MATH NEWS

Grade 8, Module 4, Topic B

LAFAYETTE PARISH SCHOOL SYSTEM

8th Grade Math

Module 4: Linear Equations

Math Parent Letter

This document is created to give parents and students a better understanding of the math concepts found in Eureka Math (© 2013 Common Core, Inc.) that is also posted as the Engage New York material which is taught in the classroom. Module 4 of Eureka Math (Engage New York) builds on what students already know about unit rates and proportional relationships to linear equations and their graphs. Students understand the connections between proportional relationships, lines, and linear equations in this module. Also in this module, students learn to apply the skills they acquired in Grades 6 and 7, with respect to symbolic notation and properties of equality to transcribe and solve equations in one variable and then in two variables.

Focus Area Topic B:

Linear Equations in Two Variables and Their Graphs

Students work with constant speed, a concept learned in Grade 6, but this time with proportional relationships related to average speed and constant speed. Students will also find solutions to linear equations in two variables, organize them in a table, and plot the solutions on a coordinate plane. As students begin to investigate the shape of a graph of a linear equation, they will predict that the graph of a linear equation is a line and select points on and off the line to verify their claim. Students will also be presented with equations in standard form, $ax+by=c$. They will also determine when $a=0$ or $b=0$ the line produced is either vertical or horizontal.

Words to Know:

average speed: speed calculated by dividing the total distance traveled by the total time required to travel that distance.

constant speed: determined only when the same average speed can be maintained over *any* time interval. (ex: When we assume that someone can actually walk at the same average speed, then we can say that person is walking at a *constant speed.*)

Some time is spent establishing the difference between average speed and constant speed. Constant speeds are necessary when establishing a proportional relationship.

A Critical Look at Proportional Relationships

Students use information that is organized in the form of a table to write linear equations in two variables.

Example:

Paul walks 2 miles in 25 minutes. How many miles can Paul walk in 137.5 minutes?

Begin by organizing work using a table for time and distance:

Time (in minutes)	Distance (in miles)
25	2
50	4
75	6
100	8
125	10

Focus Area Topic B:

Linear Equations in Two Variables and Their Graphs

Example: (continued) Using the information in the table, let y represent the distance Paul walks in 137.5 minutes and write a proportion.

Hint: Use ratio $\frac{time}{distance}$

One suggested solution:

$$\frac{25}{2}=\frac{137.5}{y}$$

$$(\cancel{2})(y)\frac{25}{\cancel{2}}=\frac{137.5}{\cancel{y}}(2)(\cancel{y})$$

Multiply by a product of the two denominators to eliminate the fractions.

$$25y=275$$

$$\frac{25y}{25}=\frac{275}{25}$$

Divide by 25 to "undo" multiplication.

$$y=11$$

So, Paul can walk 11 miles in 137.5 minutes.

How many miles y can Paul walk in x minutes?

$$\frac{25}{2}=\frac{x}{y}$$

linear equation in disguise (Topic A)

$$(\cancel{2})(y)\frac{25}{\cancel{2}}=\frac{x}{\cancel{y}}(2)(\cancel{y})$$

Multiply by a product of the two denominators to eliminate the fractions.

$$25y=2x$$

$$\frac{25y}{25}=\frac{2x}{25}$$

Divide by 25 to "undo" multiplication.

$$y=\frac{2}{25}x \quad \text{or} \quad y=0.08x$$

Note: Teachers may or may not require students to simplify rates.

Paul can walk $0.08x$ miles in x minutes.

Example: **(when you must assume constant rate)**

Alexxa walked from Grand Central Station on 42*nd* street to Penn Station on 7*th* avenue. The total distance traveled was 1.1 miles. It took Alexxa 25 minutes to make the walk. How many miles did she walk in the first 10 minutes?

Since Alexxa could have made stops along the way, her average speed will be her assumed constant speed.

$$\frac{1.1}{25}=C \quad \text{and} \quad \frac{y}{10}=C$$

Since each of these represents her constant speed, they are equal to each other.

$$\frac{1.1}{25}=\frac{y}{10}$$

$$(10)\frac{1.1}{25}=\frac{y}{\cancel{10}}(\cancel{10})$$

Multiply by 10 to "undo" the division.

$$\frac{11}{25}=y$$

$$0.44=y$$

$$y=0.44$$

Symmetric property of equality allows us to rewrite the equation with y on the left.

She walked 0.44 miles in 10 minutes.

So if Alexxa walks y miles in x minutes, then:

$$\frac{y}{x}=C \quad \text{and} \quad \frac{1.1}{25}=C$$

$$\frac{y}{x}=\frac{1.1}{25}$$

$$(\cancel{x})(25)\frac{y}{\cancel{x}}=\frac{1.1}{\cancel{25}}(x)(\cancel{25})$$

Multiply by a product of the two denominators to eliminate the fractions.

$$25y=1.1x$$

Divide by 25 to "undo" multiplication.

$$y=\frac{1.1}{25}x \quad \text{Or} \quad y=0.044x$$

This linear equation can be used to find the distance y Alexxa walks in any given time x.

Focus Area Topic B:
Linear Equations in Two Variables and Their Graphs

Constant Rate

Constant rate problems appear in a variety of contexts like painting a house, typing, walking, water flow, etc. and can be expressed as a two variable equation. The equation can be used to complete a table of values that can then be graphed on a coordinate plane.

Example:

Pauline mows a lawn at a constant rate. Suppose she mows a 35 square foot lawn in 2.5 minutes. What area, in square feet, can she mow in 10 minutes? in *t* minutes?

Let *A* represent the area, in square feet, that Pauline mows.

$$\frac{35}{2.5} = \frac{A}{10}$$

$$(10)\frac{35}{2.5} = \frac{A}{\cancel{10}}(\cancel{10})$$ ← Multiply 10 to "undo" the division.

$$\frac{350}{2.5} = A$$

$$140 = A$$

Pauline mows 140 square feet of lawn in 10 minutes.

Write a two variable equation that represents the area of lawn, *y*, Pauline can mow in *t* minutes.

$$\frac{35}{2.5} = \frac{y}{t}$$

$$(\cancel{2.5})(t)\frac{35}{\cancel{2.5}} = \frac{y}{\cancel{t}}(2.5)(\cancel{t})$$ ← Multiply by a product of the two denominators to eliminate the fractions.

$$35t = 2.5y$$

$$\frac{35}{2.5}t = y$$ ← Divide by 2.5 to "undo" multiplication.

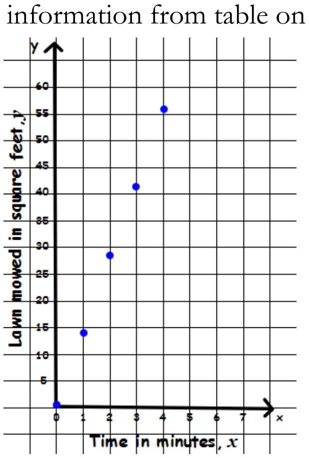
$$y = \frac{35}{2.5}t$$ ← Symmetric property of equality allows us to rewrite the equation with *y* on the left.

Notice: The number $\frac{35}{2.5}$ represents the rate at which Pauline can mow a lawn.

Use this equation to organize the information in a table.

t (time in minutes)	Linear equation $y = \frac{35}{2.5}t$	*y* (area in square feet)
0	$y = \frac{35}{2.5}(0)$	0
1	$y = \frac{35}{2.5}(1)$	$\frac{35}{2.5} = 14$
2	$y = \frac{35}{2.5}(2)$	$\frac{70}{2.5} = 28$
3	$y = \frac{35}{2.5}(3)$	$\frac{105}{2.5} = 42$
4	$y = \frac{35}{2.5}(4)$	$\frac{140}{2.5} = 56$

Graph information from table on the coordinate plane.



Because Paula mows at a constant rate, the square feet of mowed lawn will continue to rise as the time in minutes increases.

Linear Equations in Two Variables

Students find solutions to a linear equation in two variables using a table then plot the solutions as points on the coordinate plane.

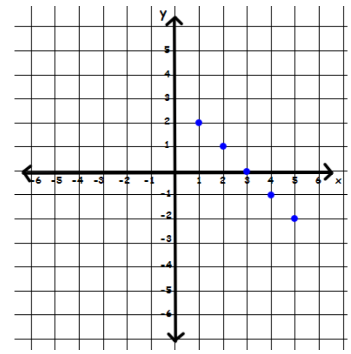
A ***solution*** to the linear equation in two variables is an ordered pair of numbers (x, y) so that x and y make the equation a true statement.

Example:

Find five solutions for the linear equation $\boldsymbol{x+y=3}$, and plot the solutions as points on a coordinate plane.

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

SOLUTIONS MAY VARY!



Note: Students develop fluency in how they generate solutions to a linear equation based on the coefficients when the equation is in standard form.

Example: Find solutions for the linear equation $x - \frac{3}{2}y = -2$.

This may require more difficult arithmetic, unless students pick values for *y* first, more specifically, values of *y* that are multiples of 2. For example: -2, 2, 4,…

x	Linear equation: $x - \frac{3}{2}y = -2$	y
-5	$x - \frac{3}{2}(-2) = -2$ $x - (-3) = -2$ $x + 3 = -2$	-2
1	$x - \frac{3}{2}(2) = -2$ $x - 3 = -2$	2
4	$x - \frac{3}{2}(4) = -2$ $x - 6 = -2$	4

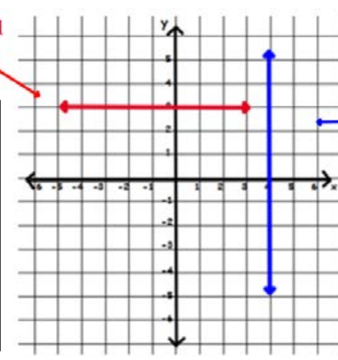
The Graph of a Linear Equation in Two Variables

Students predict the shape of a graph of a linear equation by finding and plotting solutions on a coordinate plane. All of the graphs of linear equations done so far appear to take the shape of a line. By extending the table above to include fractional values of *x* or *y*, students are convinced that the graph of a linear equation is a line (connecting the points).

To determine whether or not a point is on the graph of an equation, check to see if it is a solution to the equation.

Horizontal and Vertical Lines

Horizontal
$y = c$
$y = 3$



Vertical
$x = c$
$x = 4$

Note: Looking at standard form $ax + by = c$. Here either $a = 0$ or $b = 0$.
This example:
Horizontal
$0x + 1y = 3$
OR Vertical
$1x + 0y = 4$