Welcome To Math 34A! Differential Calculus

Instructor:

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Office Hours:

T R 11-11:50, T 3:45-4:35 Details on Gauchospace.

Warm-up

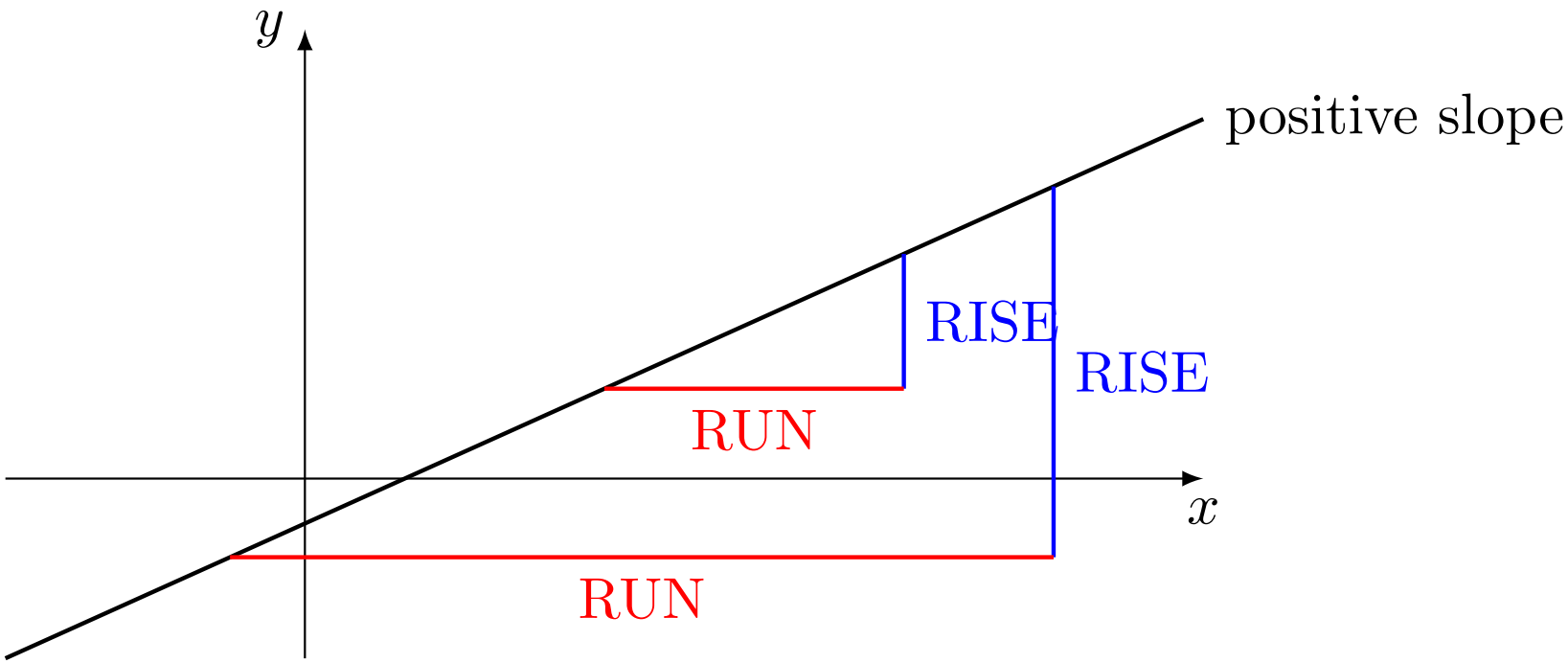
How many times do we need to double 1 to get the following numbers?

- 4 $\boxed{2}$
- 8 $\boxed{3}$
- 32 $\boxed{5}$
- 1 $\boxed{0}$
- $\frac{1}{2}$ $\boxed{-1}$

Straight Lines (§6.1)

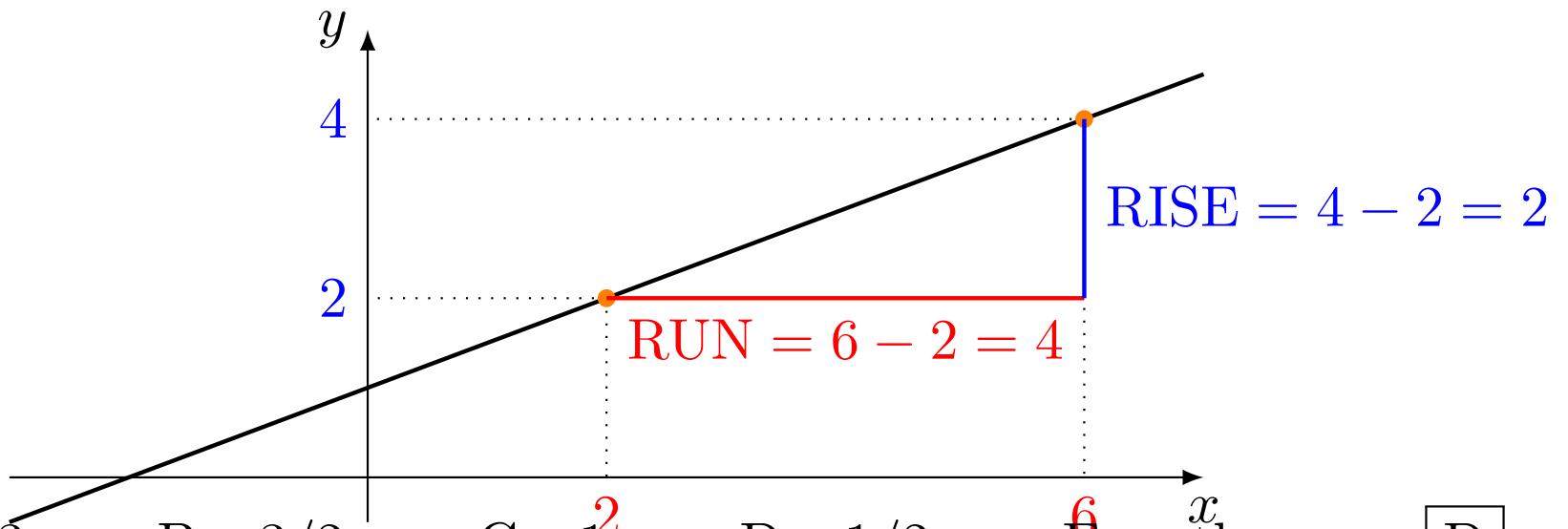
Calculus is about derivatives (Math 34A) and integrals (Math 34B).

A derivative is the slope of a line. = RISE/RUN



Examples

1. What is the slope here?



A= 3 B= 3/2 C= 1 D= 1/2 E= other D

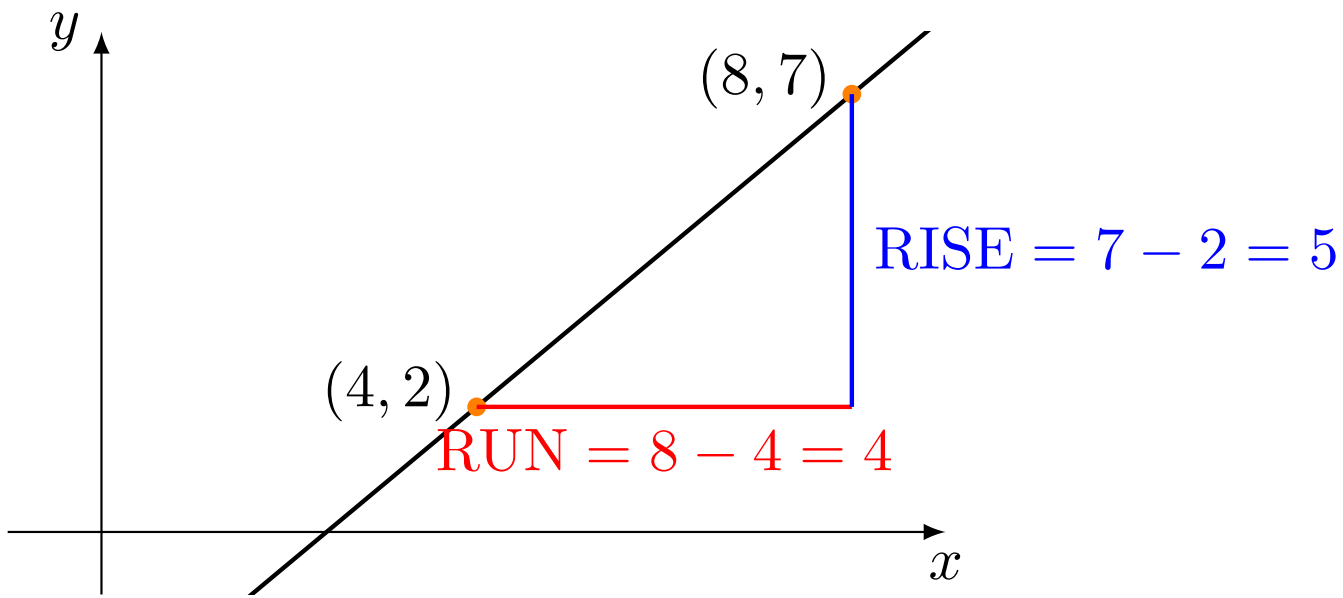
slope = # units UPWARDS you move for each unit you move TO THE RIGHT

Idea: RISE = slope × RUN So if RUN = 1 then RISE=slope.

A 10% gradient on a mountain road is a slope of 1/10. It means for every 10 feet you move horizontally you go up (or down) 1 foot.

Examples (page 2)

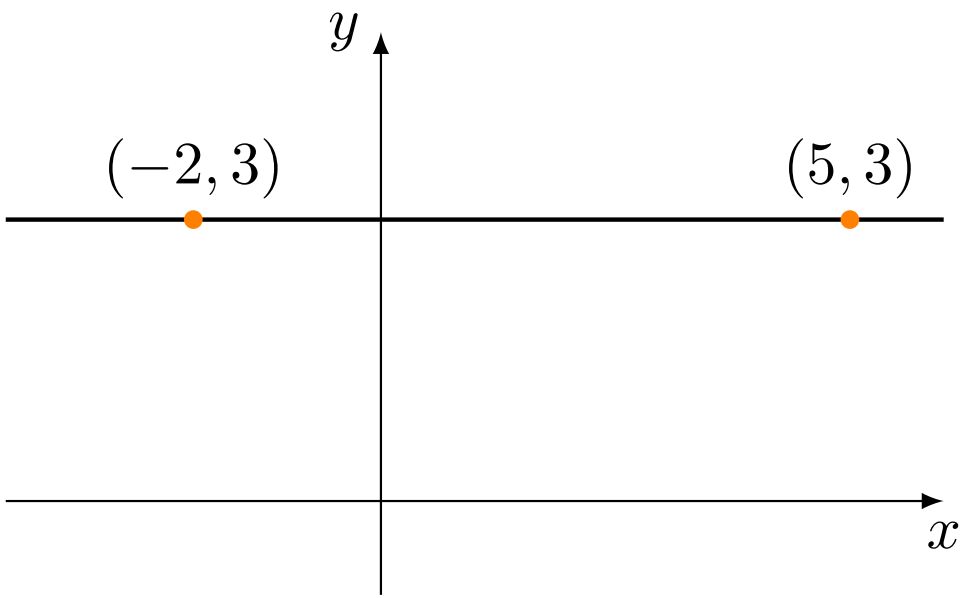
2. What is the slope here:



A= 5/4 B= 4/5 C= 1/4 D= 4 E= 5 A

Examples (page 3)

3. What is the slope here:



RISE $= 3 - 3 = 0$

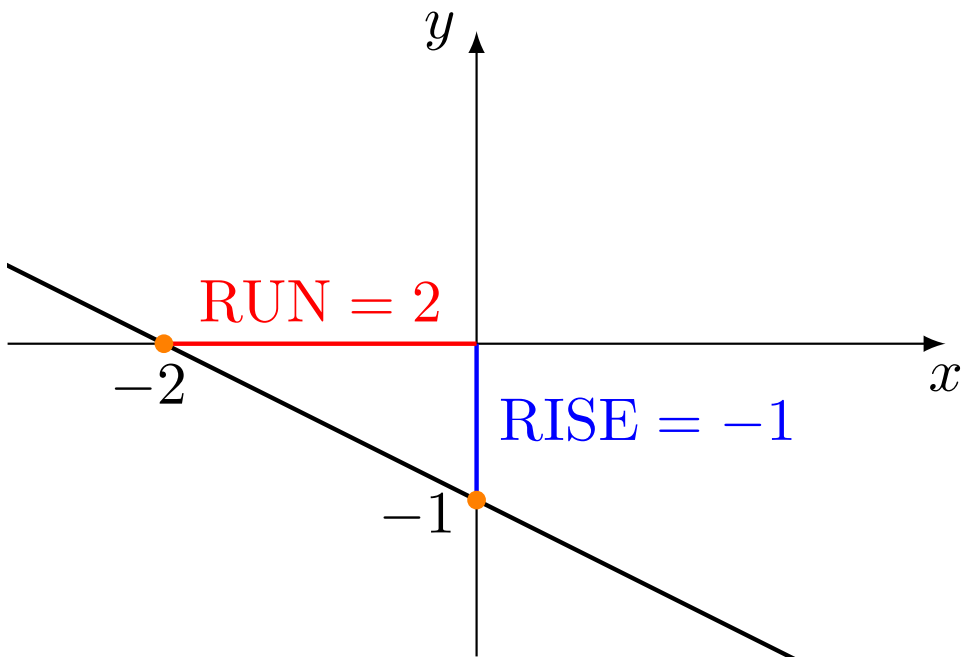
RUN $=$ who cares?

$$\text{slope} = \frac{0}{\text{something}} = 0$$

A$= 0$ B$= 7$ C$= 5/3$ D$= \infty$ E$= 3/5$ $\boxed{\text{A}}$

Examples (big finish!)

4. What is the slope here:



A= -1 B= 1 C= $1/2$ D= $-1/2$ E= -2 D

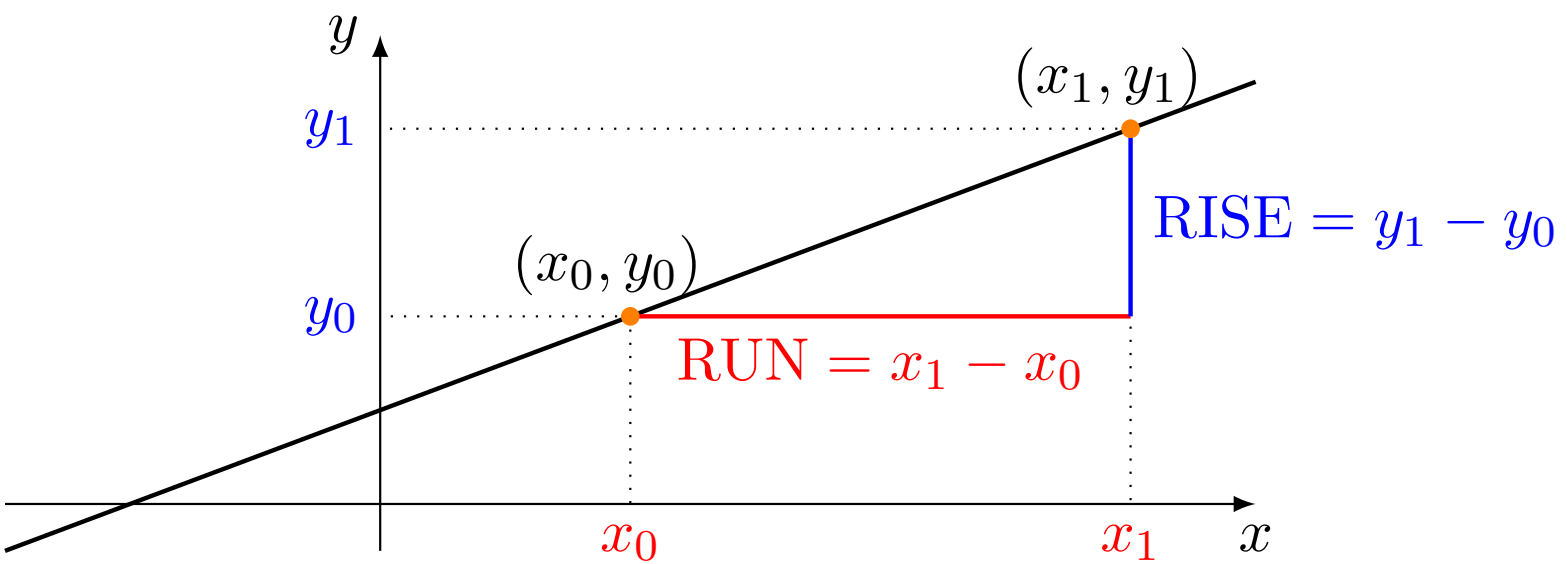
General Case

5. A line goes through two points: (x_0, y_0) and (x_1, y_1). Find the slope of this line. Draw a picture!

A= $y_1 - y_0$ B= $(y_1 - x_1)/(y_0 - x_0)$

C= $(y_1 - y_0)(x_1 - x_0)$

D= $(y_1 - y_0)/(x_1 - x_0)$ E= Shirley you're joking D



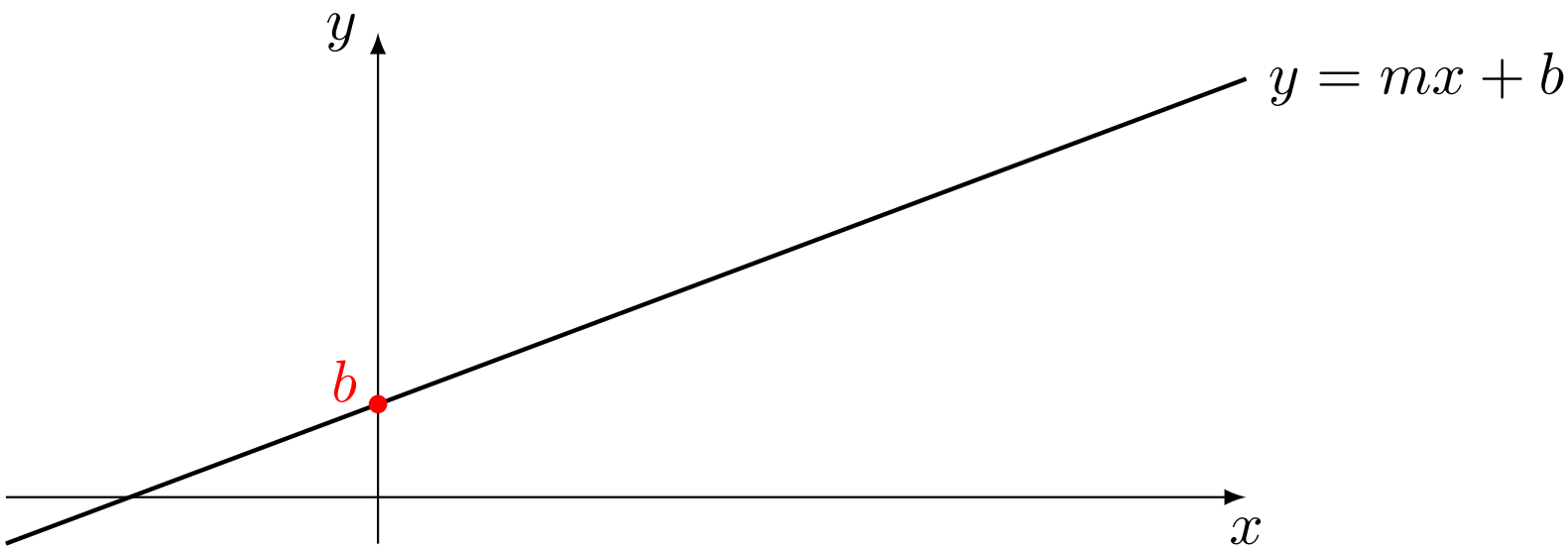
$$\text{Slope} = \frac{\text{RISE}}{\text{RUN}} = \frac{y_1 - y_0}{x_1 - x_0}$$

The Equation of a Line

The Slope Intercept Form

The **slope intercept** equation of a straight line is

$\boxed{y = mx + b}$.



m = the **slope**. CRUCIAL for calculus.

b = where the line crosses the y-axis (the "y-intercept").

WHY? Because when you plug in $x = 0$, you get $y = b$.

Example

6. Find the equation of the line $\boxed{y = mx + b}$ through the points $(1, 3)$ and $(7, 5)$.

Plan: Find m, then find b.

- What is m?

  A= 1 B= 3 C= 5 D= 1/3 E= 2 D

So $y = \frac{1}{3}x + b$. What is b? Plug in either point!

- What do you get for b?

  A= 1/3 B= 4/3 C= 7/3 D= 8/3 E= 10/3

  D

Can we check?

You Try It

7. A line has slope $1/2$ and goes through the point $(2, 5)$. What is the y-coordinate of the point on this line where $x = 6$?

A= 3 B= 4 C= 5 D= 6 E= 7 E

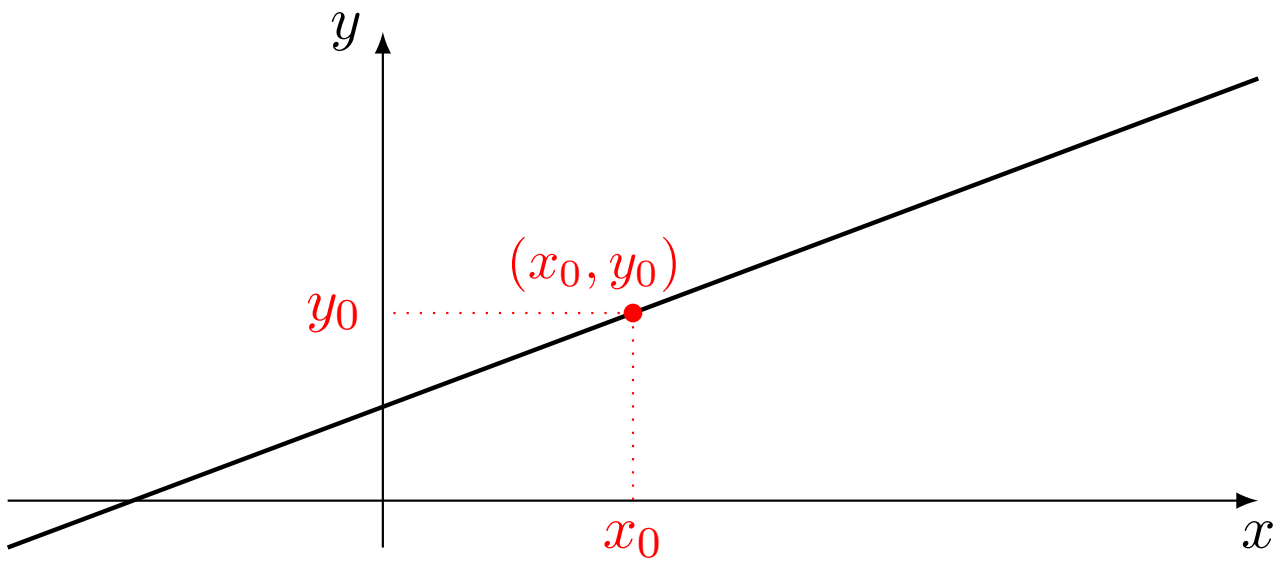
Plan: 1. Find equation of the line.
2. Plug in $x = 6$ to find y.

Another Equation of a Line

The Point-Slope Form

The **point slope** equation of a straight line is

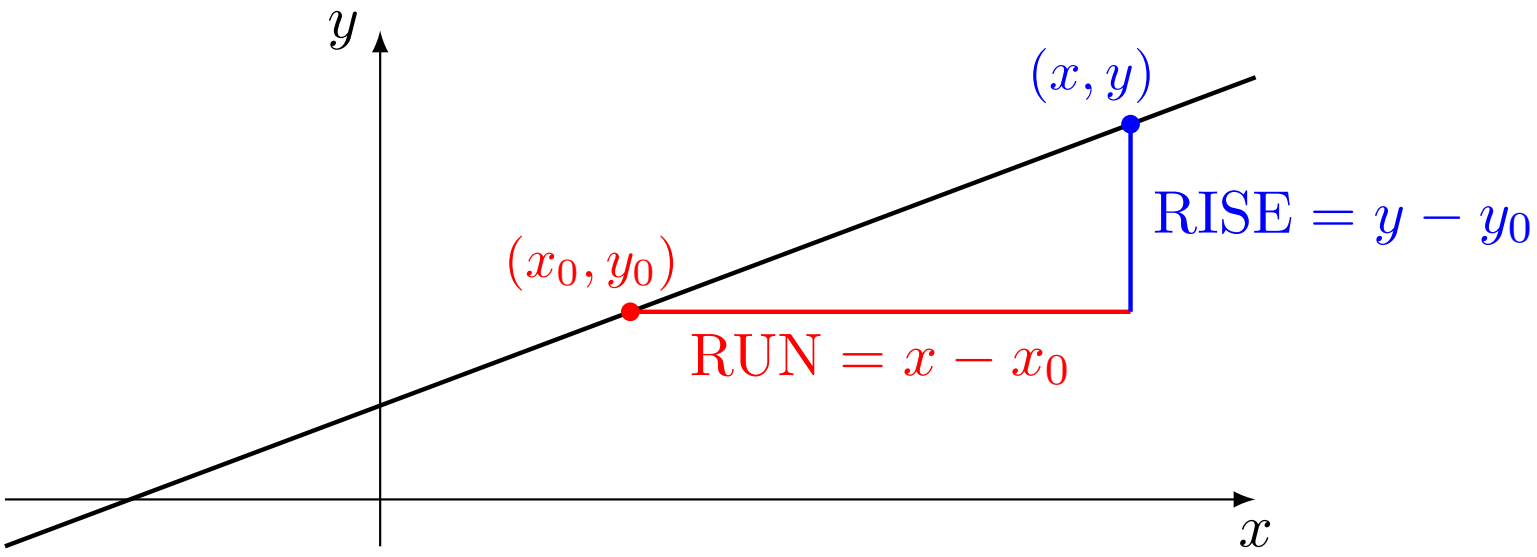
$$\boxed{y = y_0 + m(x - x_0)}.$$



m = the **slope**. Still CRUCIAL for calculus.

(x_0, y_0) = any point on the line.

Why Does This Work?



(x, y) lies on the line exactly when

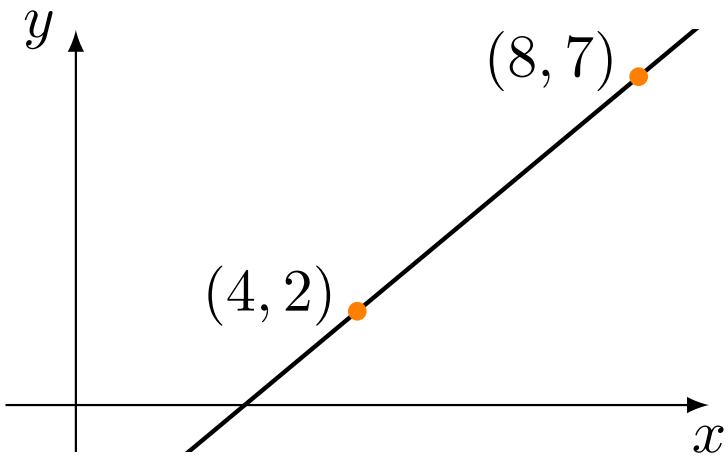
$$\frac{y - y_0}{x - x_0} = m$$

$$y - y_0 = m(x - x_0)$$

$$y = y_0 + m(x - x_0)$$

Examples

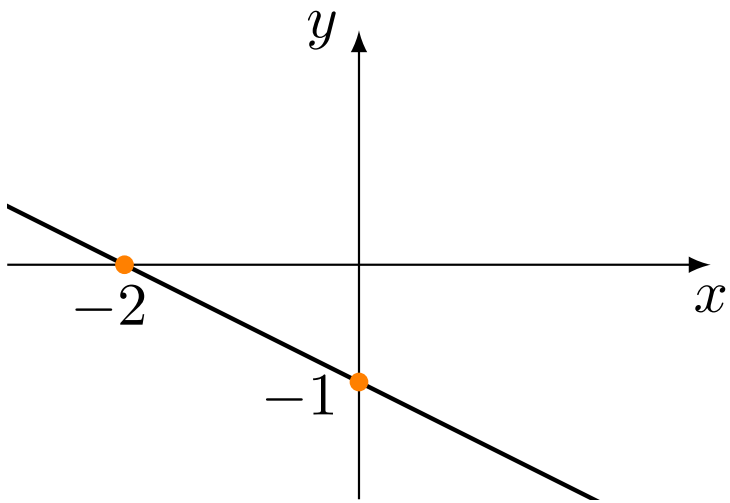
8. Find the equations of these lines (whose slopes we've already found):



$m = 5/4$

$y - 2 = \frac{5}{4}(x - 4)$

$y = \frac{5}{4}x - 3$



$m = -1/2$

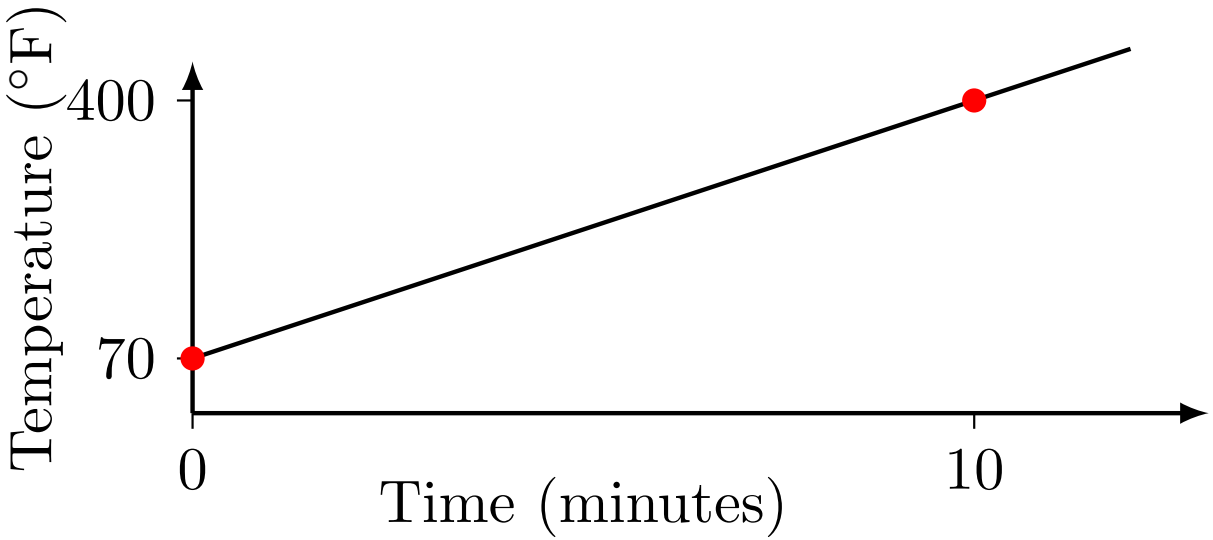
$y - (-1) = -\frac{1}{2}(x - 0)$

$y = -\frac{1}{2}x - 1$

And. . . ?

Yes, but what's this got to do with calculus?
Derivatives are about **rate of change** and that is what **slope** is!

Example: This graph shows the temperature in an oven as it heats up:



9. How quickly (in °F/min) is the oven heating up?

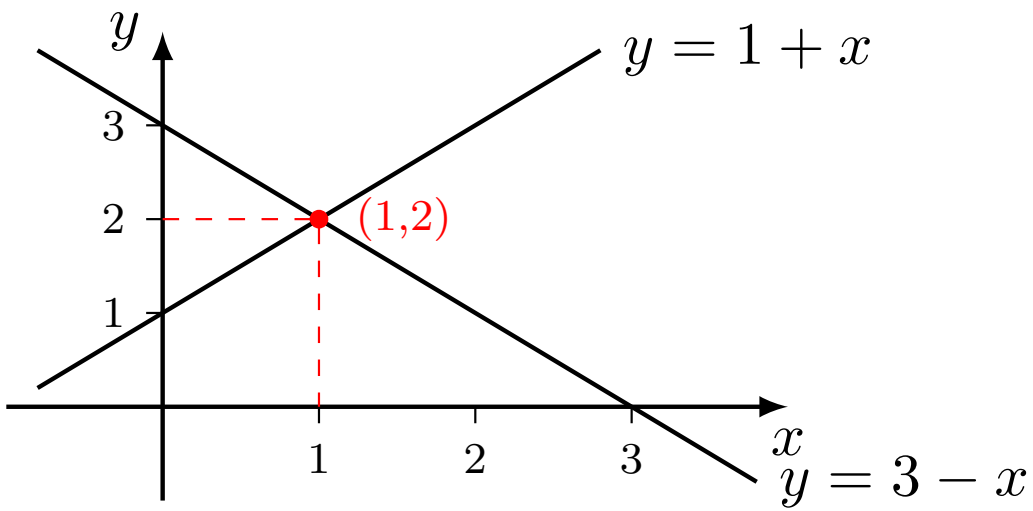
A= 70 B= 10 C= 40 D= 33 E=Other D

One More Example

10. Where does the line $y = 1 + x$ cross the line $y = 3 - x$?
Find both the x and y coordinates of the crossing point.

Plan:

1. Draw a picture! showing two straight lines crossing.
2. Solve the two simultaneous equations
3. THINK why this gives the answer!



That's it. Thanks for being here.