Chapter 3

Differentiation Rules

Differentiation Rules:	
$\frac{d}{dx}(c) = 0$	$\frac{d}{dx}[c\,f(x)] = c\frac{d}{dx}\,f(x)$
$\frac{d}{dx}(x) = 1$	$\frac{d}{dx}[f(x) \pm g(x)] = \frac{d}{dx}\,f(x) \pm \frac{d}{dx}\,g(x)$
$\frac{d}{dx}(x^n) = n\,x^{n-1}, \quad n \in \mathbb{R}$	$\frac{d}{dx}\left(\sqrt{x}\right) = \frac{1}{2\sqrt{x}}$
$\frac{d}{dx}(cx^n) = c\,n\,x^{n-1}, \quad n \in \mathbb{R}$	$\frac{d}{dx}\left(\sqrt{f(x)}\right) = \frac{f'(x)}{2\sqrt{f(x)}}$

Example: Find the derivative:

(1) $f(x) = x^6$	**(2)** $y = x^{1000}$
(3) $y = t^4$	**(4)** $\frac{d}{dr}(r^3) =$
(5) $f(x) = \frac{1}{x^2}$	**(6)** $y = \sqrt[3]{x^2}$
(7) $\frac{d}{dx}(-3x^4) =$	**(8)** $\frac{d}{dx}\left(x\sqrt{x}\right) =$
(9) $\frac{d}{dx}(x^8 + 12x^5 - 4x^4 + 10x^3 - 6x + 5)$ $=$	**(10)** $\frac{d}{dt}(7x^5) =$
(11) $\frac{d}{dx}\left(\sqrt{x}\right) =$	**(12)** $\frac{d}{dx}\left(\sqrt{6x^3 - 4x}\right) =$

Exponential Functions

Derivatives of Exponential Functions:	
$\frac{d}{dx}(a^x) = a^x . \ln a$	$\frac{d}{dx}(e^x) = e^x$
$\frac{d}{dx}\left(a^{f(x)}\right) = a^{f(x)} . f'(x) . \ln a$	$\frac{d}{dx}\left(e^{f(x)}\right) = e^{f(x)} . f'(x)$

Example: Find the derivative:

(1) $f(x) = e^x + 10$	**(2)** $y = e^{x^2-3x}$
(3) $f(x) = e^7$	**(4)** $y = 5^{6x^4}$

Example: If $f(x) = e^x - x$, find f', f'' and f'''.

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Homework: **Page 181**

Differentiate the function.

9. $g(x) = x^2(1 - 2x)$

15. $R(a) = (3a + 1)^2$

16. $h(t) = \sqrt[4]{t} - 4e^t$

22. $y = \dfrac{\sqrt{x} + x}{x^2}$