— Today we are going to review some important ideas. Keep this review handy for the rest of the semester.

Functions: A rule that takes certain numbers as inputs and assigns to each a definite output.

$$y = f(x)$$

dependent variable (y) — independent variable (x)

• each x-value gives exactly one y-value

The set of inputs = DOMAIN
The set of outputs = RANGE

• you are expected to know what functions look like without using a graphing calculator.

Practice this! Desmos.com – online graphing!

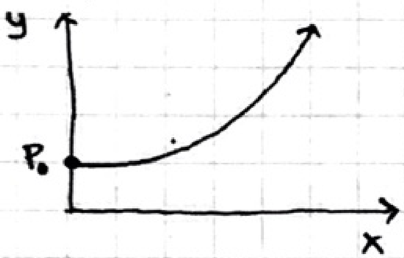
Important Functions

★ Linear Functions: $y = mx + b$

m = slope $= \frac{\text{rise}}{\text{run}}$ b = intercept

- given two points or a point and slope you should be able to find the line eqn!

★ Exponential Functions: $y = P_0 a^x$



P_0 = Initial quantity value when $x = 0$

a = factor by which the function changes when $x = 1$

You can always plug in given points to fit an exponential curve.

An important one $y = P_0 e^{kx}$

Eulers #
$e = 2.71828$
it's just a #

k - positive = exponential growth
k - negative = exponential decay

RULES

$$e^{ax} e^{bx} = e^{ax+bx} = e^{(a+b)x}$$

$$(e^{ax})^b = e^{abx}$$

$$\ln(e^{ax}) = ax$$

These must be memorized!

★ Logarithmic Functions $y = \log_a x$ or $y = \ln(x)$

natural log $\log_e(x)$

Why do we need this?

Ex solve: $10^y = x$ for y...

to get the y out of the exponent:

$$\log_{10}(10^y) = \log_{10}(x)$$ take $\log_{10}$ of both sides.

$$y \cdot \log_{10}(10) = \log_{10}(x)$$

$$y = \log_{10}(x)$$ solved!

We sometimes go the other way $10^{\log_{10}(x)} = x$.

Ex. Solve $e^y = x$ for y

use the natural log...

$$\ln(e^y) = \ln(x)$$
$$y \cdot \ln(e) = \ln(x)$$
$$y = \ln(x).$$

<u>RULES</u>

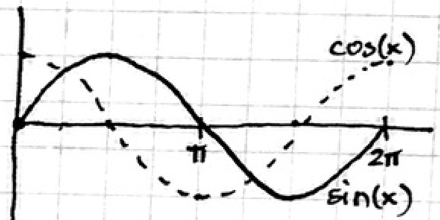
$$\left.\begin{aligned} \log(AB) &= \log(A) + \log(B) \\ \log\left(\frac{A}{B}\right) &= \log(A) - \log(B) \\ \log(1) &= 0 \\ \log(A^p) &= p\log(A) \end{aligned}\right\}$$

These must be memorized!

common mistake: $\log(A+B) \neq \log(A) + \log(B)$

★ Trig Functions. – always use radians.

$y = \sin(x)$
$y = \cos(x)$



memorize the graphs and important values.
$0,\ \pi/2,\ \pi,\ 3\pi/2,\ 2\pi$

$$\sin^2 x + \cos^2 x = 1$$
$$\tan(x) = \frac{\sin(x)}{\cos(x)}$$

$\sin(AB) \neq \sin(A)\sin(B)$

common mistake: $\sin(A+B) \neq \sin(A) + \sin(B)$

ALWAYS USE TRIGONOMETRIC IDENTITIES TO SIMPLIFY THESE!

★ Power Function $y = kx^p$ k and p are constants

Polynomials are sums of power functions

$$y = a_n x^n + a_{n-1}x^{n-1} + \cdots + a_1 x + a_0$$

<u>EX</u> $y = 3x^3 + x^2 + 4x + 1$

polynomial of degree three

★ Rational Function is a ratio of two polynomials

$$y = \frac{f(x)}{P(x)}$$

EX $y = \dfrac{x+1}{x^2+4x+3}$ $\dfrac{\text{polynomial degree 1}}{\text{polynomial degree 2}}$

we can often simplify these but be careful!

$y = \dfrac{\cancel{(x+1)}}{\cancel{(x+1)}(x+3)} = \dfrac{1}{x+3}$ we can cancel multiplied factors

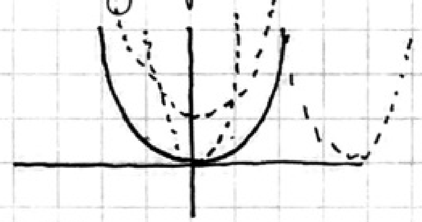
common mistake: $y = \dfrac{x}{x+3} \neq \dfrac{1}{3}$

can't cancel out if things are added
must factor first !!

These are the basic functions... remember that we can add and multiply by constants to shift these functions around and make new graphs.

practice on DESMOS.com

EX $y = x^2$



$y = x^2 + a$ shift up

$y = ax^2$ squeeze or flatten

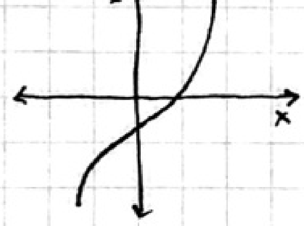
$y = (x+a)^2$ shift left or right.

• Ch 1.3 goes over this in more detail

Continuity – a function is continuous on an interval if on that interval there are no breaks, jumps, or holes.

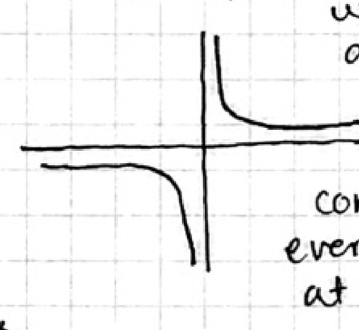
calculus relies on the idea of continuity.

EX $y = 3x^3 - x^2 + 2x - 1$



continuous everywhere

$y = 1/x$ undefined when $x=0$ and $y \neq 0$



continuous everywhere BUT at the origin.

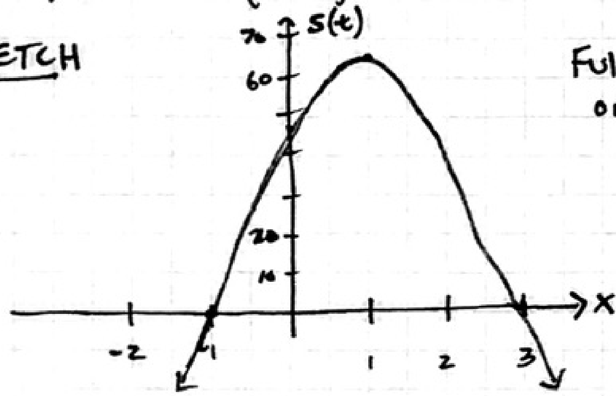
1.8

NEXT TIME MORE... Limits and Continuity.

Example Recording: Activity 1.1.2

$s(t) = 64 - 16(t-1)^2$

SKETCH

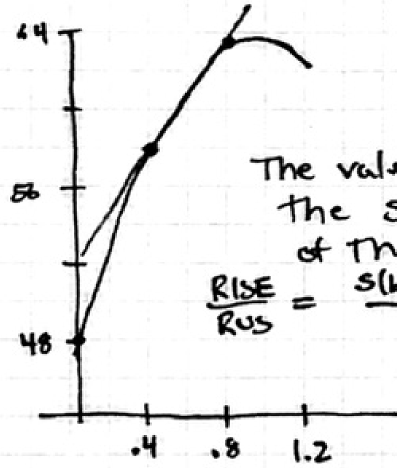


Full function on Desmos.

Average Velocity: USING CALCULATOR. plug into eqn $\longrightarrow$ $AV_{[a,b]} = \dfrac{s(b) - s(a)}{b - a}$

a	b	$AV_{[a,b]}$
.4	.8	12.8 ft/s
.7	.8	8 ft/s
.79	.8	6.56 ft/s
.799	.8	6.416 ft/s
.8	1.2	0 ft/s
.8	.9	4.8 ft/s
.8	.81	6.24 ft/s
.8	.801	6.384 ft/s

PLOT $\longrightarrow$



The values are the SLOPE of this line!

$\dfrac{\text{RISE}}{\text{RUN}} = \dfrac{s(b) - s(a)}{b - a}$

When I plot on desmos.com and zoom in, it starts to look like a straight line.

I think the velocity at exactly $t = .8$ is about 6.4 ft/s.