Weekly Focus: slope
Weekly Skill: finding slope

LESSON 34: Finding Slope and Graphing, part 1

Lesson Summary: For the warm-up, students will solve a problem about lifeguard pay. In Activity 1, students will learn how to find the slope with the points. In Activity 2, they will find the slope from an equation. In Activity 3, they will do problems in the student book. In Activity 4, they will graph a word problem. There is an extension to the problem in Activity 4 if there is time. Estimated time for the lesson is 2 hours.

Materials Needed for Lesson 34:

- Video (length 4:06) on finding the slope with two points
- Video (length 2:40) on finding the slope with an equation. The videos are required for teachers and recommended for students.
- Graph paper
- Notes 34A for finding the slope
- 2 Worksheets (34.1, 34.2) with answers (links embedded)
- *Mathematical Reasoning Test Preparation for the 2014 GED Test* Student Book (pages 74 – 75)

Objectives: Students will be able to:

- Find the slope using two methods
- Solve word problems by writing equations, making a table, and graphing

ACES Skills Addressed: N, CT, LS
CCRS Mathematical Practices Addressed: Building Solution Pathways, Model with Math, Use Appropriate Tools
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 34 Warm-up: Solve the lifeguard pay question	**Time: 5-10 Minutes**

Write on the board: Morton is a certified lifeguard. He paid $160 to get his certification. His base salary is $80 a week and he is paid $20 for each class he teaches.

Basic Questions:

- How many classes does he need to teach the first week to earn back the cost of his certification?
  - 4 classes. 4 classes x $20 + $80 base = $160
  - Note: some students may solve as ($160 – $80) – $20 – $20 – $20 – $20 = 0

Extension Questions:

- Write an equation to solve the problem.
  - 20x + 80 = y. Let x = number of classes

- Make a table to solve the problem. The solution is when y = $160

x = classes taught	y = pay
0	80
1	100
2	120
3	140
4	160

Lesson 34 Activity 1: Find the Slope with 2 Points	**Time: 25 Minutes**

1. Introduce slope by asking students what it means. Then draw a **positive slope** (like walking uphill), a **negative slope** (like walking downhill), a **zero slope** (walking on a flat surface), and an **undefined slope** (a vertical line). Slope is a number that measures how steep a line is.
2. Use the attached **Notes 34A** as your guide to introduce how to find slope. Have the students take their own notes as you write on the board.

3. Explain how to find the slope by using two points (the first five pages of the notes).
4. Practice with **Worksheet 34.1**
5. Graph some of the problems from the worksheet so that students can see the slope and the points on the coordinate grid. Make sure to do at least one positive (#3) and one negative (#2).

Lesson 34 Activity 2: Find Slope with Equation of a Line and Graph the Lines	**Time: 30-40 Minutes**

1) Use the last 3 pages of Notes 34A as your guide to teach how to find the slope by using the equation of a line.
2) Explain how the equation must first be changed to the **slope-intercept form of y = mx + b** form and that **m = slope.**
3) Practice with **Worksheet 34.2.** Note that numbers 1 – 4 are already in slope-intercept form.
4) Make a table and a graph for some of the problems. After students have done this, ask them to find the slope again by using two points. The answer should be the same.
5) Remind students to make x = 0 for one of the points. Help them discover that the **b in the y = mx + b form is the y-intercept.**
6) Note: It is important for students to see the big picture of how tables, equations, slopes, and lines all work together now that they know all the aspects of graphing linear equations.

Lesson 34 Activity 3: Practice Problems	**Time: 20 Minutes**

1. Do the problems in the **student book pages 74-75.**
2. Note that the slope-point form is not taught separately because it is a variation on finding the slope from two points: $y_2 - y_1 = m(x_2-x_1)$ is a variation of $m = \frac{y_2-y_1}{x_2-x_1}$.
3. For Question 9, draw both parallel lines on a graph by making a table for each line first.

Lesson 34 Application: Graph the 2 Car Problem	**Time: 10 Minutes**

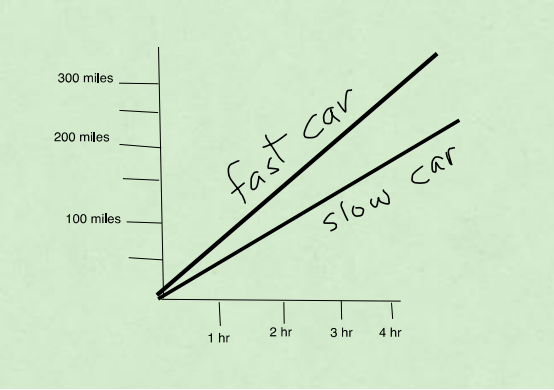
1) Two friends are driving in separate cars but want to arrive at the same place at the same time. The first car can only go 40 miles per hour and the second car can go 60 mph. How long will it take each to drive 200 miles?
2) You can write an equation and solve for the time first or you can make a table and equation

for each car to show how long it takes to get to 200 miles. Either way you will get the answer.

3) Slower car goes 40 miles x time in hours = distance. t = time, d = distance. 40t = d.
4) The faster car goes 60 mph x time in hours = distance. 60t = d
5) How long does it take the slower car? 5 hours
6) How long does it take the faster car? 3 hours and 20 minutes
7) Measure the slope by showing the change in y units over the change in x units.

Slower- Car: 40t = d			Faster car: 60t = d	
t = time in hours	d = distance in miles		t = time in hours	d = distance in miles
1	40		1	60
2	80		2	120
3	120		3	180
4	160		4	240
5	200		5	300

The graph should be similar to this:



Lesson 34 Finish Early?	Time: 5 Minutes

1. Add a third car that goes 55 mph. How long will it take for it to go 200 miles?
2. If you make a table and a graph, you see it's between 3 and 4 hours.
3. You can also set a proportion of $\frac{55\ miles}{1\ hour} = \frac{200\ miles}{h\ hours}$. 55h = 200, h = 200/55 = 3.6 hours = 3:36.

Notes 34A

SLOPE of a LINE

consider the equation

$$y = 2x - 4$$

We can make an x, y chart to help graph the line represented by this equation.

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

Do you notice a pattern between the change of y values and the change of x values?

This pattern is referred to as the **slope** of the line.

The **slope** of a line is the ratio of the change in y (vertical change) to the change in x (horizontal change).

We use the letter **m** to represent slope.

$$m = \frac{\text{change of } y}{\text{change of } x}$$

Let's look at $y = 2x - 4$

x	y
1	-2
2	0
3	2
4	4

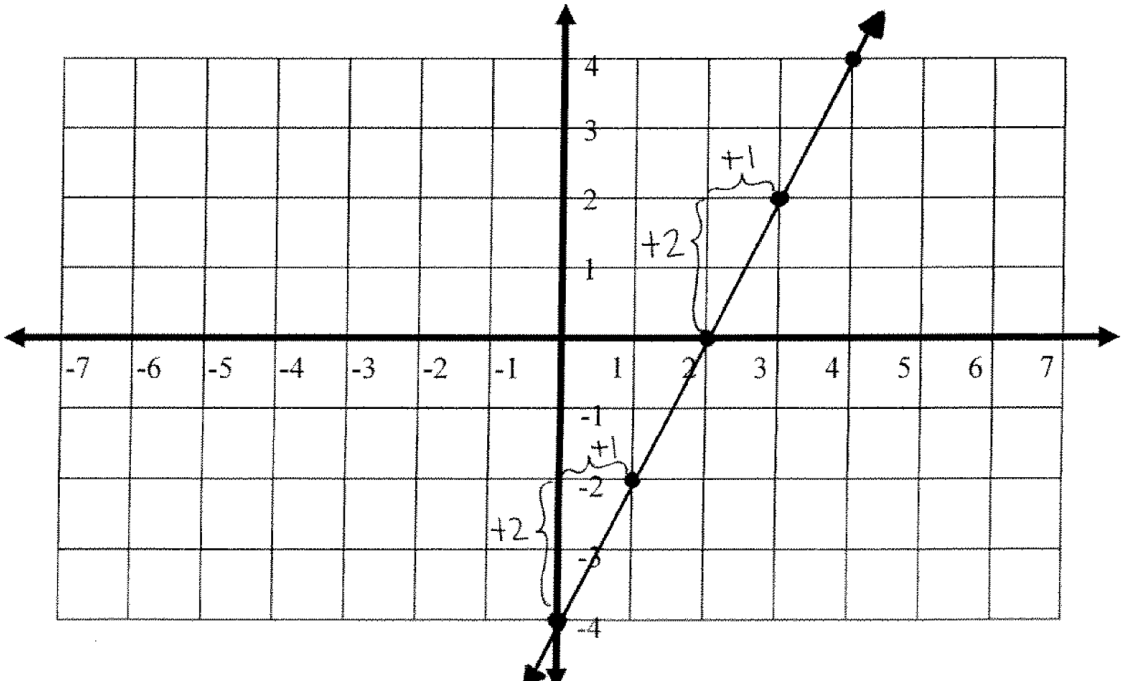
the x values increase by 1 (+1 → 2 → 3 → 4)

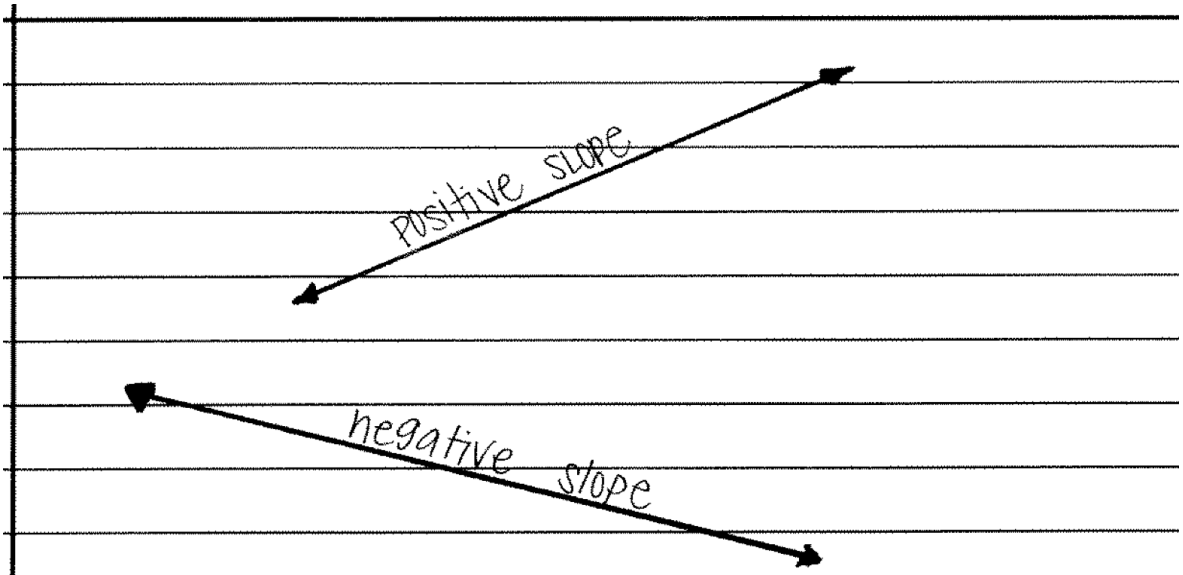
the y values increase by 2 (-2 → 0 → 2 → 4, +2 each step)

$$m = \frac{\text{change of } y}{\text{change of } x} = \frac{2}{1} = 2$$

therefore $m = 2$ for the line $y = 2x - 4$

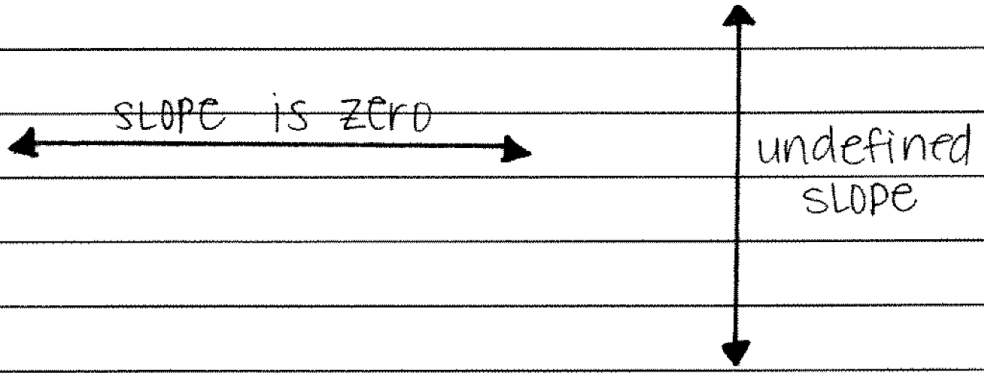
We can use slope to help graph the line represented by the equation $y = 2x - 4$





Looking left to right:

- If the line is going up, the line has a positive slope
- If the line is going down, the line has a negative slope

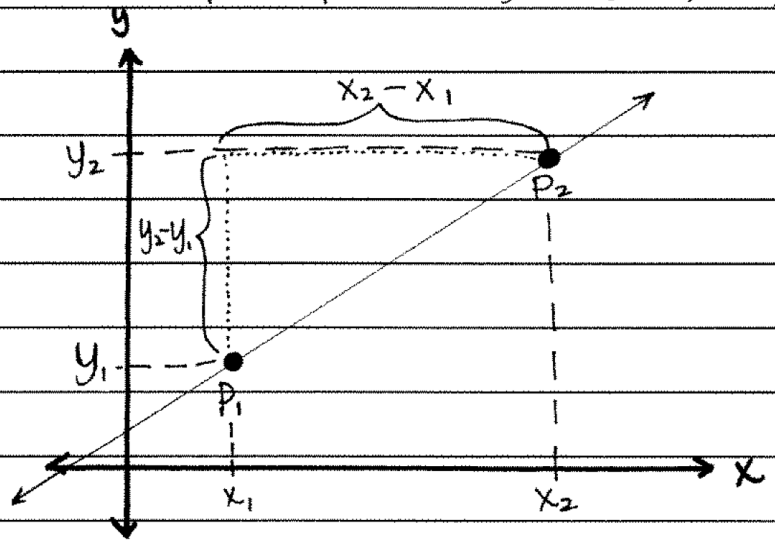


All horizontal lines have a slope equal to zero.

All vertical lines have an undefined slope.

Finding the slope of a line given two points on the line:

Let's call P_1 (point 1) (x_1, y_1) and P_2 (point 2) (x_2, y_2)



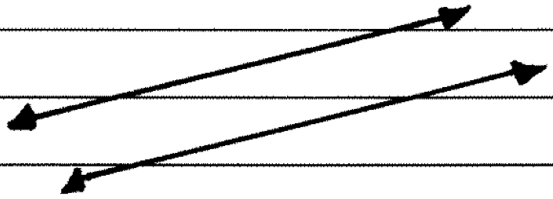
$$m = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$

example 1: Find the slope of the line that passes through the points (6, 2) and (18, 8).

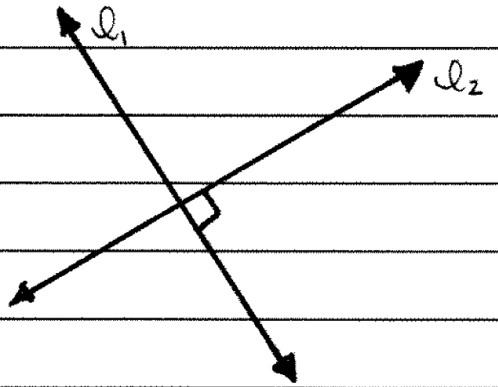
$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 2}{18 - 6}$$

$$= \_\_\_\_ = \_\_\_\_ \quad \text{(reduce)}$$

Parallel lines: Two lines are parallel if and only if they never intersect. Parallel lines have the same slope.



Perpendicular lines: Two lines are perpendicular if and only if they intersect at a 90° angle. The slopes of two perpendicular lines are negative reciprocals of each other



Examples:

m_1	m_2
-3	$\frac{1}{3}$
-4	
	$\frac{2}{5}$
0	undefined

Finding the slope using the equation of a line:

STEP 1: SOLVE the equation for y

step 2: identify the coefficient of x — this is the slope of the line.

example 2: Find the slope of the line $2x + y = 8$

STEP 1: $2x + y = 8$

$-2x \quad -2x$

$y = -2x + 8$

Note: We prefer to see the x terms before the constant

STEP 2: The coefficient of x is -2

Therefore the slope of the line $2x + y = 8$ is -2

Note: Any line parallel to the line $2x + y = 8$ has a slope of -2 and any line perpendicular to the line has a slope of $\frac{1}{2}$

example 3:

Identify the lines as being parallel, perpendicular or neither:

$x + y = 4$

$3x + 3y = 6$

First we find the slope of each line

Line 1: $x + y = 4$

$-x \quad -x$

$y = -x + 4$

Slope of line 1:

$m_1 = -1$

Line 2: $3x + 3y = 6$

Step 1: solve for y

$-3x \quad -3x$

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

$y = -x + 2$

Slope of line 2

$m_2 = -1$

Therefore these two lines are parallel.

Slope of a Line Practice Problems

1. Find the slope of the line that passes through the points $(5, 7)$ and $(-1, 3)$

2. Match each equation with its corresponding graph:

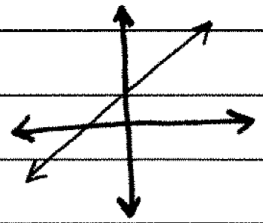
a: $x + y = 1$

b: $-x + y = 1$

c: $y = 1$

d: $x = 1$

I:



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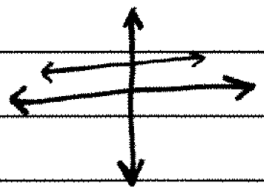

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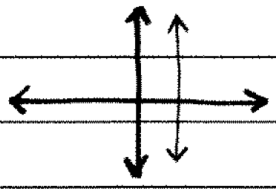

IV: