Show all your work.

1. (9 pts. ea.) Compute $y'$ for each of:

   (a) $y = \sin x + 2 \cos x - \tan 3x$

   (b) $y = \frac{x^2 e^{2x}}{\sec x}$

   (c) $y = \cot(csc(x^2 + 1))$
2. (9 pts. ea.) In each of the following problems, $f$ and $g$ are functions of $x$. Compute $\frac{dy}{dx}$.

(a) $y = f(xg(x) + 2)$

(b) $y = \frac{f + g}{fg}$
3. (10 pts.) For \( y = \ln x + x^2 \), find all points (\( x \)-coordinates are sufficient) where the tangent slope is 3.

4. (10 pts.) Use differentials to approximate the value of \( \sqrt[3]{1005} \).
5. (10 pts.) Suppose that a particle moves along the y-axis with position (in meters) after \( t \) seconds given by \( y(t) = 3t - e^{2t+1} \).

(a) Find all times when the particle’s velocity is 0.

(b) Find the acceleration at each of those times.
6. (10 pts.) Find all values of the constant $\omega$ for which $y = \sin \omega t + 2 \cos \omega t$ would solve the differential equation $y'' + 4y = 0$. 
7. (15 pts.) An airplane flying at a constant altitude of 30000 feet passes over a radar station on the ground. When the angle $\theta$ (as shown at right) is $30^\circ$, it is changing at $-0.005$ radians per second. How fast is the plane flying?