Read carefully the following instructions:

- Write your name, section number, and problem number on EACH of the answer sheets. Do no more than ONE full problem per answer sheet, you may use the back or additional sheets if necessary.

- You may <u>not</u> use any books, notes, or calculators. If your solution contains exponentials or logarithms, you do not need to evaluate them.

- Show all your work and explain everything you write.

- As announced in class and on the webpage, problem Number 0 will be graded on a scale of 0 to 1. This number will multiply the total points for the other problems. To get a grade of 1 you should sketch correctly 3 out of the 4 graphs.

- Exam time: 75 minutes. Solve all 5 problems. The maximum grade is 100.

- Good luck!

Problems:

0. (This problem will be graded on a 0-1 scale. That number will multiply the total points you get for the other problems. To get 1 on this problem you should sketch correctly 3 out of the 4 graphs).

   Sketch the graphs of the following functions. Write the values of all intercepts.

   (a) $f(x) = e^x$,   for $-\infty < x < \infty$

   (b) $f(x) = \log_{10} x$,   for $0 < x < \infty$

   (c) $f(x) = \dfrac{1}{\log_{10} x}$,   for $0 < x < \infty$

   (d) $f(x) = \sin(2x)$,   for $-\pi \le x \le \pi$

1. (Each problem 10 points)

   Using the definition of the derivative, find $f'(x)$ for the following functions:

   (a) $f(x) = 6x^2 - 4$.

   (b) $f(x) = \dfrac{2}{x}$.

   Remember that you know how to compute the derivatives of these functions, so checking your answers should be easy.

2. (Each problem 10 points)

   Find the derivatives of the following functions:

   (a) $y(x) = \dfrac{e^x - e^{-x}}{x}$

   (b) $y(t) = t3^{\sqrt{t}}$

   (c) $y(x) = (\ln|x + 1|)^4$

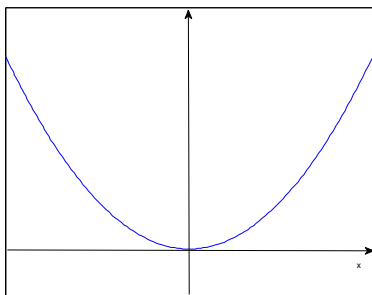   (d) $y(x) = \sqrt{\dfrac{\sin x}{\sin 3x}}$

3. (Each problem 10 points)

   Find the equation of the tangent line to the following curves at the given point

   (a) $f(x) = -\dfrac{3}{e^{x+1}}$ at $x = 0$.

   (b) $f(x) = \dfrac{x^3 - 1}{2\ln x}$ at $x = e$. Do not attempt to evaluate expression like e^3.

4. (a) (10 points) Sketch the graph of the derivative $f'(x)$ of the following function:

   (b) (5 points) Let $f(x) = \cos(2x)$. What is the average rate of change of $f(x)$ over the interval $[0, \frac{\pi}{2}]$? What is the instantaneous rate of change of $f(x)$ at $x = 0$?

   (c) (5 points) For what x is the function $f(x) = |x|$ differentiable? Explain.