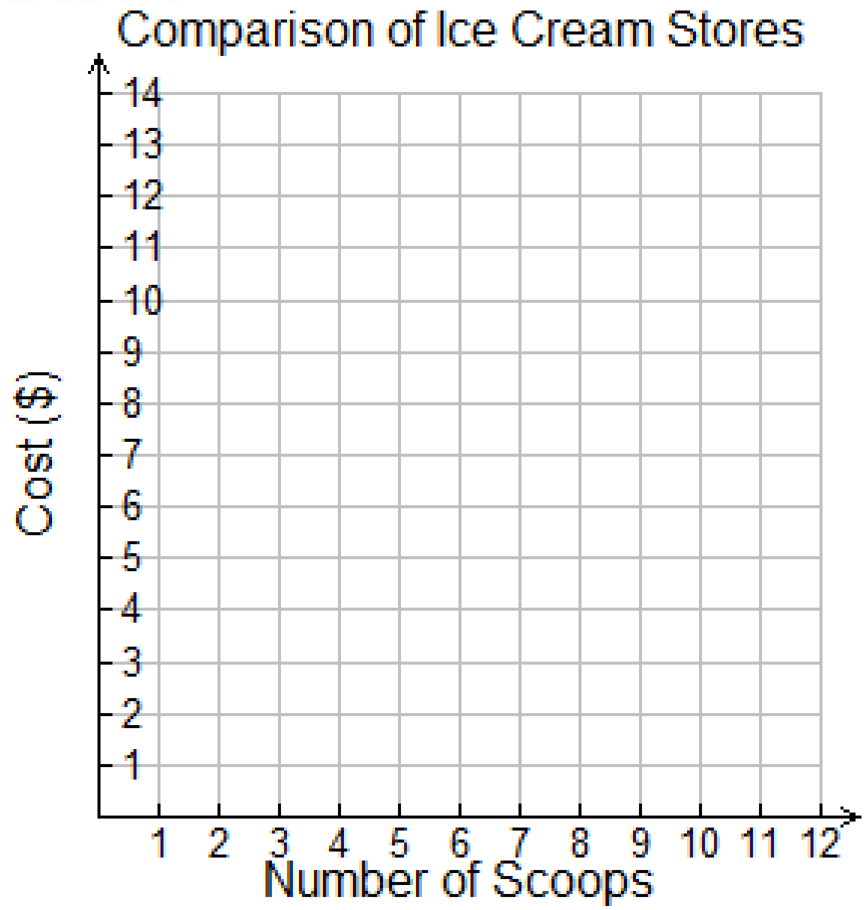


Fitness Centre A charges an annual membership fee of $50 plus $5 for each visit. **Fitness Centre B** charges an annual membership fee of $25 plus $10 for each visit. How would you decide which fitness centre to join? Use the grid below to do your analysis.



Problem 3

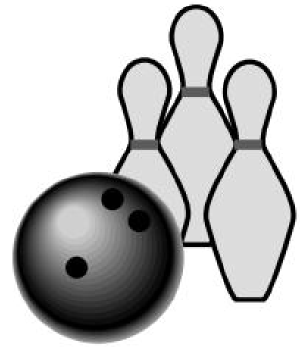
Pure Dairy charges $2 for a scoop of ice cream (cone included). **Cones 'R Us** charges $2 for a scoop of ice cream plus an additional $1 for the cone. How would you decide where to buy your ice cream? Use the grid below to do you analysis.



Homework
pp. 348 – 351 # C2, 1, 2, 3, 7, 9, 10, 11, 14, 15

Task 1: Bowling

Task 1: Bowling!



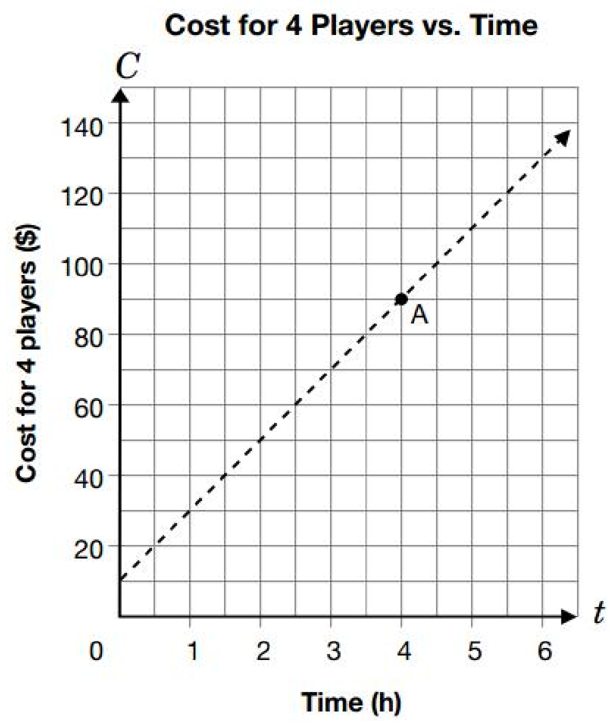
A group of 4 friends is going bowling at **Bowling Bonanza.**
Bowling Bonanza charges

- \$2.50 for each player to rent shoes
  plus
- \$20/h for a group of 4 to bowl.

a) The graph below represents the relationship between cost, C, in dollars, and time, t, in hours, for 4 players to bowl.

i) **Write the coordinates** of point A.

ii) **Explain** what the coordinates of point A tell you about the cost of bowling.



b) **Explain** how this graph would change if the cost for renting the shoes increased.

c) **Circle** the equation that represents the graph in question **a)**.

$C = 20t + 10$ $\qquad$ $C = 20t^2 + 10$ $\qquad$ $C = \dfrac{20}{t} + 10$

d) This group of friends wants to spend $80.
How many hours can they bowl at **Bowling Bonanza?**
Give reasons for your answer or **show your work.**

e) William **and** his 3 friends are going bowling.
He finds an advertisement in the newspaper for a new bowling alley, **Super Bowl.**
William and his friends will play **6** games in 3 hours.

Determine whether William and his friends should go bowling at **Bowling Bonanza** or **Super Bowl.** Use the information given in the advertisement and in the hint box.

Give reasons for your answer.

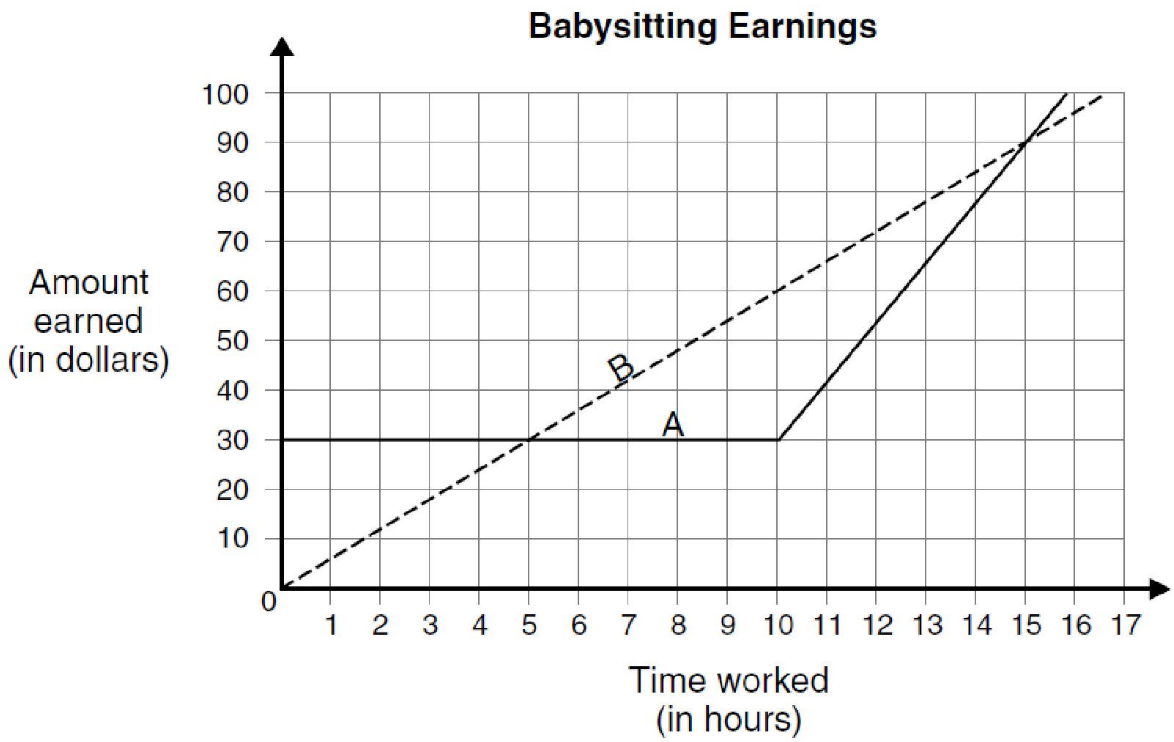
Hint:
Bowling Bonanza charges
- $2.50 for each player to rent shoes and
- $20/h for a group of 4 to bowl.

Task 2: Babysitters' Club

Nadia and Lisa are comparing their **weekly earnings** from babysitting. The following graph shows their earnings compared to the number of hours they worked in the week.

a) Lisa says:
"If we both work **less than 5 hours** or **more than 15 hours**, I earn more than you do."

Label Lisa's line with her name. Write Nadia's name on the other line.



b) Describe what the graph shows about how each girl is paid for her week of work. Include specific mathematical details about hourly rates of pay.

c) Sana also offers babysitting in the home. She lives on the edge of town and travels by bus to the home where she babysits.

Sana charges a family a set fee of **$15.00 per week** to cover her bus pass **plus an additional $4.00 per hour**.

Draw the graph for Sana's earnings on the graph in question **a)**. Label your line.

d) Your neighbour needs a babysitter for 12 h this week.
How much would each of the three girls charge for this 12 h of babysitting?
Show your work or explain how you get each answer.

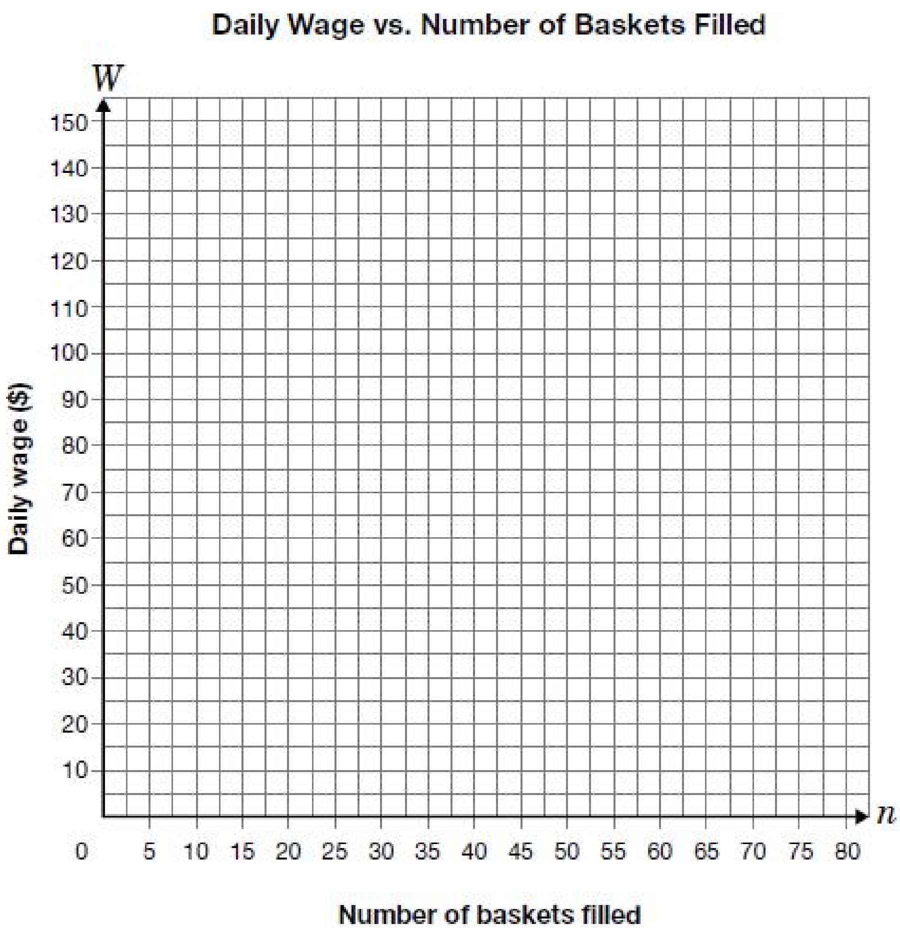
e) Several neighbours have inquired about babysitters. Some require a lot of hours of babysitting per week while others require very few hours. They have asked you which of the babysitters charges the least. What would your answer be?
Explain your reasoning. Be specific about the time intervals.

2. Berries for Picking

Sanya has a summer job picking berries at a farm. Each day, she is paid a base salary, plus an amount for each basket she fills with berries.

The equation $W = 15 + 1.25n$ represents the relationship between Sanya's **daily wage, W,** in dollars, and the **number of baskets** she fills, n.

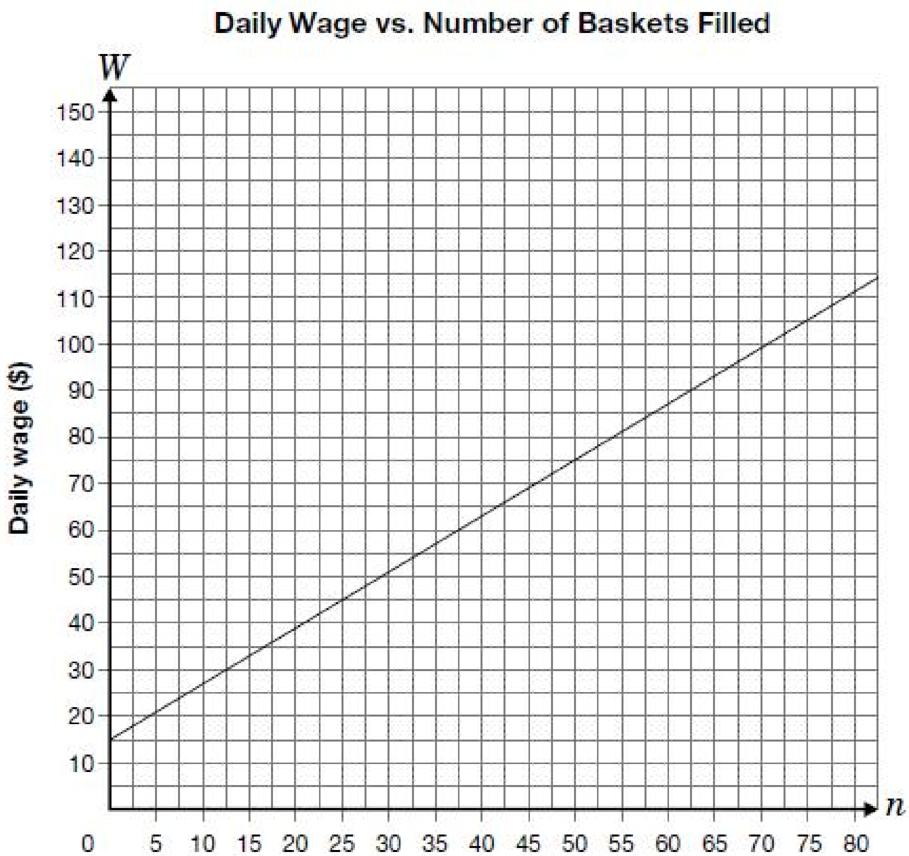
a) Graph the relationship represented by the equation on the grid below.



b) Explain what the **slope** of the line means in relation to picking berries.

c) Determine **the number of baskets** that Sanya must fill to have a daily wage of **$70.** Show your work.

d) Sanya's brother picks cucumbers at another farm. His payment structure is represented on the graph below.



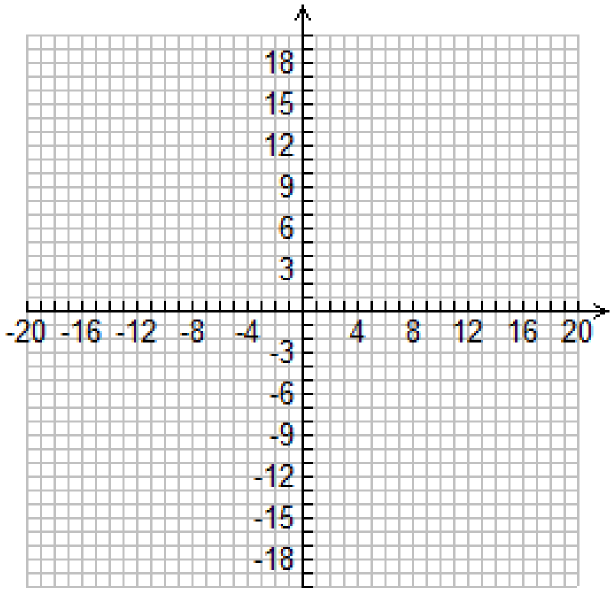
He is offered a **new** payment structure of $2.00 per basket but **no daily base salary.**

Should Sanya's brother accept this new payment structure?
Explain your answer.

VERY IMPORTANT REVIEW OF LINEAR RELATIONS

1. Find an equation of the line with ***slope 6*** and having ***x-intercept −8***.

(a) Make a sketch and use it to ***estimate*** the equation of the required line.

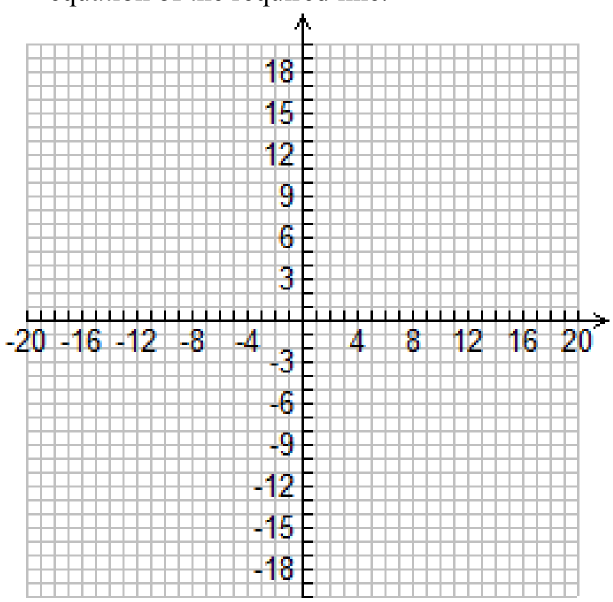


Estimate of Equation:______________________

(b) Use an algebraic method to find the ***exact*** equation of the required line.

2. Find an equation of the line that passes through (–5, 0) and (5, 6).

(a) Make a sketch and use it to ***estimate*** the equation of the required line.

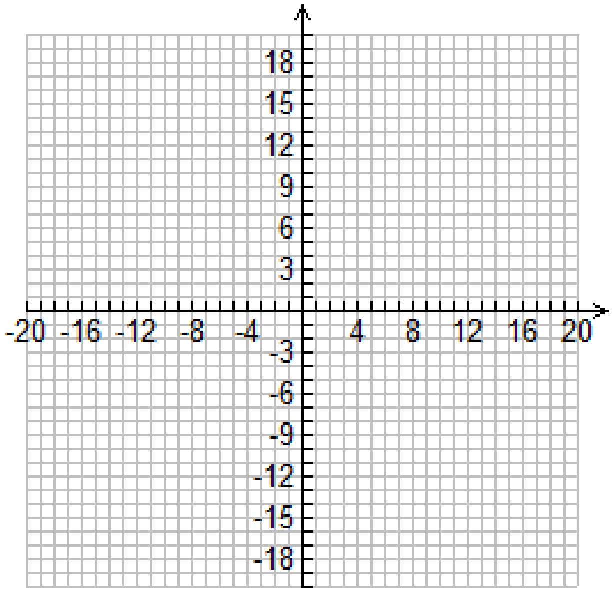


Estimate of Equation:______________________

(b) Use an algebraic method to find the ***exact*** equation of the required line.

3. A line is parallel to $5x + 2y - 8 = 0$ and has the same y-intercept as $x + 4y - 12 = 0$. Find an equation of the line.

(a) Make a sketch and use it to ***estimate*** the equation of the required line.

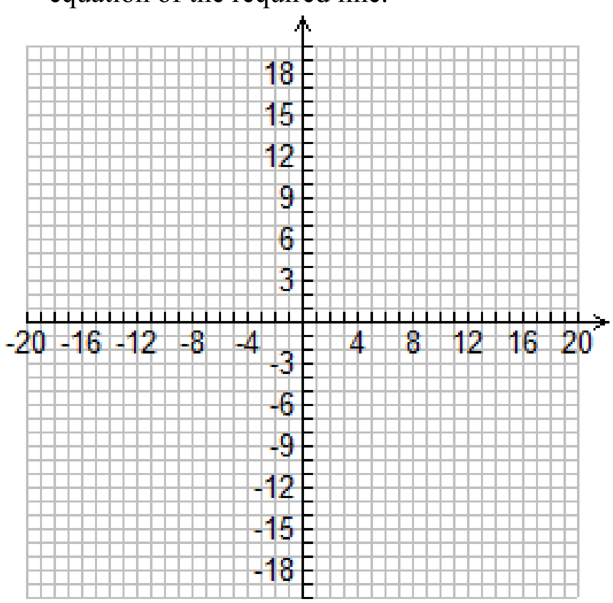


Estimate of Equation:______________________

(b) Use an algebraic method to find the ***exact*** equation of the required line.

4. A line is perpendicular to $x + 3y - 4 = 0$ and has the same y-intercept as $2x + 5y - 20 = 0$. Find an equation of the line.

(a) Make a sketch and use it to ***estimate*** the equation of the required line.



Estimate of Equation:______________________

(b) Use an algebraic method to find the ***exact*** equation of the required line.

Practice Test 1

Multiple Choice

For each question, select the best answer.

1. Which are the slope and y-intercept of the line $y = 5x + 3$?
   A $m = 3, \ b = 5$
   B $m = -3, b = -5$
   C $m = -5, b = 3$
   D $m = 5, \ b = 3$

2. What are the x- and y-intercepts of the line $5x - 4y = 20$?
   A x-intercept = 4, y-intercept = –5
   B x-intercept = –4, y-intercept = –5
   C x-intercept = –4, y-intercept = 5
   D x-intercept = 4, y-intercept = 5

3. What is the slope of a line parallel to $x + 2y = 4$?
   A 2 **B** –2
   C $\frac{1}{2}$ **D** $-\frac{1}{2}$

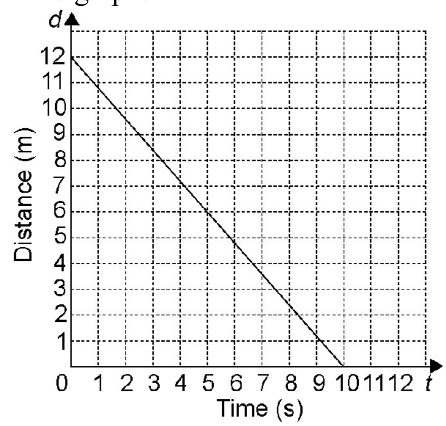
4. What is the slope of a line perpendicular to $x + 2y = 4$?
   A 2 **B** –2
   C $\frac{1}{2}$ **D** $-\frac{1}{2}$

5. Which is the solution to the linear system $y = 6 - x$ and $y = x - 4$?
   A (1, 5) **B** (5, 1)
   C (–1, 5) **D** (–5, –1)

Short Response

6. Write $x - 2y + 4 = 0$ in the form $y = mx + b$.

7. Erynn used a motion sensor to create this distance-time graph.



   a) Find the slope and d-intercept. What information does each of these give us about Erynn's motion?
   b) Write an equation that describes this distance-time relationship.

8. Find an equation for a line
   a) with slope –1 passing through (2, 2)
   b) that passes through (10, 3) and (5, 6)

Extend

Show all your work.

9. A line is perpendicular to $x + 3y - 4 = 0$ and has the same y-intercept as $2x + 5y - 20 = 0$. Find an equation for the line.

10. A fitness club offers two membership plans.
    Plan A: \$30 per month
    Plan B: \$18 per month plus \$2 for each visit
    a) Graph the linear system. When would the cost of the two membership plans be the same?
    b) Describe a situation under which you would choose each plan.

Answers

1. D **2.** A **3.** D **4.** A **5.** B

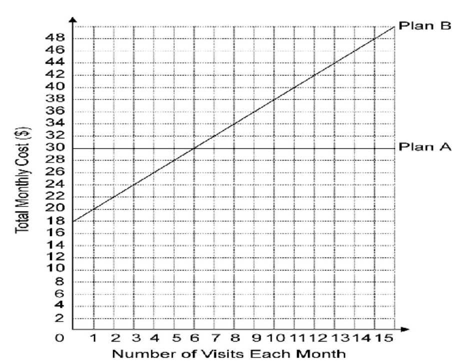
6. $y = \frac{1}{2}x + 2$

7. a) **slope:** –1.2; ***d*-intercept:** 12
b) $d = -1.2t + 12$

8. a) $y = -x + 4$ **b)** $y = -\frac{3}{5}x + 9$

9. $y = 3x + 4$

10. a) When you make 6 visits per month, the cost for both plans is \$30.
b) I would choose Plan A if I go to the gym more than 6 times each month. If I thought I would go fewer than 6 times per month, I would choose Plan B (or not get a membership).



Practice Test 2

Multiple Choice

For each question, select the best answer.

1. Which are the slope and y-intercept of the line $y = -x - 4$?

A $m = 0,\ b = -4$
B $m = 0,\ b = 4$
C $m = 1,\ b = 4$
D $m = -1, b = -4$

2. What are the x- and y-intercepts of the line $3x + 2y = 12$?

A x-intercept = 4, y-intercept = –6
B x-intercept = –4, y-intercept = –6
C x-intercept = –4, y-intercept = 6
D x-intercept = 4, y-intercept = 6

3. What is the slope of a line parallel to $4x + 2y = 7$?

A 2 **B** –2
C $\frac{1}{2}$ **D** $-\frac{1}{2}$

4. What is the slope of a line perpendicular to $2x - y = 3$?

A 2 **B** –2
C $\frac{1}{2}$ **D** $-\frac{1}{2}$

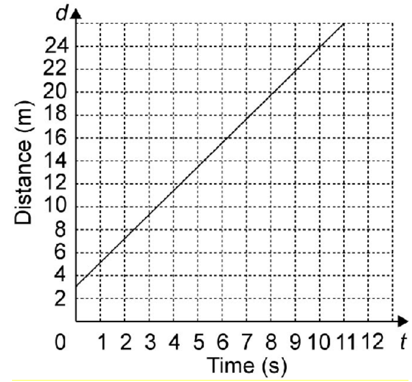
5. Which is the solution to the linear system $y = 2x$ and $y = x + 4$?

A (4, 1) **B** (4, –2)
C (4, 8) **D** (4, 4)

Short Response

6. Write $8x + 2y + 11 = 0$ in the form $y = mx + b$.

7. Frank recorded his motion with a motion sensor and produced this graph.



a) How far was Frank from the motion sensor when he started moving?
b) Was Frank moving toward the motion sensor or away from it? How fast was he moving?
c) Write an equation that describes this distance-time relationship.

8. Find an equation for a line
a) with slope 6 passing through (–1, 4)
b) that passes through (–5, 0) and (5, 6)

Extend

Show all your work.

9. A line is parallel to $5x + 2y - 8 = 0$ and has the same y-intercept as $x + 4y - 12 = 0$. Find an equation of the line.

10. A retail store offers two different hourly pay plans:
Plan A: \$9.00 per hour
Plan B: \$7.50 per hour plus a \$4.50 shift bonus.

a) Graph the linear system. When would the earnings from the two plans be the same?
b) Describe a situation under which you would choose each plan.

Answers

1. D **2.** D **3.** B **4. D** **5.** C

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

7. a) 3 m
b) Away; approximately 2.1 m/s
c) $d = 2.1t + 3$

8. a) $y = 6x + 10$
b) $y = \frac{3}{5}x + 3$

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

10. a) The earnings per shift under both plans are \$27 when you work 3 h.

b) I would choose Plan A if I usually work more than 3 h each shift. If I work fewer than 3 h per shift, I would choose Plan B.