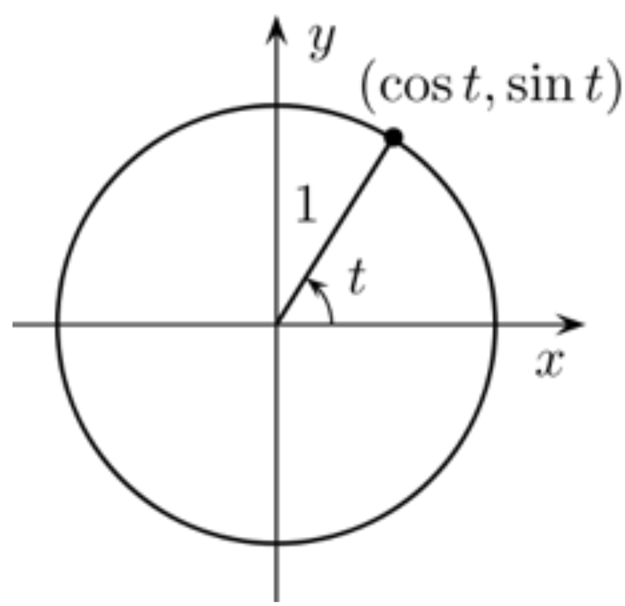
Vocabulary

ACCELERATION	EVEN	PARABOLA	SYMMETRY
COMPRESS	HORIZONTAL	PERIODIC	TANGENT
CONCAVE	INFLECTION	PERPENDICULAR	VELOCITY
CONSTANT	INTEGRATE	POLYNOMIAL	VERTICAL
COSINE	INTEGRATION	QUADRATIC	REFLECTION
DERIVATIVE	LINEAR	SECANT	
DIFFERENTIATE	ODD	SINE	
EXPONENT	OPTIMUM	STRETCH	

Trigonometry Review

Unit Circle	
$\sin t = y$	$\csc t = \frac{1}{y}$
$\cos t = x$	$\sec t = \frac{1}{x}$
$\tan t = \frac{y}{x}$	$\cot t = \frac{x}{y}$



deg	t	sin	cos
$0°$	0	0	1
$30°$	$\frac{\pi}{6}$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
$45°$	$\frac{\pi}{4}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
$60°$	$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$
$90°$	$\frac{\pi}{2}$	1	0

Memory Device					
$[0,1]$	$\frac{\sqrt{0}}{2}$	$\frac{\sqrt{1}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{4}}{2}$

Graphs of Functions

Degree	Equation	Function	Graph
0	$y = k$	constant	horizontal straight line
1	$y = mx + b$	linear	straight line with slope m
2	$y = ax^2 + bx + c$	quadratic	parabola
n	$y = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$	polynomial	smooth curves

Transformation	Function	Domain
shift up	$y = f(x) + k$	
shift down	$y = f(x) - k$	
shift left	$y = f(x + h)$	
shift right	$y = f(x - h)$	
vertically stretch	$y = af(x)$	$for\ a > 1$
vertically compress	$y = af(x)$	$for\ 0 < a < 1$
horizontally stretch	$y = f(ax)$	$for\ a > 0$
horizontally compress	$y = f(ax)$	$for\ 0 < a < 1$

Derivatives

Definition of the Derivative

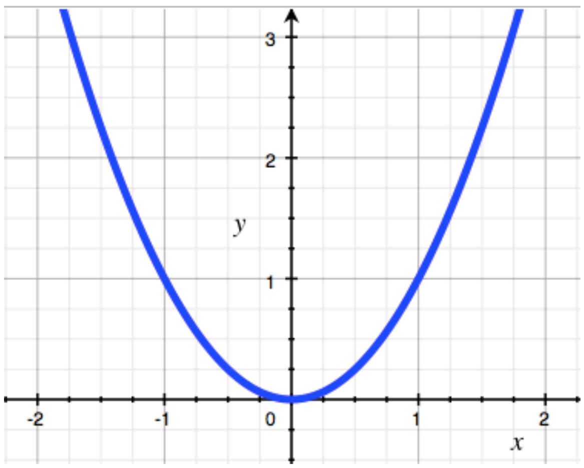
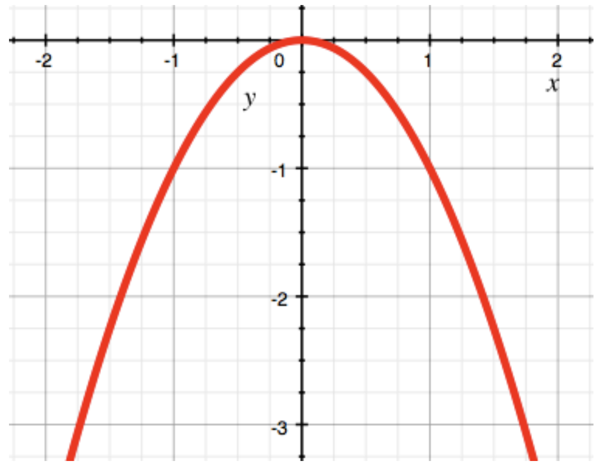
$$\frac{df}{dx} = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$
$$= \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$
$$= \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x}.$$

Derivative Notation

$$\left(\frac{d}{dx}\right)^n y(x) = \frac{d^n y}{dx^n}.$$

y	dy/dx
c	0
cx	c
$cf(x)$	$c\frac{d}{dx}f(x)$
$f(x) + g(x)$	$\frac{d}{dx}f(x) + \frac{d}{dx}g(x)$
cx^n	cnx^{n-1}

Maxima and Minima

Concave Upward	Concave Downward
	

Curve	slope	y''	point
Concave upward	increasing	(+) positive	minimum
Concave downward	decreasing	(–) negative	maximum

Rules for drawing curves

y'	y''	y=f(x)
+		increasing
–		decreasing
0		horizontal tangent at that point
	+	concave upward (holds water)
	–	concave downward (spills water)
	0	has a point of inflection, IF y'' is positive on one side of the point, and negative on the other side of the point
0	+	the point is a *local minimum*
0	–	the point is a *local maximum*

Derivatives of Complicated Functions

Rule	y	dy/dx
Power Rule	$y = x^n$	$\frac{dy}{dx} = nx^{n-1}$
Chain Rule	$y = f(u)$	$\frac{dy}{dx} = \frac{dy}{du}\ \frac{du}{dx} = f'(u)u'$
Product Rule	$y = uv$	$\frac{dy}{dx} = uv' + vu'$
Quotient Rule	$y = \frac{u}{v}$	$\frac{dy}{dx} = \frac{vu' - uv'}{v^2}$

$n =$ *any rational number*

$u = u(x)$ $\quad u' = \frac{du}{dx}$

$v = v(x)$ $\quad v' = \frac{dv}{dx}$

Derivatives of Trigonometric Functions

y	dy/dx
$\sin x$	$\cos x$
$\cos x$	$-\sin x$
$\tan x$	$\sec^2 x$
$\sin u(x)$	$(\cos u)\ \frac{du}{dx}$
$\cos u(x)$	$(-\sin u)\ \frac{du}{dx}$
$\tan u(x)$	$(\sec^2 u)\ \frac{du}{dx}$

Optimum Values and Related Rates

- Maximum possible area given perimeter (p104)
- Maximum possible volume given surface area (p106)
- Maximize volume of right cylinder given surface area (p108)
- Related rates of volume and radius of a sphere (p111)
- Related rates involving similar triangles (p112)

General Method

1) define equations (write down what you know)
2) describe a relationship in one variable
3) use derivatives to solve
    a) set derivative to zero and solve for variable, or
    b) use the chain rule

Remember rates as derivative

rate	derivative
position	s
velocity	$\frac{ds}{dt}$
acceleration	$\frac{d^2s}{dt^2} = \frac{dv}{dt}$