Closing Today: 3.9
Closing Mon: 3.10
Midterm 2 is Tuesday!
Covers 3.4-3.6, 3.9, 3.10
All derivative rules
- Product, Quotient, Chain
- Implicit (includes inverse trig)
- Logarithmic
- Parametric

Some Applications
- Related Rates
- Tangent Lines
- Linear Approximation (Friday)

Expect a problem of each type.
Expect 2 pages of related rates.

Some old exams have *critical number* or *max/min* questions, you can ignore these questions for our second midterm.

3.10 Linear Approximation

Idea: “Near” the point (a,f(a)) the graphs of $y = f(x)$ and the tangent line

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

are very close together.
We say the tangent line is a **linear approximation** or **linearization** or **tangent line approximation** to the function. Sometimes it is written as

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

In other words:
If $x \approx a$, then

$$f(x) \approx f'(a)(x-a) + f(a)$$

Examples:

1. Find the linear approximation to

$$f(x) = \sqrt{x} \text{ at } x = 81.$$

Then use it to approximate the value of $\sqrt{82}$.

2. Find the linearization of

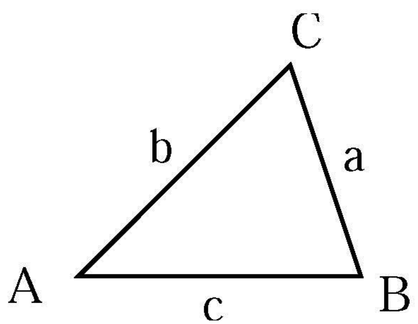
$$g(x) = \sin(x) \text{ at } x = 0.$$

Then use it to approximate the value of sin(0.03).

3. Using tangent line approximation estimate the value of $\sqrt[3]{8.5}$.

Some Homework Hints:

Problem 10: Suppose that *a* and *b* are pieces of metal which are hinged at *C*.



According to the ``law of sines,'' you always have:

$$\frac{b}{a} = \frac{\sin(B)}{\sin(A)}$$

At first: angle *A* is $\pi/4$ radians= 45^o and
angle *B* is $\pi/3$ radians = 60^o.

You then widen *A* to 46^o, without changing the sides *a* and *b*.

Our goal in this problem is to use the tangent line approximation to estimate new the angle *B*.

Problem 8: A right circular cone of height *h* and base radius *r* has total surface area *S* consisting of its base area plus its side area, leading to the formula:

$$S = \pi r^2 + \pi r\sqrt{r^2 + h^2}$$

Suppose you start out with a cone of height 8 cm and base radius 6 cm, and you want to change the dimensions in such a way that the total surface area remains the same. Suppose you increase the height by 26/100. In this problem, use tangent line approximation to estimate the new value of *r* so that the new cone has the same total surface area.