1 Some Derivatives

1. Compute the following derivatives.
   (a) $f(x) = \frac{x^2+1}{x^2}$
   (b) $f(x) = \frac{x^2}{x^2+1}$
   (c) $f(x) = 3e^{x^2}$
   (d) $f(x) = 3e^{x^2}\cot(x)$
   (e) $f(x) = \frac{1}{1+x^2}$
   (f) $f(x) = \frac{e^x}{1+e^{2x}}$
   (g) $f(x) = 4x^2\cos(x)$
   (h) $f(x) = x^2\cos(x)$
   (i) $f(x) = 6\csc(x^3)$
   (j) $f(x) = \sec(\csc(x^3))$
   (k) $f(x) = \sec^2(x^3) - \tan^2(x^3)$
2. Find $\frac{dy}{dx}$ using implicit differentiation.
   (a) $x^3 - y^3 = 1$
   (b) $y^2 + cos(y) = x$
   (c) $x^3y^3 = 1$
   (d) $3x^2\sec(y) - y = x^3$
   (e) $\sin(x^3y^3) = x^3 + y^3$
3. Find $\frac{dy}{dx}$ using logarithmic differentiaon technique.
   (a) $y = x^x$
   (b) $y = x^{\cos(x)}$
   (c) $y = x^{x^3}$
   (d) $y = (\cos(x) + x^2)^{x^3+\sin(x)}$
   (e) $y = x^{x^3/\sin(x)}$
4. Find the equation of the tangent line for the following functions at the given point
   (a) $y = x^2$ at $x = 1$
   (b) $y = 3x + 1$ at $x = 2$
   (c) $y = \frac{1}{1+x^2}$ at $x = 0$
   (d) $y = \frac{1}{1+x^2}$ at $x = -1$
   (e) $y = x^{2x}$ at $x = 1$
   (f) $y = e^{x^2}$ at $x = 1$

2 Displacement, Velocity and Accceleration

5. Let $s(t) = -4.9t^2 + 98$ represent the height of a ball thrown upward.
   (a) Find the velocity and acceleration functions.
   (b) When does the ball have position zero?
   (c) When does the ball have velocity zero?
   (d) What is the maximum height of the ball?
6. Let $s(t) = -t^3 - 2t^2 + 2t$ represent the displacement of a particle.
   (a) Find the velocity and acceleration functions.
   (b) When does the particle have position zero?
   (c) When does the particle have velocity zero?
   (d) What is the velocity of the particle at time 1 second?
7. Let $s(t) = e^{t^2-2t}$ represent the displacement of a particle.
   (a) Find the velocity and acceleration functions.
   (b) When does the particle have position zero? (Here actually show displacement is never zero)
   (c) When does the particle have velocity zero?
8. Let $s(t) = 3\sin(2t) + 3$ represent the displacement of the end of spring.
   (a) Find the velocity and acceleration functions.
   (b) When does the particle have position zero?
   (c) When does the particle have velocity zero?
   (d) What is the maximum height of the end of this spring?

3 Inverse Trig Functions

9. Compute the derivatives of the inverse trigonometric functions
   (a) $f(x) = \arcsin(x)$
   (b) $f(x) = \arcsin(x^2)$
   (c) $f(x) = \sec^{-1}(x^2)$
   (d) $f(x) = x^2 \tan^{-1}(x)$
   (e) $f(x) = \tan(x)\tan^{-1}(x)$
   (f) $f(x) = \tan^{-1}(\tan(x))$

(g) $f(x) = \cos(\tan(x^2))$

(h) $f(x) = \cos(\tan^{-1}(x))$ Simplify first

(i) $f(x) = \sec(\sin(\frac{2}{x}))$

4 Formulae and Rules

Know these by heart. Use flash cards or whatever helps you memorize them.

Formulae

0. $\frac{d}{dx}[k] =$
1. $\frac{d}{dx}[x^n] =$
2. $\frac{d}{dx}[e^x] =$
3. $\frac{d}{dx}[\ln x] =$
4. $\frac{d}{dx}[\sin x] =$
5. $\frac{d}{dx}[\cos x] =$
6. $\frac{d}{dx}[\tan x] =$
7. $\frac{d}{dx}[\cot x] =$
8. $\frac{d}{dx}[\sec x] =$
9. $\frac{d}{dx}[\csc x] =$
10. $\frac{d}{dx}\left[\sin^{-1} x\right] =$
11. $\frac{d}{dx}\left[\tan^{-1} x\right] =$
12. $\frac{d}{dx}\left[\sec^{-1} x\right] =$

The Power Rule

$\frac{d}{dx}[(f(x))^n] = n(f(x))^{n-1} f'(x)$

The Product Rule

$$\frac{d}{dx}[FS] = F'S + FS'$$

The Quotient Rule

$$\frac{d}{dx}\left[\frac{N}{D}\right] = \frac{N'D - ND'}{D^2}$$

The Chain Rule

$$\frac{d}{dx}[f(g(x))] = f'(g(x))g'(x)$$