Math 180 Written Homework
Assignment #5
Due **Tuesday, October 7th** at the beginning of your discussion class.

Directions. You are welcome to work on the following problems with other MATH 180 students, but your solutions must be hand-written, by your own hand, representing your understanding of the material. Word-by-word copying from another student or any other source is unacceptable. Any work without the proper justification will receive no credit. The list of problem solutions is to be submitted to your TA at the beginning of the discussion class listed above. No late homework will be accepted.

1. Calculate the following derivatives. Do not simplify your answers.

    (a) $\sqrt{x^2 - 7x}$

    (b) $e^{x \cos x}$

    (c) $\sin(\cos x)$

    (d) $\cos^3 x$

    (e) $x^2 e^{-5x}$

    (f) $\left(\dfrac{t^3 + 1}{t^3 - 1}\right)^4$

    (g) $\tan^2 x + \tan(x^2)$

    (h) $\dfrac{8}{\sqrt{4 + 3x}}$

    (i) $e^{\sqrt{x^2-1}+\frac{1}{x}}$

2. A differentiable function f satisfies $f(3) = 5$, $f(9) = 7$, $f'(3) = 11$, and $f'(9) = 13$. Find an equation for the tangent line to the curve $y = f(x^2)$ at the point $(x, y) = (3, 7)$.

3. (a) Verify that point $P(0, 1)$ lies on the curve $\sqrt{x^2 + y^2} = \tan(\frac{\pi}{4}(x + y))$.

    (b) Find the equation of the line tangent to the curve at P.

4. Suppose a car is travelling along a straight highway. At time $t = 0$, this car is located at $s = 0$ with initial velocity 9 ft/s. The position function $s = f(t)$ of the car after t seconds is given by

$$f(t) = t^3 - 6t^2 + 9t, \ t \geq 0.$$

    a) Find the velocity and acceleration after t seconds.

    b) For what values of $t > 0$, does the car stop?

    c) For what values of $t > 0$, does the car come back to the original position $(s = 0)$? What is the velocity at that moment?

d) Draw the position $s(t)$ vs time graph and the velocity $v(t)$ vs time graph.

e) Draw the speed $|v(t)|$ vs time graph.

f) On what intervals is the speed increasing?

5. Assume that the variables V, r, and h are all dependent on some variable t. Find $\dfrac{dr}{dt}$ if
$$V = \pi r^2 h$$

6. Consider the curve $x + y^2 - y = 1$

   (a) Find all points on the curve where a vertical tangent line occurs. If it has none, explain why.

   (b) Find all points on the curve where a horizontal tangent line occurs. If it has none, explain why.