- $\frac{d}{dx}[f(x)g(x)] = f'(x)g(x) + g'(x)f(x)$
- $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$
- $\frac{d}{dx}f(g(x)) = f'(g(x))g'(x)$ and $\frac{d}{dx}x^r = rx^{r-1}$, for all r
- $\frac{d}{dx}\sin(x) = \cos(x)$ and $\frac{d}{dx}\cos(x) = -\sin(x)$,
- $\sin^2(x) + \cos^2(x) = 1$ and $\tan^2(x) + 1 = \sec^2(x)$
- $\tan(x) = \frac{\sin(x)}{\cos(x)}$ and $\sec(x) = \frac{1}{\cos(x)}$

Good Luck! $\sim\sim$ *Yuling* $\ddot{\smile}$

1. (10 points) Find the point(s), if any, at which the graph of

$$f(x) = \frac{x^4}{x^3 + 1}$$

has a horizontal tangent line.

2. (30 points) Find an equation of the tangent line to the given graph at the given point.

$$(a)\ f(t) = (t^2 - 9)\sqrt{t+2} \quad ;\text{at}(-1,-8) \qquad (b)\ f(x) = \frac{x+1}{\sqrt{2x-3}} \quad ;\text{at}(2,3)$$

$$(c)\ x^2 - xy + y^2 = 3 \quad ;\text{at}(-2,-1)$$

3. (20 points) (a) Find $\frac{dy}{dx}$, $y = \sqrt{\tan(9x)}$ (b) Find $f'''(-5)$, $f(x) = \sqrt{4-x}$

4. (20 points) Find all relative extrema and points of inflection of

$$(a)\ g(x) = x\sqrt{x+3} \qquad (b)\ f(x) = \frac{4}{1+x^2}$$

5. (10 points) You are given $f'(x) = -x^2 + 2x - 1$. Find the intervals on which (a) $f'(x)$ is increasing or decreasing, (b) the graph of f is concave upward or concave downward, and (c) find the x-values of the relative extrema and inflection points of f.

6. (10 points) Find the absolute extrema of

$$f(x) = \frac{4}{3}x\sqrt{3-x}$$

on the closed interval $[0, 3]$.