

# Higher Derivatives

**Outcome:** Find 2<sup>nd</sup> and 3<sup>rd</sup> degree derivatives

**Warm up:** Find the following derivatives:

a)  $3x^5$

b)  $15x^4$

c)  $60x^3$

d)  $180x^2$

**Notation:** The following are common ways to write higher order derivatives

1<sup>st</sup>      $f'(x)$                        $\frac{d}{dx}(f(x))$                        $\frac{dy}{dx}$                        $y'$

2<sup>nd</sup>      $f''(x)$                        $\frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d^2y}{dx^2}$                        $y''$

3<sup>rd</sup>      $f'''(x)$                        $\frac{d}{dx}\left(\frac{d^2y}{dx^2}\right) = \frac{d^3y}{dx^3}$

4<sup>th</sup>      $f^{(4)}(x)$                        $\frac{d}{dx}\left(\frac{d^3y}{dx^3}\right) = \frac{d^4y}{dx^4}$

**Examples:**

1. Find  $\frac{d^2y}{dx^2}$  if  $y = x^6$

2. If  $y = x^3 - 2x^2$  find  $\frac{dy}{dx}$  and  $\frac{d^2y}{dx^2}$

3. Find the second derivative of  $f(x) = 5x^2 + \sqrt{x}$
4. Find  $f''(1)$  if  $f(x) = (2 - x^2)^{10}$
5. If  $x^3 + y^3 = 5$  use implicit differentiation to find the second order derivative of  $y$ .
6. Find  $y''$  if  $y^2 - xy = 3$

**Homework:** Page 111 # 1, 2, 4, 5

Stewart J. (1989) *Calculus: a first course*. McGraw-Hill Ryerson Limited.