∗ **Note:** No points will be given if no arguments are provided for an answer.

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

Good Luck! ∼∼ *Yuling* ⌣̈

1. (8 points) Show that if a function f is differentiable at $x = c$, then it is continuous at $x = c$.

2. (8 points) Find the equation of the tangent line to the curve of $2x + xy - 2 = \ln(x^3 + y^2)$ at the point $(1, 0)$.

3. (8 points) Find the equation of the tangent line to the graph of $f(x) = x - \ln(\sqrt{x})$ at the point where $x = 1$.

4. (16 points) Find the absolute maximum and absolute minimum (if any) of
   (a) $f(x) = \ln(4x - x^2)$ for $1 \le x \le 3$.
   (b) $h(t) = (e^{-t} + e^t)^3$ for $-1 \le t \le 3$.

5. (40 points) Find the derivative $\frac{dy}{dx}$ or $f'(x)$ where

   (a) $f(x) = 6\tan^3(\ln(\sqrt{3x}))$ (b) $f(x) = x^x\, 6^{x^3}$

   (c) $f(x) = \arcsin(x) = \sin^{-1}(x)$: the inverse function of $\sin(x)$

   (d) $e^{2x-x^3}\log_5 y = 2y\,\sin(x^2) + y\,\ln((3x^2+1)^2)$ (e) $y = \dfrac{(4x^3e^{-2x})^4(2x^5 - 8x + 2)^3}{[1 + \cos(5x^2 - 10x) + x^{5.2}]^{7.4}}$

6. (8 points) Find the second derivative,that is $f''(x)$, of $f(x) = e^{x^2-1} + 5e^{6x} + \ln(x^2 + 2)$.

7. (24 points) Find the indicated limit or show it does not exist. If the limiting value is infinite, indicate whether it is ∞ or $-\infty$.

   (a) $\lim_{x\to 0}(e^{-3x} + 5x)^{1/x}$ (b) $\lim_{x\to 0}\dfrac{\sin(\sqrt{5}x)}{\sin(3x)}$, (c) $\lim_{t\to\infty} t^3e^{-5t}$