Closing tonight: 2.8
Closing Fri: 3.1-2
Closing Mon: 3.3 (finish sooner!)

Exam 1 is Tuesday, Jan 31st in your normal quiz section. Covers 2.1-2.3,2.5-2.8, 3.1-3.3.

- One 8.5 by 11 inch sheet of ***handwritten*** notes (front and back)
- A Ti-30x IIs calculator (this model only!)
- Pen or pencil (no red or green)
- No make-up exams.

All homework is fair game. Know the concepts well. Practice on old exams.

1. $\frac{d}{dx}(c) = 0$
2. $\frac{d}{dx}(f(x) + g(x)) = f'(x) + g'(x)$
3. $\frac{d}{dx}\left(cf(x)\right) = cf'(x)$
4. $\frac{d}{dx}(x^n) = nx^{n-1}$
5. $\frac{d}{dx}(e^x) = e^x$ and $\frac{d}{dx}(a^x) = a^x \ln(a)$

Entry Task:

Find the derivatives of

$a)\ g(x) = \frac{x^3}{2} - \frac{3}{\sqrt{x^5}} + \frac{e^x}{10}$

$b)\ f(x) = \frac{20}{3}x^3 - \frac{7x^2}{2} - 6x + 90$

$c)$ Find all *x* at which $y = f(x)$ has a horizontal tangent.

Application Notes:

1. $f'(a) =$ "slope of tangent to f(x) at *a*"
2. *Tangent Line Equation*:

$$y = f'(a)(x - a) + f(a)$$

3. $-\frac{1}{f'(a)} =$ "slope of *normal* to f(x) at *a*"
4. *Normal Line Equation*:

$$y = -\frac{1}{f'(a)}(x - a) + f(a)$$

Example: Let $f(x) = x^2 + 3$.

a) Find $f'(x)$
b) Find the equations for the tangent and normal lines at x = 2.
c) Find all points on y = f(x) at which the normal line would also pass through (0,10)

3.2 Product and Quotient Rules

6. $\frac{d}{dx}(f(x)g(x)) = f(x)g'(x) + f'(x)g(x)$

7. $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{g(x)^2}$

Examples: Find y'

$a)\ y = x^4 e^x$

$b)\ y = \frac{2x^3}{x^2 + 4}$

6. Product Rule Proof:

$$\lim_{h\to 0}\frac{f(x+h)g(x+h)-f(x)g(x)}{h}$$
$$=\lim_{h\to 0}\frac{f(x+h)g(x+h)-f(x+h)g(x)+f(x+h)g(x)-f(x)g(x)}{h}$$
$$=\lim_{h\to 0} f(x+h)\frac{g(x+h)-g(x)}{h}+g(x)\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

You do: Find $\frac{dy}{dx}$

$a)\ y=\left(\sqrt{x}+4x\right)3^x-\frac{14}{x^5}$

$b)\ y=6(x+3)^2+\frac{e^x}{x^3}$

$$c)\ y = \frac{2x^2 + 1}{x^3 e^x}$$

3.3 Derivatives of Trig Functions

First, some things you must know about trig functions:

$\sec(x) = \dfrac{1}{\cos(x)}$	$\csc(x) = \dfrac{1}{\sin(x)}$
$\tan(x) = \dfrac{\sin(x)}{\cos(x)}$	$\cot(\mathrm{x}) = \dfrac{\cos(x)}{\sin(x)}$

Identities needed for today:

$$\sin(a+b) = \sin(a)\cos(b) + \cos(\mathrm{a})\sin(b)$$

$$\cos(a+b) = \cos(\mathrm{a})\cos(b) - \sin(a)\sin(b)$$

Consider $f(x) = \sin(x)$.

Then

$$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$$
$$= \lim_{h\to 0} \frac{\sin(x+h) - \sin(x)}{h}$$

$\frac{d}{dx}(\sin(x)) = \cos(x)$	$\frac{d}{dx}(\cos(x)) = -\sin(x)$
$\frac{d}{dx}(\tan(x)) = \sec^2(x)$	$\frac{d}{dx}(\cot(x)) = -\csc^2(x)$
$\frac{d}{dx}(\sec(x)) = \sec(\mathrm{x})\tan(\mathrm{x})$	$\frac{d}{dx}(\csc(x)) = -\csc(\mathrm{x})\cot(\mathrm{x})$