3.2 Higher Derivatives (Minimum Homework: 1, 3, 5, 9, 11, 15)

A *Second derivative* is just the derivative of a derivative.
The symbol $f''(x)$ is used to represent the second derivative of the function $f(x)$

A *Third derivative* is just the derivative of a second derivative.
The symbol $f'''(x)$ is used to represent the third derivative of the function $f(x)$

Here is a quick example:

Given $f(x) = 3x^6$

a) Find $f'(x)$

b) Find $f''(x)$, the second derivative of $f(x)$.

c) Find $f'''(x)$, the third derivative of $f(x)$.

a) $f'(x) = 6 * 3x^{6-1}$
$f'(x) = 18x^5$

b) $f''(x) = 5 * 18x^{5-1}$
$f''(x) = 90x^4$

c) $f'''(x) = 4 * 90x^{4-1} = 360x^3$

#1 – 6: For each function find the first second and third derivatives. Specifically find

a) f'(x)

b) $f''(x)$

c) $f'''(x)$

1) $f(x) = 12x^4 + 5x^3 + 3x^2 - 6x + 1$

2) $f(x) = 3x^5 - 8x^4 + 4x^3 + 5x^2 + 3x + 5$

$answer\ a)\ f'(x) = 15x^4 - 32x^3 + 12x^2 + 10x + 3$

b) $f''(x) = 60x^3 - 96x^2 + 24x + 10$

c) $f'''(x) = 180x^2 - 192x + 24$

3) $f(x) = -3x^3 + 6x^2 + 8x + 9$

4) $f(x) = -2x^4 + 3x^3 + 4x^2 - 2x - 1$

answer: a) $f'(x) = -8x^3 + 9x^2 + 8x - 2$
b) $f''(x) = -24x^2 + 18x + 8$
c) $f'''(x) = -48x + 18$

5) $f(x) = 3x^{-5}$

6) $f(x) = 2x^{-3}$

$answer$ a) $f'(x) = -6x^{-4} = -\dfrac{6}{x^4}$

b) $f''(x) = 24x^{-5} = \dfrac{24}{x^5}$

c) $f'''(x) = -120x^{-6} = -\dfrac{120}{x^6}$

#7 – 18: For each function find the first and second derivatives.
Specifically find
a) $f'(x)$
b) $f''(x)$

7) $f(x) = e^{2x+3}$

8) $f(x) = e^{2x+5}$

9) $f(x) = e^{x^2}$

10) $f(x) = e^{x^3}$

Answer a) $f'(x) = 3x^2 e^{x^3}$ b) $f''(x) = 3xe^{x^3}(3x^3 + 2)$

11) $f(x) = ln(2x)$

12) $f(x) = ln(3x)$

Answer a) $f'(x) = \frac{1}{x}$ *b)* $f''(x) = -1/x^2$

13) $f(x) = \ln(x^2)$

14) $f(x) = \ln(x^3)$

15) $f(x) = \dfrac{x+2}{x-3}$

16) $f(x) = \dfrac{x+4}{x-5}$

$answer: \; a)\; f'(x) = \dfrac{-9}{(x-5)^2}$

$b)\; f''(x) = \dfrac{18}{(x-5)^3}$

17) $f(x) = \dfrac{2x}{x+8}$

18) $f(x) = \dfrac{3x}{x-5}$