

**Problems:**

- Differentiate the following functions.
  - $f(x) = \arctan(3x^2 - 1)$
  - $h(t) = \arcsin(t^3 e^t)$
  - $g(x) = \ln(4x - 6x^2)$
  - $y = \cos(\log_4(x))$
  - $y = (\ln(3x))^{\csc(x)}$
  - $f(x) = \frac{(4x+1)^5(6-5x)^2}{2x^9 e^{4x^2+7x}}$
- Find the tangent line equation to the curve  $x^4 + x^2 y^2 + y^3 = 3$  at  $(1, 1)$ .
- Find the tangent line equation to the curve  $x e^y = x - y$  at  $(0, 0)$
- Find the tangent line equation to the curve  $y \sin(2x) = x \cos(2y)$  at  $(\pi/2, \pi/4)$
- Find the tangent line equation to the curve  $y = 5x^3 \ln(x)$  at  $(1, 0)$
- Given  $\vec{r}(t) = \langle 2 \sin(t) + 2 \cos(t), 3 \cos(t) - 3 \sin(t) \rangle$ 
  - Find  $\vec{r}'(\frac{2\pi}{3})$
  - Find the tangent line equation at  $t = 0$ .
  - Find the horizontal tangent line(s) for  $\vec{r}(t)$ .
  - Find the vertical tangent line(s) for  $\vec{r}(t)$ .
- Given  $\vec{r}(t) = \langle t^4 - 24t + 5, 10t^5 + 1 \rangle$ 
  - Find  $\vec{r}'(1)$
  - Find the tangent line equation at  $t = 0$ .
  - Find the horizontal tangent line(s) for  $\vec{r}(t)$ .
  - Find the vertical tangent line(s) for  $\vec{r}(t)$ .
- Find the angle between the velocity vector and the acceleration vector of  $\vec{r}(t) = \langle t, 2t^3 \rangle$  at the point where  $t = 1$ .
- At what point(s) on the curve  $y = t^3 - 3t^2 - 12t$ ,  $x = \frac{1}{2}t^2 - t$  is the tangent line parallel to the line of equation  $x = 4t$ ,  $y = 1 - 6t$ ?
- A ball is thrown vertically upward with a velocity of 32 feet per second. The height after  $t$  seconds is given by  $h(t) = 32t - 16t^2$ . With what velocity does the ball hit the ground?