MA 241 Calculus I
Text : *"Calculus"*
by James Stewart

Instructor : Dr. E. Jacobs

Office : COAS 301-23

Office Hours

MWF	4:00 - 5:00
Thur	1:00 - 2:00

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Section 07

Class meets on Mon, Wed, Fri from 3:00 to 3:50 in COAS 317
Class also meets on Thursday from 3:45 to 5:00 in COAS 303

Grading System

Exam Average	84%
Homework Average	16%

Grading System

Exam I	21%
Exam II	21%
Exam III	21%
Final Exam	21%
Homework	16%

Let T_1, T_2 and T_3 be the midterm exam scores
Let T_4 be the score on the final exam
Let H be the homework average

$$\begin{matrix}\text{Overall} \\ \text{Average}\end{matrix} = (0.84)\left(\frac{T_1 + T_2 + T_3 + T_4}{4}\right) + (0.16)H$$

Suppose a student scores 90, 90 and 20 on the first three exams of the course. The student has a homework average of 50. Will this student have to repeat the course if he does well on the final exam?

Solution:

Let x be the score on the final exam.
Let y be the overall average in the course

$$y = (0.84)\left(\frac{90 + 90 + 20 + x}{4}\right) + (0.16)(50)$$

This simplifies to:

$$y = 50 + (0.21)x$$

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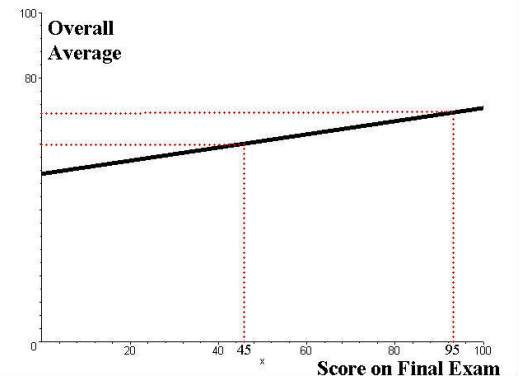
Maximum grade if $x = 100$

$$y = 50 + (0.21)(100) = 50 + 21 = 71$$



$$y = (0.21)x + 50$$

In general, the equation of a line is:

$$y = mx + b$$

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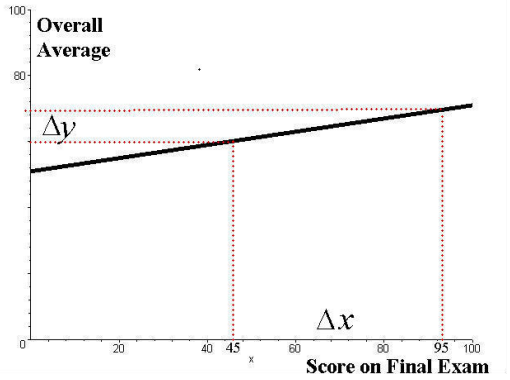
b is the y-intercept
m is the slope

$$m = \frac{\Delta y}{\Delta x}$$



Rules for Exams

1. You may not have formulas or notes with you on exams.
2. Bring your own calculator. Scientific calculators only. No graphing calculators.
3. Make-up exams will only be given for in very special circumstances. Arrangements for a make-up exam must be made within 24 hours of the original exam.

Rule for Homework

1. Homework must be neat. Show work.
2. If homework takes more than one sheet of paper, the pages must be stapled.
3. The work you hand in should be your own.
4. Homework must be handed in on time.

Attendance

Attendance is not counted in your grade in the course except for borderline cases.

Some Important Dates

Exam I	Thursday, September 22
Exams II,III	Dates to be announced
Final Exam	Monday, December 12
Assignment 1	Friday, September 2

The homework and exam schedule may be affected by the weather.

Coastal Watches/Warnings and 5-Day Cone

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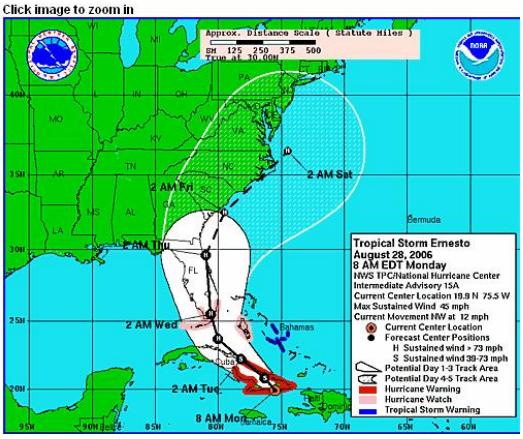

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Calculus

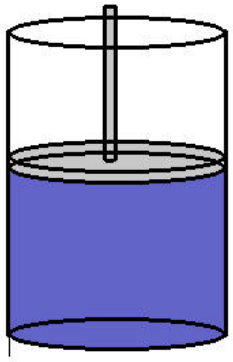
The Mathematics of Change

The two central questions of calculus:

How fast?

How much?

Let V denote the volume in a piston
Let P denote the pressure of the gas inside the piston



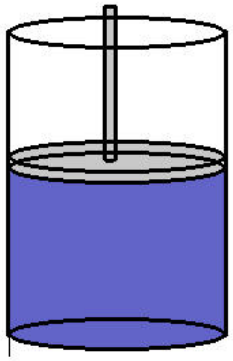
The value of P depends on the value of V
P is a **function** of V

$$P = f(V)$$

If we change the value of V, we will automatically change the value of P.

How fast is P changing with respect to V?

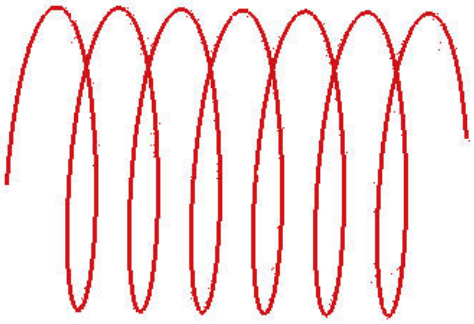
If we change V a certain amount ΔV, how much will P change?



Let $x =$ the distance (in meters) a spring is stretched.

Let $E =$ the energy it takes to stretch the spring x meters

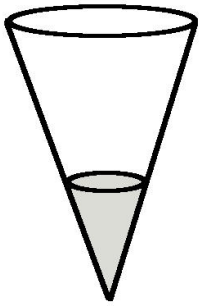
$$E = f(x)$$



How fast is E changing with respect to x?

If we change x by a certain amount Δx, how much will E change?

Water is being poured into a conical container.



Let h = the height of the water level

Let M = the mass of water inside this container

$$M = f(h)$$

How fast is the mass changing with respect to the water level?

If the water level increases by an amount Δh, how much increase in mass will we get?

A ball is dropped from cliff.

Let t be the elapsed time (in seconds) that the ball is falling.

Let s be the distance (in meters) that the ball has fallen after t seconds.

$$s = s(t)$$

How fast is the ball falling?

How much does the ball fall after t seconds?

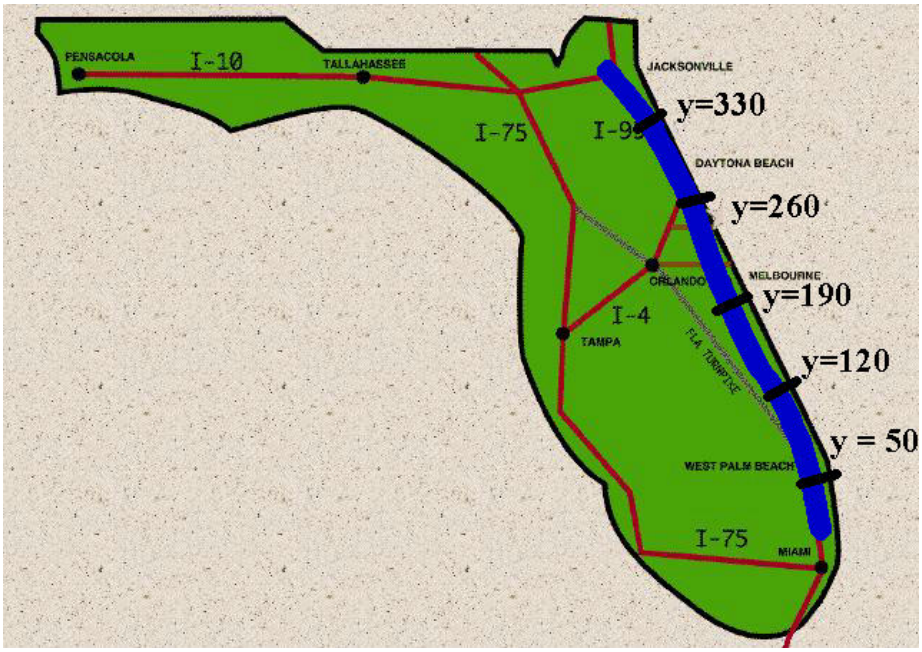
If we wait an additional Δt seconds longer, how much additional distance Δs will the ball fall?

How fast - Differential Calculus

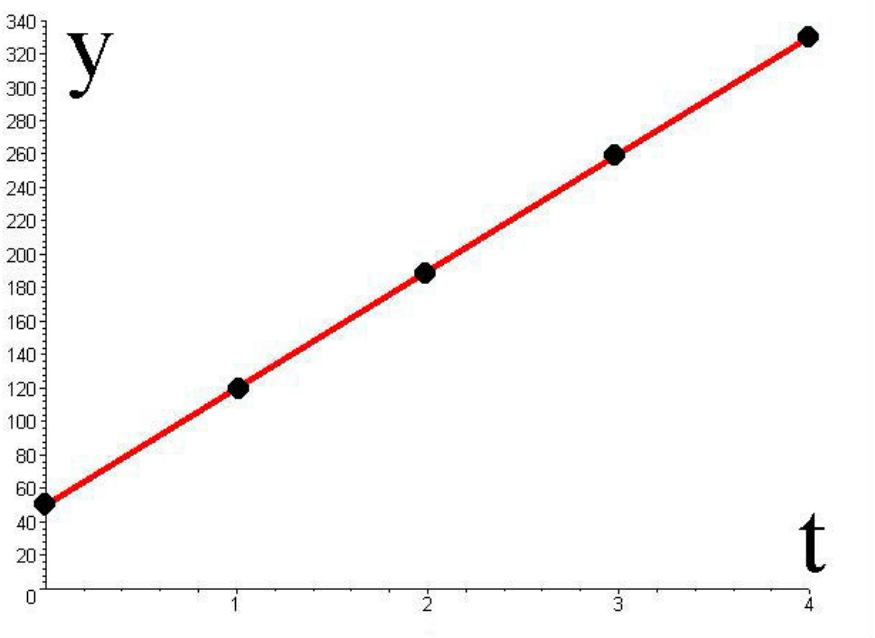
How much - Integral Calculus

A car is traveling north on Route 95 at the speed limit of 70 mph.

The car begins at Mile Marker 50.



Let t denote the time of travel (in hours)
Let y denote the mile marker that the car is up to



$$\text{Distance} = (\text{Rate})(\text{Time})$$

$$y - 50 = 70t$$

$$y = 70t + 50$$

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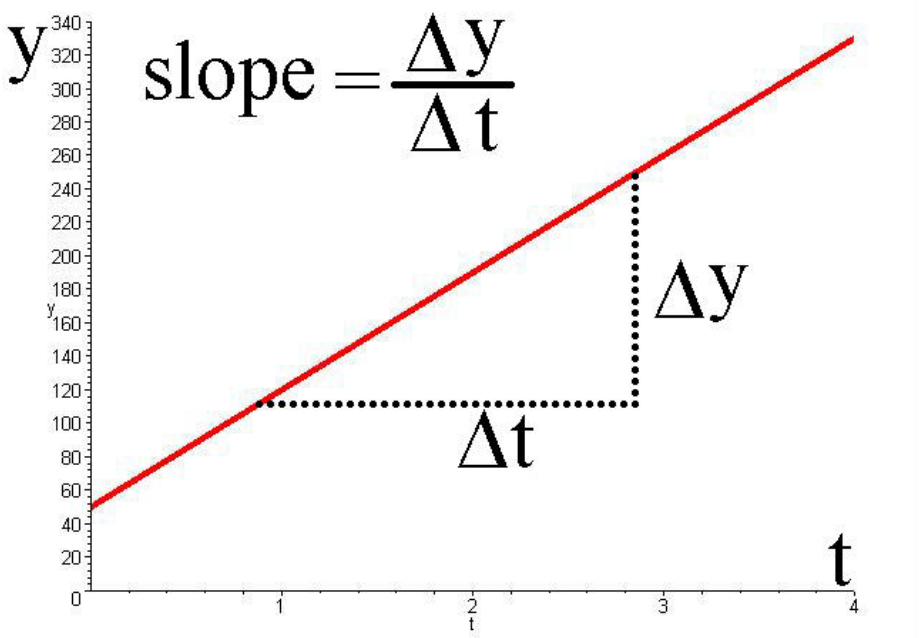
Compare to the equation of a straight line:

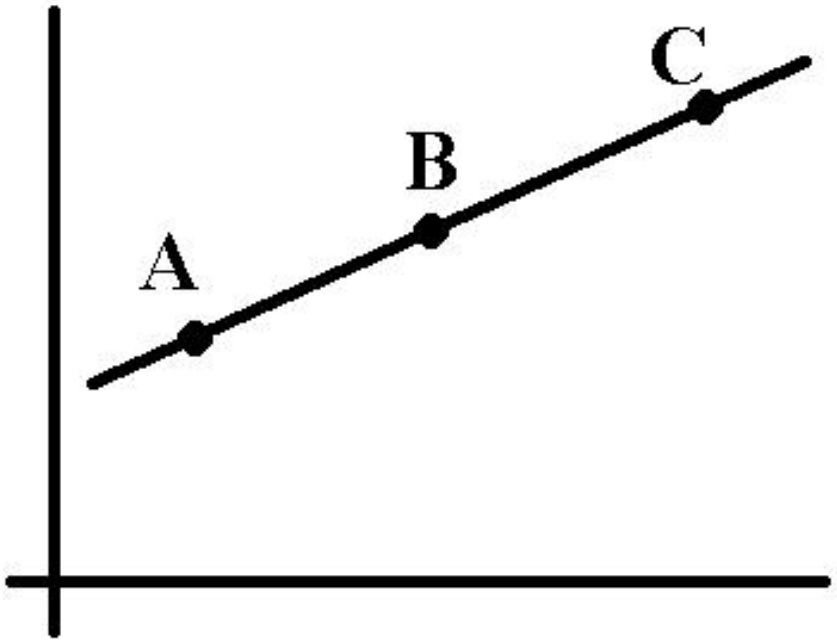
$$y = mx + b$$

$$\text{velocity} = \frac{\text{Change in distance}}{\text{Change in time}}$$



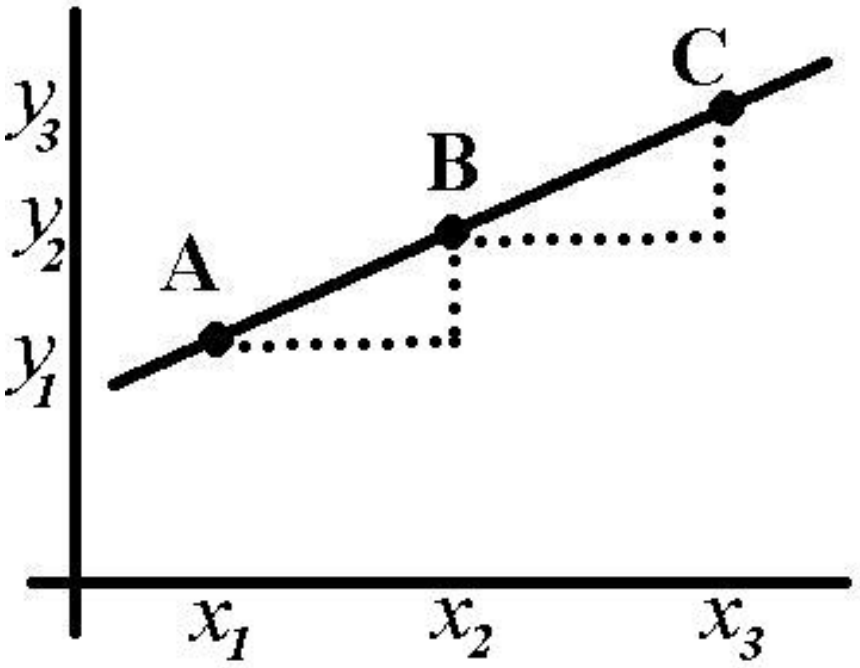
Rate of change = slope

Let A, B and C be three points on a line.



Let (x_1, y_1), (x_2, y_2) and (x_3, y_3) be the coordinates of these points. By similar triangles,

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{y_3 - y_2}{x_3 - x_2}$$



The ratio of the change in height to the change in base is the *slope*

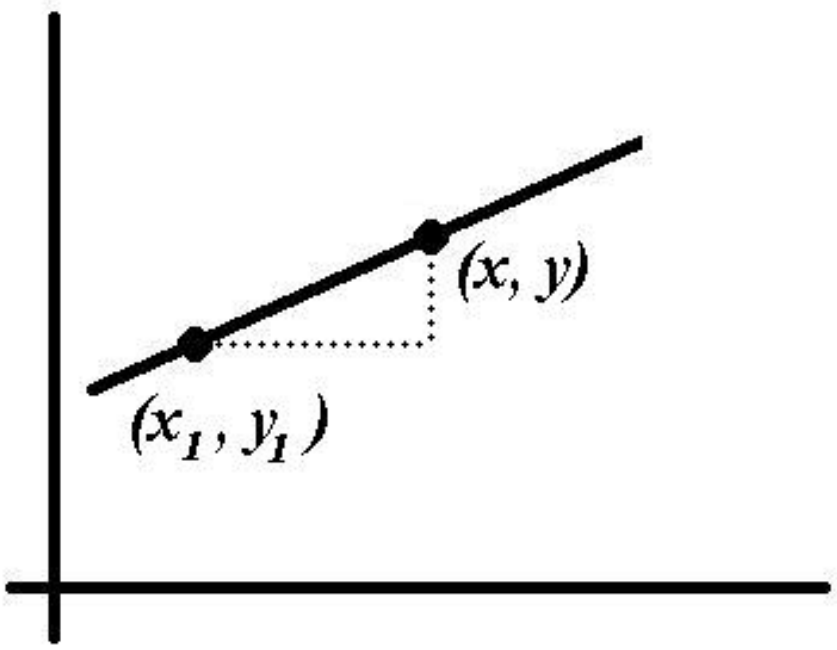
$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{y_3 - y_2}{x_3 - x_2}$$

Other notation:

$$m = \frac{\Delta y}{\Delta x} = \frac{\text{rise}}{\text{run}}$$

If (x_1, y_1) is a point on the line and (x, y) is any other point on the line, then

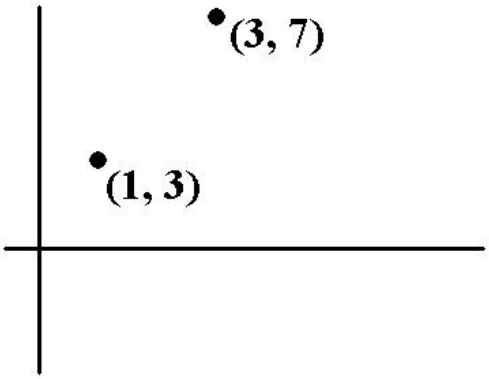
$$m = \frac{y - y_1}{x - x_1}$$



$$y - y_1 = m(x - x_1)$$

Point-Slope Formula of the Straight Line

Example:
Find the equation of the line that passes through the points $(1, 3)$ and $(3, 7)$



Find the equation of the line that passes through the points $(1, 3)$ and $(3, 7)$

$$m = \frac{\Delta y}{\Delta x} = \frac{7-3}{3-1} = 2$$

$$\text{Let } (x_1, y_1) = (1, 3)$$

$$y - y_1 = m(x - x_1)$$

$$y - 3 = 2(x - 1)$$

$$y = 2x + 1$$

The equation $y = 2x + 1$ is in the form:

$$y = mx + b$$

Slope-Intercept Formula

The point $(0, b)$ is the y-intercept

Example:
Find the equation of the line that passes through the points $(0, -3)$ and $(3, 3)$

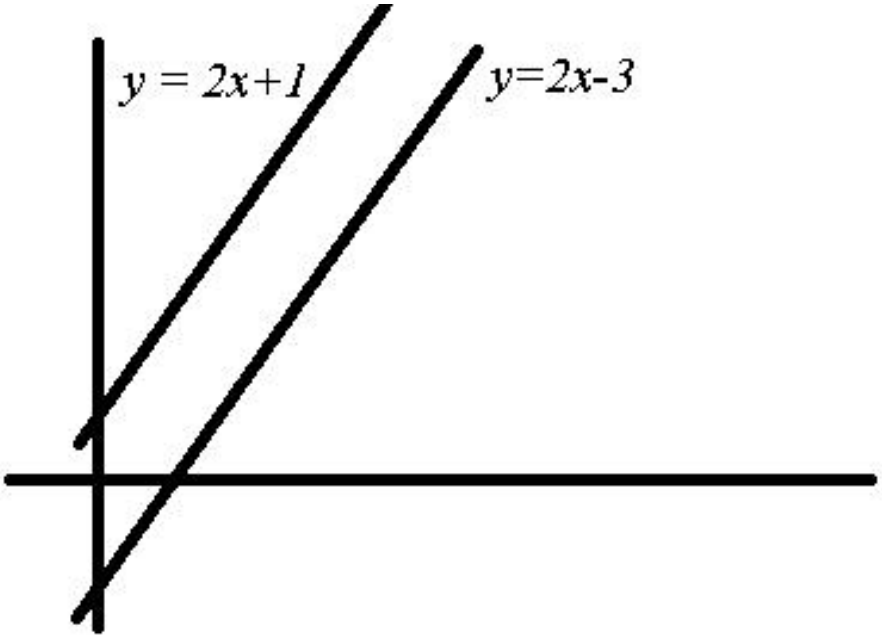
Find the equation of the line that passes through the points $(0, -3)$ and $(3, 3)$

$$m = \frac{\Delta y}{\Delta x} = \frac{3 - (-3)}{3 - 0} = 2$$

$$b = -3$$

$$y = 2x - 3$$

Parallel lines have the same slope



Find the equation of the line through the points $(-2, 1)$ and $(4, -2)$

Find the equation of the line through the points $(-2, 1)$ and $(4, -2)$

$$m = \frac{\Delta y}{\Delta x} = \frac{-2-1}{4-(-2)} = -\frac{1}{2}$$

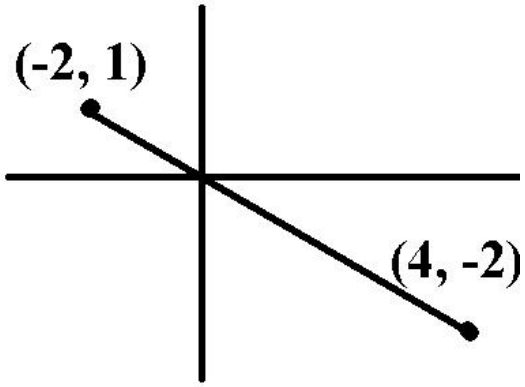
$$y - y_1 = m(x - x_1)$$

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

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

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

$y = -\frac{1}{2}x$ is in the form $y = mx + b$ where $m = -\frac{1}{2}$ and $b = 0$



Increasing lines have positive slopes.
Decreasing lines have negative slopes.

What does it mean if a line has a slope of 0