Problems:

1. Find the point(s) on the curve $x = t^2 + 4t$, $y = t^2 + 5t$ where the tangent line is vertical or horizontal.

2. Find the tangent vector of unit length for $\overrightarrow{r}(t) = \langle e^{t^2}, 3t\cos(t)\rangle$ at $t = 0$.

3. The radius of a sphere was measured to be 10 in with a possible error of 0.25 in. Use differentials to estimate the maximum error in the calculated surface area and find the relative error.

4. Let $H(x) = f(g(x^2 + 4x))$. Given $f'(1) = 2$, $f'(5) = 0$, $g(5) = 1$, $g'(1) = 4$, and $g'(5) = 3$, find $H'(1)$.

5. Two sides of a triangle have the length 8 ft and 4 ft. The angle in between is decreasing at a rate of $\frac{\pi}{8}$ rad/s. Find the rate at which the area of the triangle is changing when the angle between the sides of fixed length is $\frac{\pi}{3}$.

6. Find the tangent line equation to the curve $2x^3y - 5y^4 = 11$ at the point (2,1).

7. Use linear approximation to estimate $\sqrt[3]{10}$.

8. A particle moves according to the position function $s(t) = t^2 - 4t + 1$, where t is in seconds and s is in feet. What is the total distance traveled by the particle in the first 3 seconds.

9. Find the 77^{th} derivative of $g(x) = 2\sin(4x)$.

10. A bacteria culture doubles very 6 hours. How long will it take to triple in size?

11. Compute $\frac{dy}{dx}$.
    (a) $y = (3x + 1)^{\tan(x)}$
    (b) $y = (\ln(x))^{x^4-7}$
    (c) $\sin(xy^3) - \tan(4x) = 2x^3 + 3^{y^2}$
    (d) $y = \arccos(e^{3x})$
    (e) $y = \ln\left(\frac{e^{3x}(2x+7)^4}{\sqrt[3]{x^2-5}}\right)$

12. Given (2,-7), find the line equations from this point that is tangent to the parabola $y = x^2 - x$.

13. A camera is positioned 3000 feet from the base of a rocket launching pad. At a particular moment, the rocket rises vertically. Its speed is 1500 ft/s, when it has risen 4000 ft.
    (a) How fast is the distance from the camera to the rocket changing at that moment?
    (b) If the camera is focused on the rocket, how fast is the camera's angle of elevation changing at that moment?