

Eye Opener

Solve each equation for y.

$-2y - 2x = 4$ $3x = y + 2$ $2y - x = 4$

$y = 3x - 2$ $y = \frac{1}{2}x + 4$

The following three functions are linear. What is the pattern to each one's rate of change?

x	f(x)
0	-4
2	-2
4	0

$y = x - 4$

x	f(x)
-2	1
0	3
2	5

$y = x + 3$

x	f(x)
-1	2
0	0
1	-2

$y = -2x + 2$

The table shows the horizontal and vertical distances from the base of the mountain at several poles along the path of a ski lift. The poles are connected by cable. Between which two poles is the cable's path the steepest? How do you know?

Pole	Horizontal Distance	Vertical Distance
A	20	30
B	40	35
C	60	60
D	100	70

$AB = \frac{30}{20}$ $BC = \frac{35}{40}$ $CD = \frac{10}{40}$

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$R + T = D$

$T = ?$

$\frac{R \times T = D}{R} \quad \frac{D}{R}$

$T = \frac{D}{R}$

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5-1: Rate of Change / Slope

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Essential Understandings for Slope


Ratios can be used to show a relationship between changing quantities, such as vertical and horizontal change.

Rate of change shows the relationship between changing quantities. When one quantity depends on the other, the following is true:

Rate of change = $\frac{\text{change in the dependent variable}}{\text{change in the independent variable}}$

The **slope** of a line represents the constant rate of change of a linear function

Slope = $\frac{\text{vertical change}}{\text{horizontal change}} = \frac{\text{rise}}{\text{run}}$



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Slope

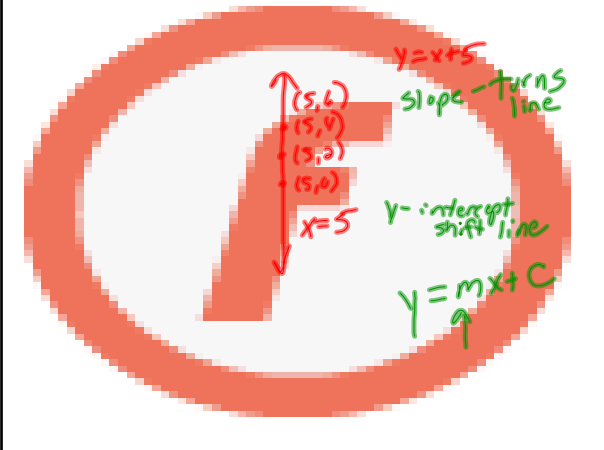
Rate of change of a line as you move from left to right on the line

$\frac{\text{Change in the dependent variable}}{\text{Change in the independent variable}}$

Rise or Vertical Change
Run Horizontal Change

Formula: Given the ordered pairs (x_1, y_1) and (x_2, y_2) that lie on a line, slope of line is: $\frac{y_2 - y_1}{x_2 - x_1}$

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There are four possible kinds of slopes:

$\frac{\text{Rise}}{\text{Run}} = \frac{+}{+} = +$
 $\frac{\text{Rise}}{\text{Run}} = \frac{-}{+} = -$
 $\frac{\text{Rise}}{\text{Run}} = \frac{0}{\neq} = 0 \text{ zero}$
 $\frac{\text{Rise}}{\text{Run}} = \frac{+}{0} = \text{no slope}$

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You can find the slope of a line given any one of four pieces of information:

- Given a table of values of the line
- Given a graph of the line
- Given the equation of the line
- Given two points / two ordered pairs on the line

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Finding the slope of a line given a table of values of the line

Use the process used in Chapter 3 to determine if a data table constituted a linear function by finding the constant pattern of change:

- Determine the constant pattern change in the y's (dependent variable)
- Determine the constant pattern change in the x's (independent variable)

Slope = $\frac{\text{constant pattern change in y's}}{\text{constant pattern change in x's}}$

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Calculate the slope of each of the following data tables.

Time (minutes)	Distance Traveled (feet)
1	1120
2	2240
3	3360
4	4480

$m = 1120$

Hours	Cars
1	4
2	8
3	12
4	16

$m = 4$

Gallons	Miles
1	28
3	84
5	140
7	196

$m = \frac{56}{2} = 28$

Games	Goals
1	2
2	4
3	6

$m = 2$

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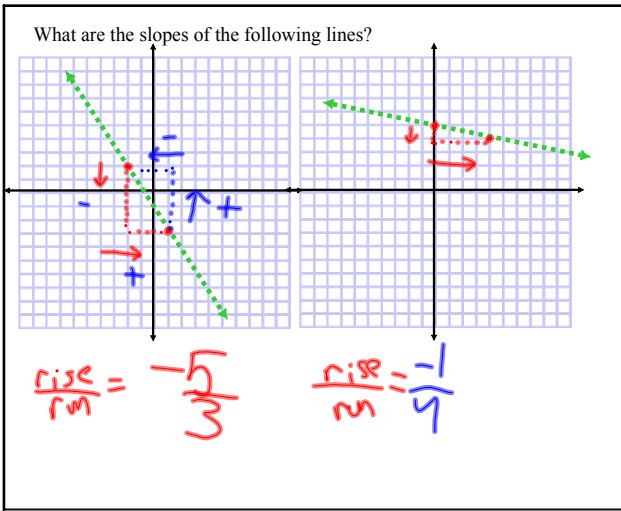
Finding the slope of a line given a graph of the line

- Triangulate between two points (draw a triangle connecting two points)
- Count off the rise - vertical movement needed to get from one point to another on the line - up is positive; down is negative
- Count off the run - horizontal movement needed to get from one point to another on the line - right is positive; left is negative
- Calculate "rise / run" - be careful with your signs (directions of motion)

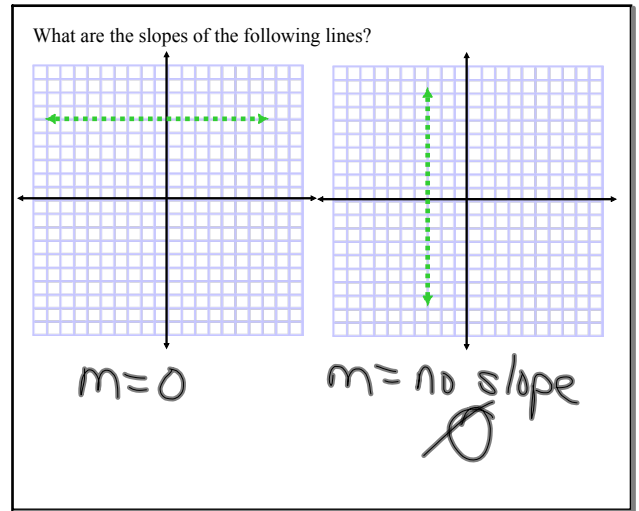
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What are the slopes of the following lines?

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Finding the slope of a line given the equation of the line

- Solve for "y" - put the equation into $y = mx + b$ format
- Identify "m" - it is your slope

$y = mx + b$ ← y-intercept
 ↑
 Slope

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What are the slopes of the following lines?

$2x + 3y = 8$
 $\frac{+3y}{-3y} = \frac{-2x}{-3y} + \frac{8}{-3y} \rightarrow y = -\frac{2}{3}x + \frac{8}{3}$
 $m = -\frac{2}{3}$

$1/2 - 7 = y$
 $y = \frac{1}{2}x - 7 \rightarrow y = \frac{1}{2}x - 7$
 $m = \frac{1}{2}$

$1/5y + 2/3x = 15$
 $15(\frac{1}{5}y) + 15(\frac{2}{3}x) = 15 \cdot 2$
 $3y + 10x = 225$
 $\frac{3y}{-3} = \frac{-10x + 225}{-3}$
 $y = -\frac{10}{3}x + 75$
 $m = -\frac{10}{3}$

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Finding the slope of a line given two points (ordered pairs) on the line using the slope formula.

- Label one point (x_1, y_1)
- Label the second point (x_2, y_2)
- Calculate: $\frac{y_2 - y_1}{x_2 - x_1}$
- This is your slope

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What are the slopes of the following lines?

Line through $(-2, 1)$ and $(5, 7)$
 $\frac{7-1}{5-(-2)} = \frac{6}{7} \rightarrow m = \frac{6}{7}$

Line through $(2, 5)$ and $(4, 7)$
 $\frac{7-5}{4-2} = \frac{2}{2} = 1 \rightarrow m = 1$

Line through $(-1, 4)$ and $(3, -2)$
 $\frac{-2-4}{3-(-1)} = \frac{-6}{4} = -1.5 \text{ or } -\frac{3}{2}$
 $\frac{4-(-2)}{-1-3} = \frac{6}{-4} = -\frac{3}{2}$

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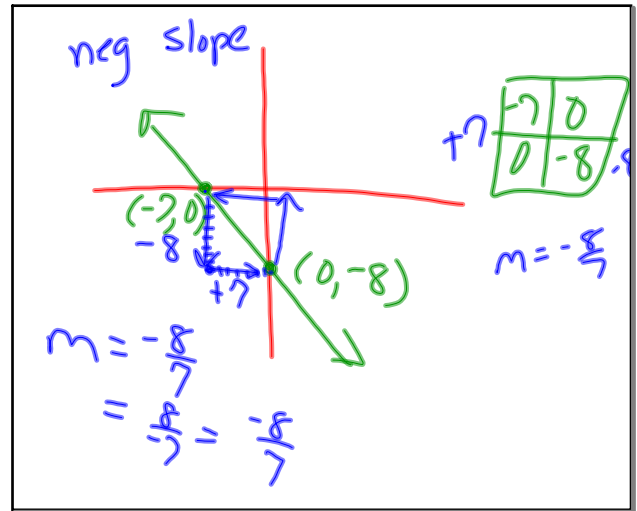
$$3x + 5y = 15 - 3x$$

$$-3x \quad \div \quad -5 \quad \cdot 5$$

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

3/5

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$(3, -9)$

$(8, 15)$

$$\frac{-9 - 15}{3 - 8} = \frac{-24}{-5} = \frac{24}{5}$$

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