Highwood High School

Math 9

Linear Relations

Ms. Mulholland

2016

Name:_____

UNIT: Linear Inequalities and Equations **NUMBER OF DAYS: 13**

LEGEND OF ABREVIATIONS USED IN TABLE

SLO PR1 Generalize a pattern arising from a problem solving context using linear equations, and verify by substitution

SLO PR2 Graph linear relations, analyze the graph, and interpolate or extrapolate to solve problems

SLO PR3. Model and solve problems using linear equations of the form:

- ax=b, $\frac{x}{a}=b, a\neq 0$, ax+b=c, $\frac{x}{a}+b=c, a\neq 0$, ax = b+cx, a(x+b)=c, ax+b=cx+d, a(bx+c)=d(ex+f), $\frac{a}{x}=b, x\neq 0$, where a, b, c, d, e, and f are rational numbers

SLO PR4. Explain and illustrate strategies to solve single variable linear inequalities and rational coefficients within a problem solving context

STRAND: Patterns and Relations

SUBSTRAND:
Variables and Equations

GLO(s):
- Represent algebraic expressions in multiple ways.

Day	SLO	Key Concepts	Assignment
1	PR1, PR2	• Linear Relations I	• Pg 170 #4, 5, 7cd, 8, 9cd, 10adf, 13, 15
2	PR1, PR2	• Linear Relation I	• Work Period (see yesterday's assignment)
3	PR1	• Writing Equations	• Pg 159 #5 - 9, 11, 12, 14
4	PR1, PR2	• Linear Relations II	• Pg 178 #4, 5, 7 - 9, 11, 12, 13a, 14, 18 • **Need graph paper**
5	PR2	• Matching Equations with Graphs	• Pg 188 #3-9, 11abc • **Creating Equations from a Graph Worksheet**
6	PR2	• Using Graphs to Estimate Values	• Pg 196 #5, 7-9, 11, 13, 14
7	PR2	• Linear Relations Review • **Quiz 1 Linear Relations**	• **Linear Relations Review Worksheet**
8	PR3, PR4	• Introduction to Linear Inequalities • Solving Linear Inequalities by Using Addition and Subtraction	• Pg 292 #3aceg, 4, 9aceg, 10, 11, 12ab, 13ab • Pg 298 #8ace, 9ace, 13, 14
9	PR4	• Solving Linear Inequalities by Using Multiplication and Division	• Pg 305 #3, 5a, 7(solve only), 9ace, 10, 11, 13, 14, 16ac
10	PR4 PR3,PR4	• Linear Inequalities Review • **Quiz 2 Linear Inequalities**	• Pg 309 #10, 11ab, 12ab (i&ii), 14-16 • Pg 310 #4-6
11	PR1, PR2, PR3, PR4	• Review Cont.	
12	PR1, PR2, PR3, PR4	• **Unit Assignment**	
13	PR1, PR2, PR3, PR4	• **Unit Exam**	

Linear Relations I

Definitions:

Dependent Variable (y axis)

A variable whose value is determined by the value of another variable (on y-axis)

Independent Variable (x-axis)

A variable whose value is not determined by the value of another

Relation

A rule that relates two quantities

Linear Relation

A relation that has a straight line graph

Rules for a Graph:

1. Graph must have a title
2. Dependent and independent axes must be labeled
3. Scale must be provided on each axes

Slope-Intercept Form:

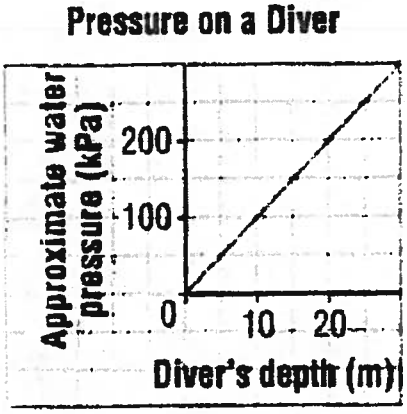
$$y = mx + b$$

(m: slope; b: y-intercept)

* Learn more Tuesday! :)

Example 1: When a scuba diver goes under water, the weight of the water exerts pressure on the diver.

Diver's Depth (m)	Approximate Water Pressure (kilopascals)
0	0
5	50
10	100
15	150
20	200



What patterns do you see? What do these patterns tell you about the relationship between depth and water pressure?

* As diver dives 5km, pressure increases 50kp
* Straight Line
* Linear Relationship

$p = 10d$

Example 2: A local phone company offers a cell phone plan that has a fixed cost per month and a cost related to the number of text messages sent. The fixed cost is $2.00 and each message sent costs $0.50.

a) Determine the dependent and independent variables.

Cost depends on # of texts made

∴ Cost = dependent

texts = independent

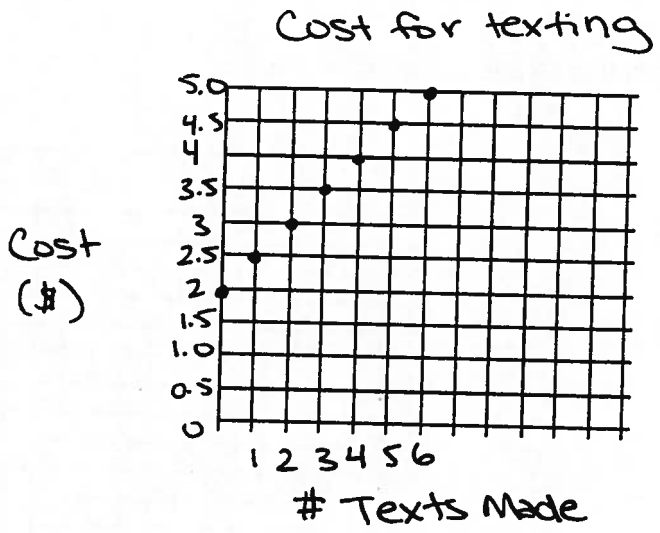
b) Represent the relation between the total cost and the number of total text messages sent as a table of values.

# of texts	Cost
0	$2.00
1	$2.50
2	$3.00
3	$3.50
4	$4.00
5	$4.50

c) Represent the relation as an equation in slope-intercept form.

$C = 0.5t + 2.00$

d) Represent the relation as a graph.



e) Should we connect the dots on the graph? *Go over definitions first!*

Discrete Data: Counted data and can only take certain values

* Do NOT connect the dots

Continuous Data: Continuous Data is measured and can take any value (within a range)

∴ Do connect dots

Cost for texts is discrete data
⇒ cannot make ½ a text
∴ do not connect dots

Example 3:

A certain relationship has the equation $y = 3x - 5$.

X is the independent variable and is plotted on the horizontal axis

Y is the dependent variable and is plotted on the vertical axis

Create a table of values and graph the relation.

$y = 3x - 5$

x	y
0	-5
1	-2
2	1
3	4
4	7

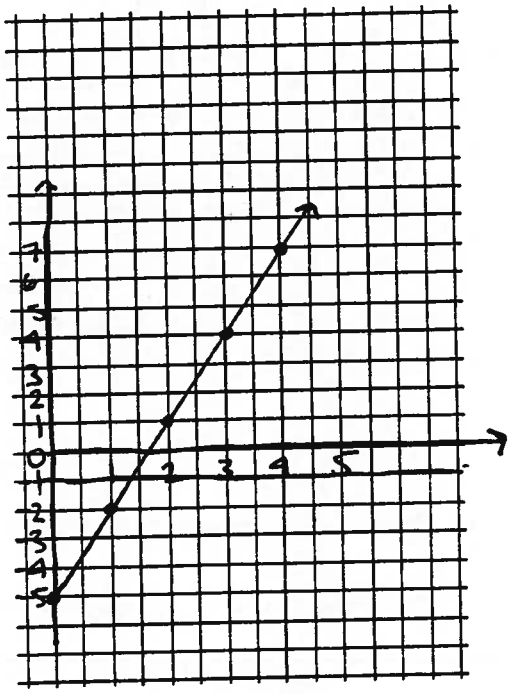
$y = 3(0) - 5$
$= 0 - 5$
$= -5$

$y = 3(1) - 5$
$= 3 - 5$
$= -2$

$y = 3(2) - 5$
$= 6 - 5$
$= 1$

$y = 3(3) - 5$
$= 9 - 5$
$= 4$

$y = 3(4) - 5$
$= 12 - 5$
$= 7$



Connect the dots!

Is the relation linear? How do you know?

Yes! Straight line :)

Example 4: The student council is planning to hold a dance. The profit in dollars is 4 times the number of students who attend, minus $200 for the cost of the music.

a) Write an equation that relates the profit to the number of students who attend

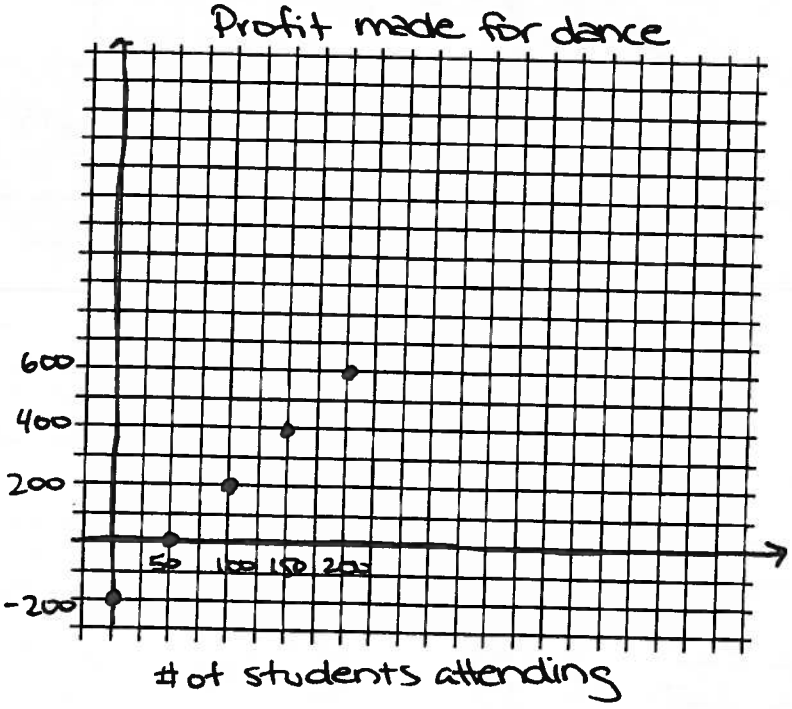
$P = 4n - 200$

b) Create a table of values for this relation assuming that anywhere from 0 – 200 students will attend. Choose at least 4 values (what is an appropriate scale).

n	P
0	-200
50	0
100	200
150	400
200	600

$P = 4(0) - 200$
$= 0 - 200$
$= -200$

c) Graph the data from your table. Decide if you connect the ordered pairs.



* Do NOT connect dots because # of students attending is discrete.
* can't have ½ a student

d) How many students have to attend to make a profit?

More than 50 students $(n > 50, n \in \mathbb{Z}$
or

Writing Equations

Slope-Intercept Form

$$y = mx + b$$

m ↑ slope

b ↑ y-intercept

What makes relations linear?

- Constant change in x and y values
- Straight line ∴ proportional

Determine the equation of each of the tables below.

a.

x	y	
5	10	+3
6	13	+3
7	16	+3
8	19	

(+1, +1, +1)

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

$= 3x - 5$

b.

x	y	
-3	-4	+4
-2	0	+4
-1	4	+4
0	8	

(-1, -1, -1)

$y = \frac{4}{1}x + 8$

$y = 4x + 8$

c.

x	y	
3	10	-2
4	8	-2
5	6	-2
6	4	

d.

x	y	
0	10	-2
2	8	-2
4	6	-2
6	4	

e.

x	y	
3	7	-4
5	3	-4
1	-1	-4
-3	-5	

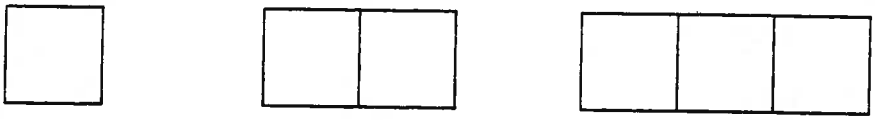
f.

x	y	
0	7	-2
5	3	-2
10	-1	-2
15	-5	

g.

x	y	
0	1	+4
2	5	+4
7	15	+4
10	21	

A chicken farmer uses wooden boards as edging for pens in his chicken coop.



1 pen 2 pens 3 pens

Complete the table below

Number of Pens, p	Number of Boards, b
1	4
2	7
3	10
4	13

+1, +1, +1 (between the p values)
+3, +3, +3 (between the b values)

- By how much does the number of pens, p, increase by? 1
- By how much does the number of boards, b, increase by? 3
- Can you determine an equation that relates the number of board to the number of pens?

$b = 3p + 1$

- According to this table, how many boards would we have if we had zero pens? What do you notice?

0 pens would have 1 board.

* This is the number we add to each equation

Extra Foods has 900 thick, juicy rib eye steak. Each hour 30 steak are bought from deli. Create a table showing how many steaks will be left after the first 4 hours.

Time (t hours)	Steak (n number)
0	900
1	870
2	840
3	810
4	780

a) Describe in words the relationship between the number of steaks that are left and the time that has past.

Each hour we have 30 less steaks

b) Write an equation that relates the number of steaks that are left and the time that has past.

$n = -30t + 900$

c) How many steaks will be left after 9 hours?

$n = (-30)(9) + 900$

$= -270 + 900$

$= 630$ ∴ 630 steaks left after 9 hours

d) How long will it take for all the steak to be sold?

$0 = (-30)t + 900$

$-900 = -30t$

$t = 30$

∴ It will take 30 hours

Peggy Sue called Kelly's Cab. The cost of a ride is shown on the poster in the cab

Fixed Cost: $2.50 + $1.60 per Kilometer

a) Write an equation that relates the fare to the distance traveled.

$C = 1.60d + 2.50$

b) What is the fare for an 11 km ride?

$C = 1.60(11) + 2.50$

$= 17.60 + 2.50$

$= 20.10$

$20.10

Linear Relations II

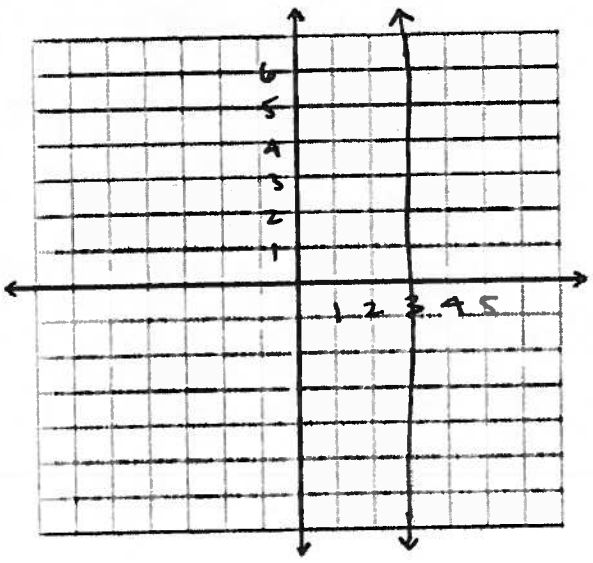
Oblique line: A line that is not horizontal or vertical → diagonal line

y-intercept: The coordinate in which a graph crosses the y-axis

x-intercept: The coordinate in which a graph crosses the x-axis

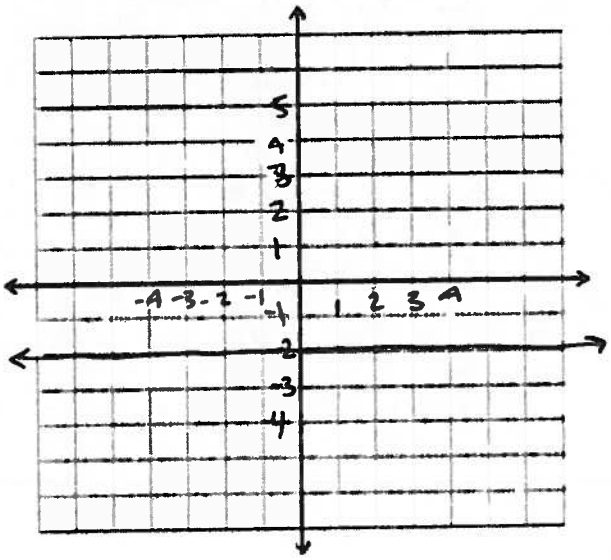
Graph the following equations. Describe the graph.

a) $x = 3$



Is a vertical line that crosses the x axis at 3.

b) $y = -2$



Is a horizontal line that that crosses the y axis at -2.

Examples:

1. Predict what the graph will look like.

a) $x + 3 = 0$

$x = -3$

* vertical line
* crosses x-axis at -3

b) $y - 6 = 1$

$y = 7$

* horizontal line
* crosses y axis at 7

c) $2y = 5$

d) $2x - 3y = 0$

2. Determine the x and y intercept of the following equations. Graph the equation using your intercepts. Label each of the lines.

a) $x + y = 3$

x-intercept: Let $y = 0$: $x + 0 = 3$, $x = 3$

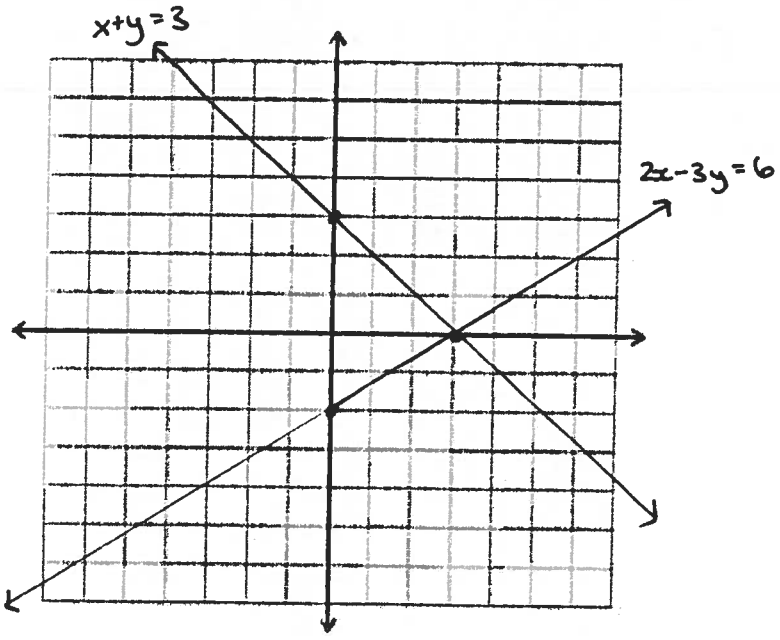
y-intercept: Let $x = 0$: $0 + y = 3$, $y = 3$

b) $2x - 3y = 6$

x-int: Let $y = 0$: $2x - 3(0) = 6$, $2x = 6$, $x = 3$

y-int: Let $x = 0$: $2(0) - 3y = 6$, $-3y = 6$, $y = -2$

c) $-4x + 2y = 4$



3. For the equation $3x - 2y = 6$:

a) Make a table of values for x = -4, 0, 4

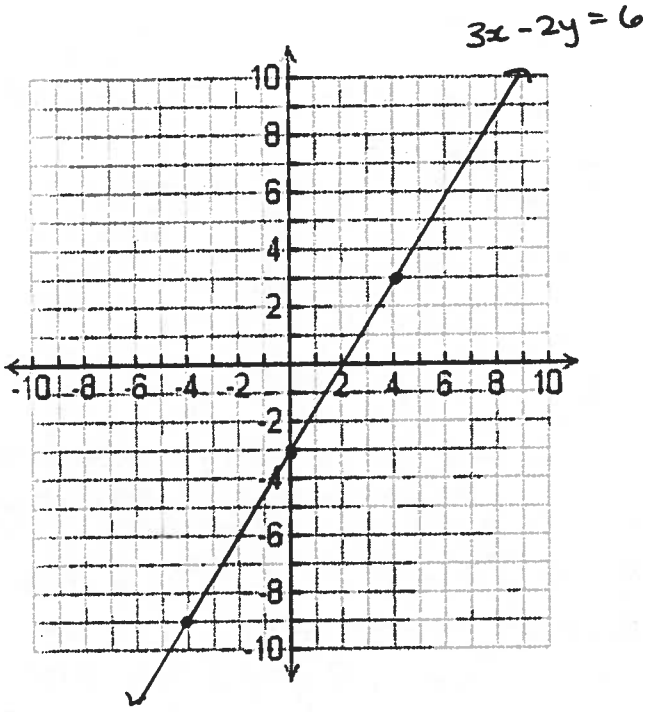
x	y
-4	-9
0	-3
4	3

$3(-4) - 2y = 6$
$-12 - 2y = 6$
$-2y = 18$
$y = -9$

$3(0) - 2y = 6$
$-2y = 6$
$y = -3$

$3(4) - 2y = 6$
$12 - 2y = 6$
$-2y = -6$
$y = 3$

b) Graph the equation



4. For the equation $-4x + 2y = 2$:

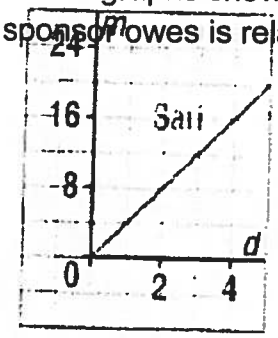
a) Make a table of values for x = -2, 0, 2

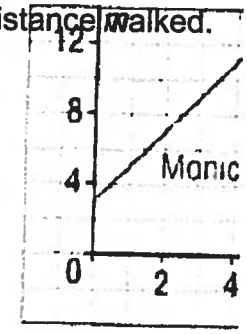
b) Graph the equation

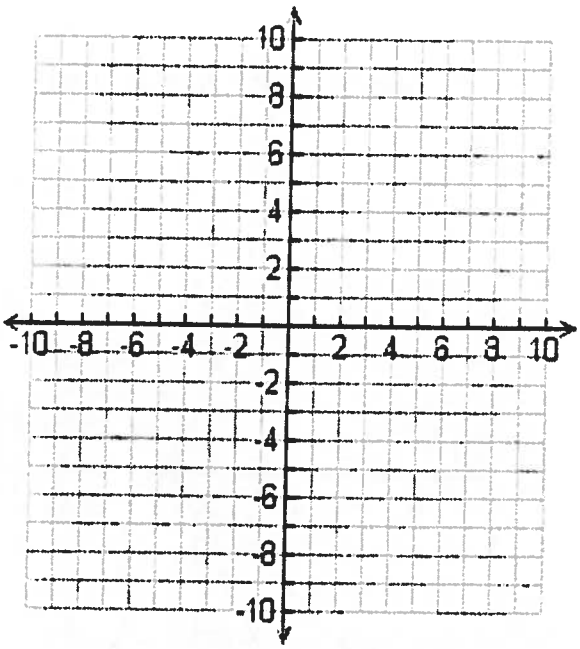
Matching Equations and Graphs

Bruce, Monica, and Sari participate in a 5 km walk for charity. Each student has a different plan to raise money from his/her sponsor. These graphs show how much money a sponsor owes is related to the distance walked.

* photocopy error!!







Match each graph with each equation:

$m = 2d + 3$

$m = 4d$

$m = d + 5$

Examples:

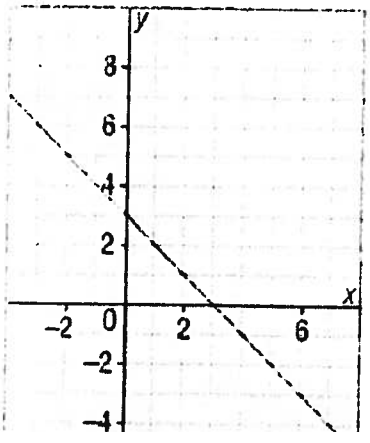
1. The 3 graphs below have these equations, but the graphs are not in order:

$y = 3x + 3$
slope = 3
y-int = 3

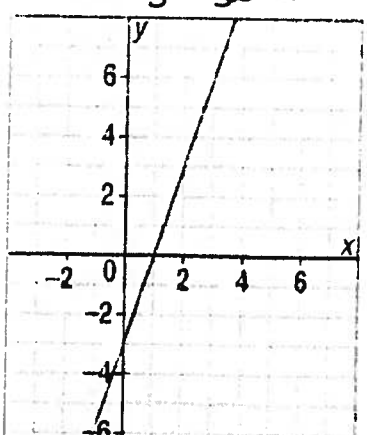
$x + y = 3$ $y = -x + 3$
slope = -1
y-int = 3

$y = 3x - 3$
slope = 3
y-int = -3

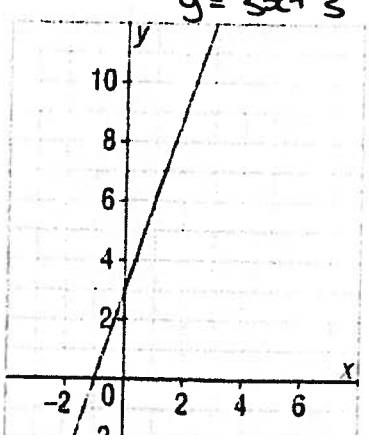
Graph A $y = -x + 3$



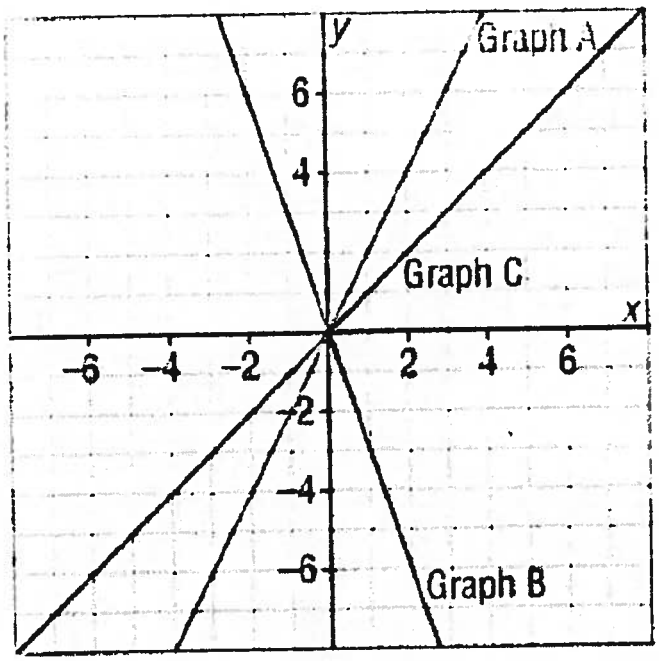
Graph B $y = 3x - 3$



Graph C $y = 3x + 3$



2. Match each graph on the grid with its equation below:

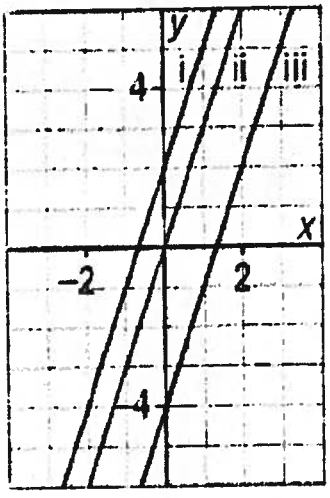


$y = x$

$y = 2x$

$y = -3x$

3. Which graph on this grid has the equation y = 3x – 4. Justify your answer.

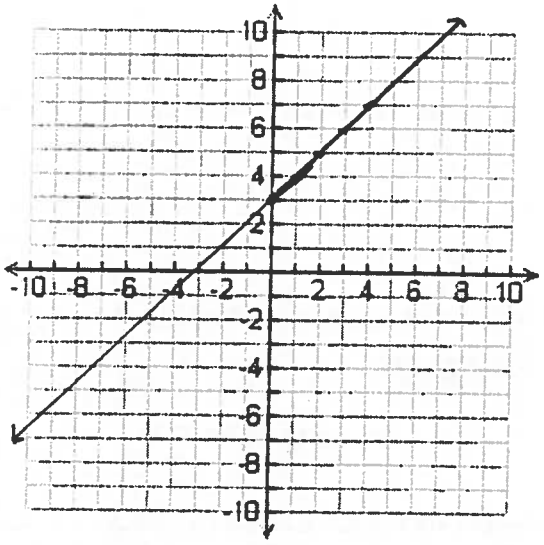


4. Graph the following.

a. $y = x + 3$

y-int = 3

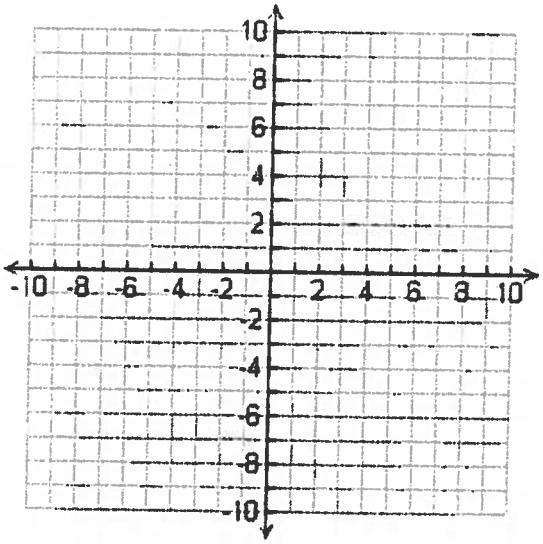
m = 1/1



b. $y = 2x + 4$

y-int = 4

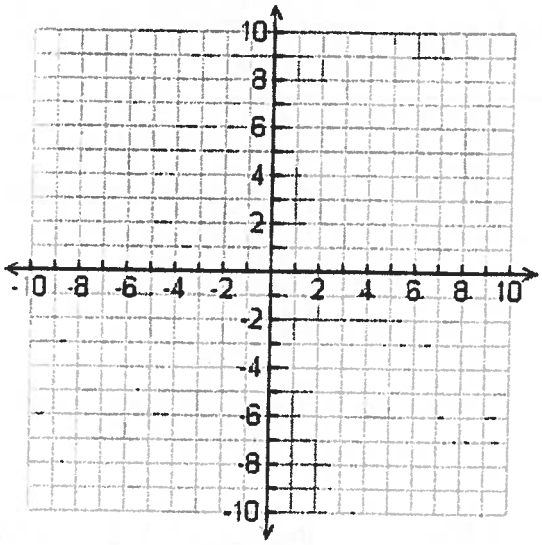
m = 2



c. $y = \frac{2}{3}x - 1$

y int = -1

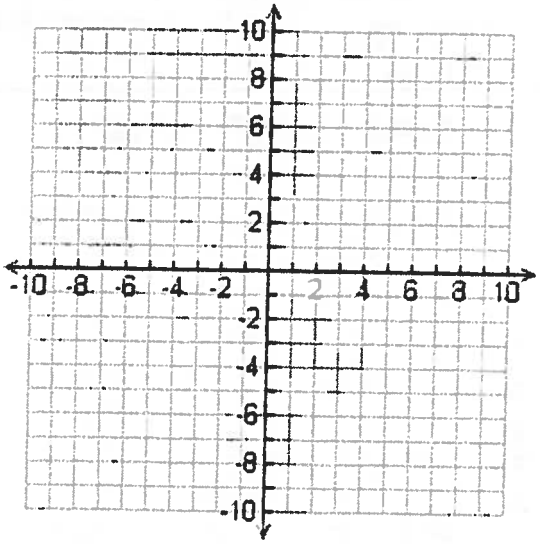
$m = {}^{2}/_{3}$



d. $y = -\frac{2}{3}x - 1$

y-int = -1

$m = -{}^{2}/_{3}$



Using Graphs to Estimate Values

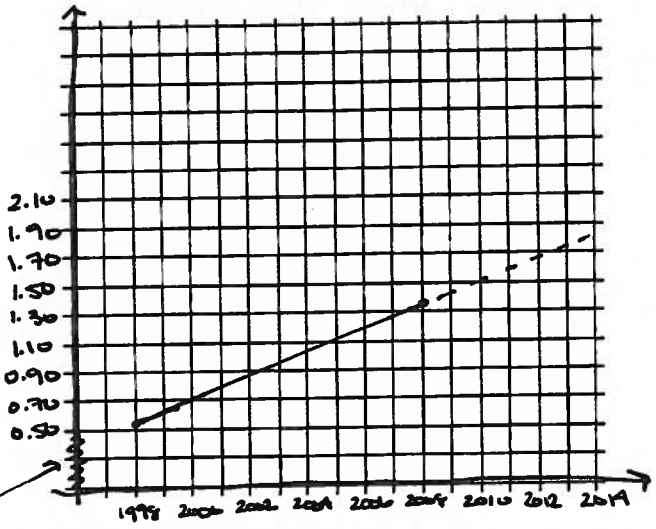
Definitions:

Interpolation: To estimate a value that lies between 2 data points on a graph

Extrapolation: To predict an unknown value from known values

The price of gasoline in 1998 was $0.55/L. By 2008, the gas prices were about $1.35/L.

Plot the data points and connect the dots.



a) Predict the price of gas in 2003

$0.95/L

Interpolation

b) Predict the price of gas in 2013

$1.75/L

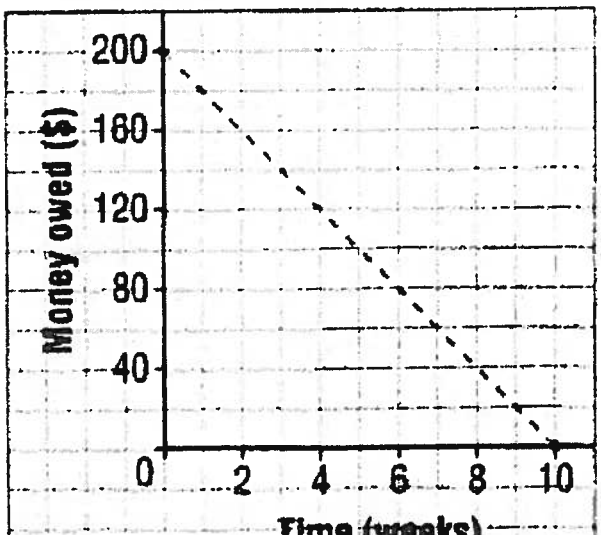
Extrapolation

mpresses
e graph

Examples:

1. Jenna borrows money from her parents for a school trip. She repays the loan by making regular weekly payments. The graph shows how the money is repaid over time.

Jenna's Loan Payments



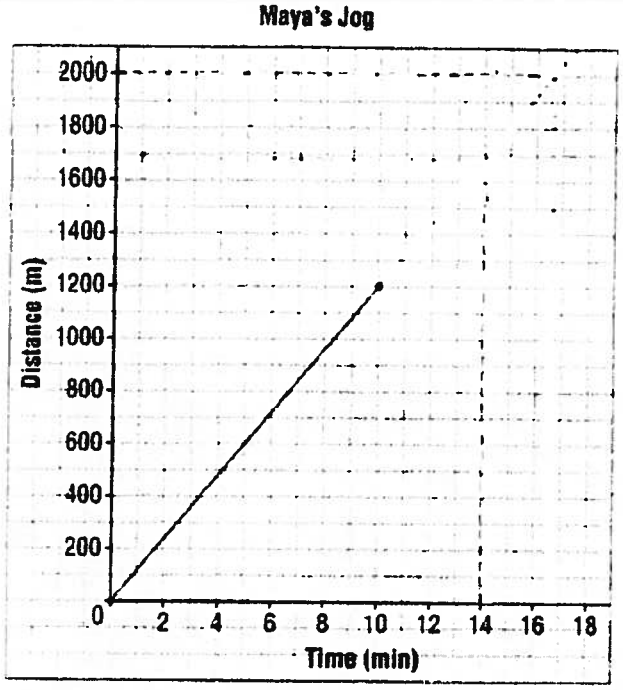
a) Is the data discrete or continuous?

b) How much money did Jenna originally borrow?

c) How much does she still owe after 3 weeks?

d) How many weeks will it take Jenna to repay ½ of the money she borrowed?

2. Maya jogs on the running track. This graph shows how far she jogs in 10 min. Assume Maya continues to jog at the same average speed.



a) Predict how long it will take Maya to jog 1800 m

b) Predict how long Maya will jog in 12 min.

c) Maya trips and sprains her ankle after 5 minutes, how far did she jog?

3. Use this graph as a linear relation.
   a) Determine the value of x when y = 3
   b) Determine the value of y when x = 5