Weekly Focus: linear equations
Weekly Skill: application: graphing word problems

LESSON 33: Graphing Linear Equations part 2

Lesson Summary: For the warm-up, students solve a problem about taxi rates. In Activity 1, students graph a word problem. In Activity 2, they do problems in the workbook. In Activity 3, they make a table, write an equation, and graph two more real-life word problems. There is also a third graphing problem if students have time. Estimated time for the lesson is 2 hours.

Materials Needed for Lesson 33:

- Video (length 5:00) on graphing linear equations with an in/out table. The video is required for teachers and optional for students.
- Graph Paper
- *Mathematical Reasoning Test Preparation for the 2014 GED Test* Workbook (pages 102 – 105)
- Note: The equations graphed in the application problems are all positive numbers graphed in Quadrant I, but they help students understand real-life applicability of algebra.

Objectives: Students will be able to:

- Solve the taxi word problem
- Solve problems about graphing linear equations
- Write equations, make tables, and graph word problems

ACES Skills Addressed: N, CT, LS, ALS
CCRS Mathematical Practices Addressed: Building Solution Pathways, Mathematical Fluency, Model with Math
Levels of Knowing Math Addressed: Intuitive, Pictorial, Abstract, and Application

Notes:
You can add more examples if you feel students need them before they work. Any ideas that concretely relates to their lives make good examples.

For more practice as a class, feel free to choose some of the easier problems from the worksheets to do together. The "easier" problems are not necessarily at the beginning of each worksheet. Also, you may decide to have students complete only part of the worksheets in class and assign the rest as homework or extra practice.

The GED Math test is 115 minutes long and includes approximately 46 questions. The questions have a focus on quantitative problem solving (45%) and algebraic problem solving (55%).

Students must be able to understand math concepts and apply them to new situations, use logical reasoning to explain their answers, evaluate and further the reasoning of others, represent real world problems algebraically and visually, and manipulate and solve algebraic expressions.

This computer-based test includes questions that may be multiple-choice, fill-in-the-blank, choose from a drop-down menu, or drag-and-drop the response from one place to another.

The purpose of the GED test is to provide students with the skills necessary to either further their education or be ready for the demands of today's careers.

Lesson 33 Warm-up: Solve the taxi problem	**Time: 10 Minutes**

Write on the board: LaToya wants to take a taxi from downtown Minneapolis to the airport, a distance of 12 miles. Taxicab A charges $5.00 for the first mile and $0.25 per *tenth* of a mile. Taxicab B charges a flat rate of $0.30 per *tenth* of a mile.

Basic Questions:

- Which is less expensive?
- It is easier to convert the rate to what it is per mile than deal with tenths of a mile
  - Taxi A is $5 for mile 1 + $2.50 x 11 miles = $5 + $27.50 = $32.50
  - Taxi B is $3 per mile x 12 = $36
  - Taxi A is less expensive
- About how many km is 12 miles?
  - 12 miles x 1.6 = 19.2 km

Extension Questions:

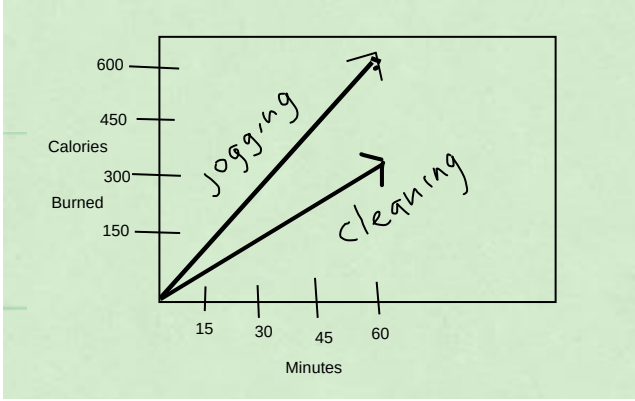
- Write an expression for each taxicab rate.
  - Taxi A: $5.00 + $0.25(10(x – 1)) if x = $\frac{1}{10}$ of a mile or $5.00 + $2.50(x – 1) if x = 1 mile
  - Taxi B: $0.30(10x) if x = $\frac{1}{10}$ of a mile or $3.00x if x = 1 mile
  - Note: The second expression for both is probably easier because it's easier to think in miles

Lesson 33 Activity 1: Graph 2 Activities	**Time: 15 Minutes**

1. You will compare two activities to see which one burns more calories. One activity is housework (i.e. vacuuming) and the other is jogging.
2. Which do you predict burns more calories? (answers may vary)
3. Here is an incomplete table of calories burned for each activity.

Minutes Jogging x	*Calories Burned y*		*Minutes Cleaning House x*	*Calories Burned y*
1			1	
15	150		15	75
30			30	
45			45	
60	600		60	300

4. Now we will write equations for each activity. Teacher note: Give students time to think about this. It may be easier to complete the whole table first and then figure out the equation.
5. What is the pattern you see between minutes jogging and calories burned?
    a. For every minute jogging, you burn 10 calories.
6. What happens to x (minutes jogging) to get y (calories burned)? What is the equation?
    a. 10x = y
7. What is the pattern for cleaning house (x) and calories burned (y)?
    a. For each minute of cleaning house, you burn 5 calories.
8. What is the equation?
    a. 5x = y
9. Fill in the rest of the two tables.
10. Which activity burns more calories? (jogging)
11. Predict how the lines will look when you graph the two equations. (jogging line will be more steep)
12. Graph the two equations on the same graph. What information should go on the x-axis? (time) The reason is because time is the **independent variable**. The information that goes on the y-axis depends on what is on the x-axis. The information on the y-axis is **dependent.** In this case, the calories burned (y) depend on the amount of time spent doing the activity (x).
13. Give students time to think about how they will set up their graphs with intervals on each axis. Circulate to help.
14. Graph should look somewhat like this:



Lesson 33 Activity 2: Independent Practice	Time: 30 Minutes

1. Do the **workbook pages 102-105.**
2. Review the meaning of systems of equations and the distance formula.
3. Do questions 1 and 2 on page 102 together.
4. Let students work independently on the rest of the pages and circulate to help.
5. Do challenging problems on the board.

Lesson 33 Activity 3 Application: Graph Word Problems	Time: 40 Minutes

For each of the following problems, you are making comparisons. In each case, make in/out tables, write equations, and make a graph with both lines on it. This is similar to what you did in Activity 1.

Problem A:

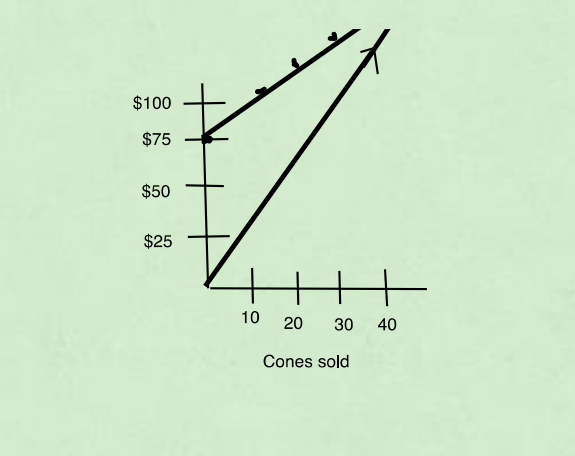
Fernando operates a small ice cream store. He wants to compare his daily expenses and revenue to see what the break-even point is. Any revenue higher than the breaking point is profit, which means Fernando can take a small salary.

- Daily expenses: $75 in fixed expenses (lease, electricity, insurance, etc.) + $1.25 (cost of ice cream, cones, napkins, etc.) per ice cream cone sold.
- Daily revenue: $3 per ice cream cone sold
- Write an equation for each. Let x = ice cream cones sold
- Expenses: $1.25x + $75 = y
- Revenue: $3x=y

- Note to teacher: Help students start by starting each table together. Here is one possibility:

Ice Cream Cones Sold x	*Revenue* y		*Ice Cream Cones Sold* x	*Expenses* y
0	$0		0	$75
10	$30		10	$87.50
20	$60		20	$100
30	$90		30	$112.50
40	$120		40	$125.00
50	$150		50	$137.50

- The graph of the equations should look similar to the one below.
- What is the break-even point, when the revenue equals the expenses? By looking at the table and the graph, the break-even is somewhere between 40 and 50 cones sold.
- To find out exactly, we can make the two equations equal to each other and solve: 1.25x + $75 = $3x, x = 42.8 = 43 cones.
- Another way is to look at how much profit Fernando makes from each cone: $3 revenue- $1.25 food cost =$1.75 per cone. Then figure out how many cones he needs to sell to pay his daily fixed expenses: $75 divided by $1.75 = 42.8 = 43 cones.

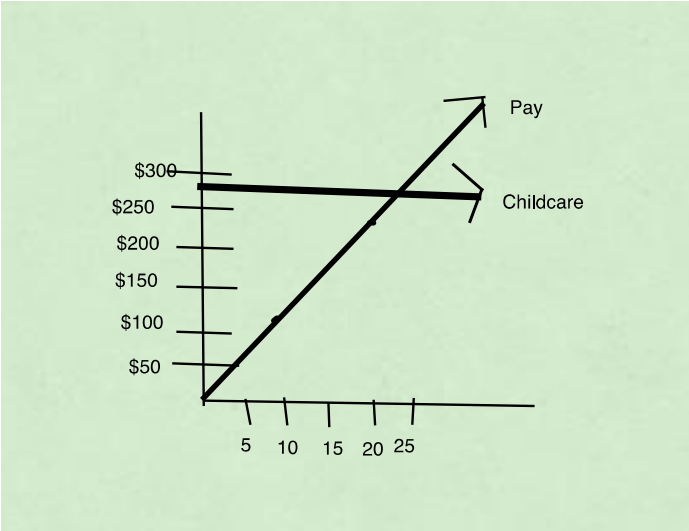


Problem B: Roman is a student and part-time worker with a child. He wants to decide if it is worth his time to pay for daycare while he works or if he should stay home with his daughter. Child care for Roman's daughter costs $265 a week. Roman makes $11/hr.

- Make a table and a graph to show the break-even point.
- What is the equation for the childcare expense for the week? It's always the same: y = $265.
- What is the equation for Roman's pay? $11x = y. Let x = hours worked.

Childcare	*Weekly cost* *y*		*Hours Worked* *x*	*Pay* *y*
	$265		0	0
			5	$11
			10	$110
			15	$165
			20	$220
			25	$275

- What is the break-even point? We can look at the graph below where the two lines intersect. We can also set the 2 equations equal to each other and solve: 11x = 265, x = 24.09= 24 hours



- Note that the weekly childcare is a straight line at y=$265
- The breakeven point is where the two lines intersect at 24 hours of paid work
- Note: There are other considerations such as work experience that are involved in deciding whether one should work or not, not just the costs vs. pay comparison.

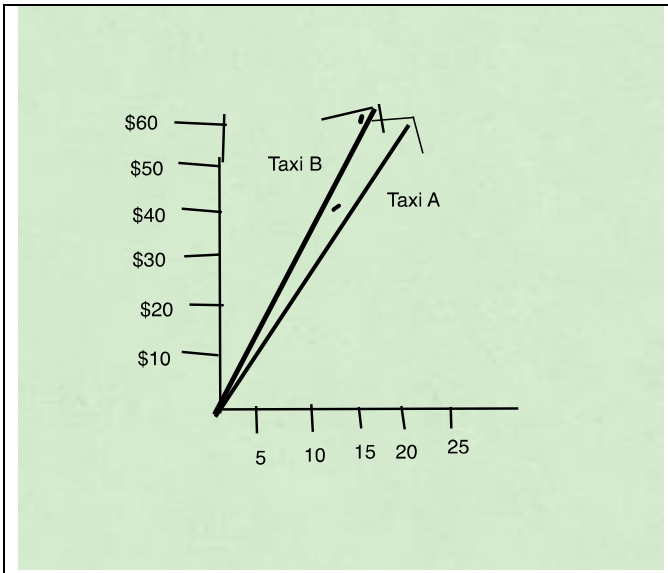
Lesson 33 Finish Early?	**Time: 10 Minutes**

Graph the taxicab rates from the warm up activity. Let x = miles

- Taxi A: $5.00 + $2.50(x – 1) = y
- Taxi B: $3x = y

Taxi A x	*Fare* *y*		*Taxi B* x	*Fare* *y*
1	$5.00		1	$3
5	$15.00		5	$15
10	$27.50		10	$30
15	$40.00		15	$45
20	$52.50		20	$60

The graph will look similar to the one below. Note that the line for Taxi B goes up slightly faster.


$60
$50
$40
$30
$20
$10
Taxi B
Taxi A
5
10
15
20
25