Basic Derivative Rules
2.1 – Power Rule

Leibniz's Notation

Power Rule

$$\boldsymbol{\frac{d}{dx}x^n = n \cdot x^{n-1}}$$

Derivative of a Constant

$$\frac{d}{dx}c = 0$$

A Special Application of the Power Rule

$$\frac{d}{dx}x = 1$$

Constant Multiple Rule

$$\frac{d}{dx}[c \cdot f(x)] = c \cdot \frac{d}{dx}[f(x)]$$

Sum-Difference Rule

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

Evaluating

$$\left.\frac{df}{dx}\right|_{x=2}$$

Evaluate *g(t)* at 4 $\left.\frac{dg}{dt}\right|_{t=4}$

Evaluate w^3 at 1 $\left.\frac{dw}{dx}\right|_{x=1}$

Evaluate *f(x)* at 0 $\left.\frac{df}{dx}\right|_{x=0}$

Newton's Notation

Power Rule

If $f(x) = x^n$, then $f'(x) = n \bullet x^{n-1}$

Derivative of a Constant

If $f(x) = c$, then $f'(x) = 0$.

A Special Application of the Power Rule

If $f(x) = x$, then $f'(x) = 1$

Constant Multiple Rule

$$[c \cdot f(x)]' = c \cdot f'(x)$$

Sum-Difference Rule

$$\boldsymbol{[f(x) \pm g(x)]' = f'(x) \pm g'(x)}$$

Evaluating

$$f'(2)$$

Evaluate *g(t)* at 4 $g'(4)$

Evaluate w^3 at 1 $f'(1)$

Evaluate *f(x)* at 0 $f'(0)$

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A: The Power Rule

#1) $\frac{d}{dx}x^{10}$ $= 10x^9$

#2) $\frac{dx^{50}}{dx}$ $= 50x^{49}$

#3) If $y = x^{-8/3}$, find *y'*

$y' = -\frac{8}{3}x^{-11/3}$

#4) If $y = 8\sqrt{x}$, find *y'*

$y = 8x^{\frac{1}{2}}$

$y' = 4x^{-\frac{1}{2}}$

$y' = \frac{4}{\sqrt{x}}$

#5) $\frac{d}{dx}\left(\frac{x^2}{6}\right)$ $= \frac{d}{dx}\left(\frac{1}{6}x^2\right)$

$= \frac{1}{3}x$

#6) $\frac{d}{dx}90{,}000{,}000{,}000$ $= 0$

#7) $\frac{d}{dx}\left(\frac{6}{x^9}\right)$ $= \frac{d}{dx}\left(6x^{-9}\right)$

$= -54x^{-10}$

$= \frac{-54}{x^{10}}$

#8) If $y = \sqrt[7]{x}$, find *y'*

$y = x^{\frac{1}{7}}$

$y' = \frac{1}{7}x^{-\frac{6}{7}}$

$y' = \frac{1}{7\sqrt[7]{x^6}}$

#9) If *y = 6x*, find *y'*

$y' = 6$

#10) $\frac{d}{dx}\left(x^3 - \frac{5}{2}x^2 + 4x - 6\right)$

$= 3x^2 - 5x + 4$

#11) If $y = 5x^{-7} + 9x^{-3} - 9$, find *y'*

$y' = -35x^{-8} - 27x^{-4}$

#12) If *f(x) = 0*, find *f '(x)*

$f'(x) = 0$

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Ex B: Evaluating a Derivative

#1) If $h(x) = 6\sqrt{x}$, find $h'(8)$.

$h(x) = 6x^{\frac{1}{2}}$

$h'(x) = 3x^{-\frac{1}{2}}$

$h'(x) = \frac{3}{\sqrt{x}}$

$h'(8) = \frac{3}{\sqrt{8}}$

$h'(8) = \frac{3}{2\sqrt{2}}$

#2) If $f(r) = \frac{4}{3}\pi r^3$, find $\left.\frac{df}{dr}\right|_{r=4}$

$\left.\frac{df}{dr}\right|_{r=4} = \left.4\pi r^2\right|_{r=4}$

$= 4\pi(4)^2$

$= 4\pi(16)$

$\left.\frac{df}{dr}\right|_{r=4} = 64\pi$

#3) If $f(x) = ex^6 - x^e$, find $f'(5)$

$f'(x) = 6ex^5 - ex^{e-1}$

$f'(5) = 6e(5)^5 - e(5)^{e-1}$

$f'(5) = 6(3125)e - 5^{e-1}e$

$f'(5) = 18{,}750e - 5^{e-1}e$

#4) $\left.\frac{d}{dw}\left(\frac{8}{\sqrt[4]{w}} - \frac{5}{\sqrt{w}}\right)\right|_{w=81}$ $\left.\frac{d}{dw}\left(8w^{-\frac{1}{4}} - 5w^{-\frac{1}{2}}\right)\right|_{w=81}$

$= \left.\left(2w^{-\frac{5}{4}} + \frac{5}{2}w^{-\frac{3}{2}}\right)\right|_{w=81}$

$= \left.\left(\frac{2}{\sqrt[4]{w^5}} + \frac{5}{2\sqrt{w^3}}\right)\right|_{w=81}$

$= \frac{2}{(\sqrt[4]{81})^5} + \frac{5}{2(\sqrt{81})^3}$

$= \frac{2}{3^5} + \frac{5}{2\cdot(9)^3}$

$= \frac{2}{27} + \frac{5}{2(729)}$

$= \frac{2}{27}\frac{\cdot 54}{\cdot 54} + \frac{5}{1458}$

$= \frac{108}{1458} + \frac{5}{1458}$

$= \frac{113}{1458}$

#5) $\left.\frac{d}{dt}\left(\frac{t^4+t^5}{t+1}\right)\right|_{t=10}$

$= \left.\frac{d}{dt}\left[\frac{t^4\cancel{(t+1)}}{\cancel{t+1}}\right]\right|_{t=10}$

$= \left.\frac{d}{dt}\left(t^4\right)\right|_{t=10}$

$= \left.4t^3\right|_{t=10}$

$= 4(10)^3$

$= 4\cdot(1000)$

$= 4000$

#6) Find $v'(1)$ if $v(t) = \sqrt[6]{t^7} - \frac{5}{\sqrt[7]{t^5}}$

$v(t) = t^{\frac{7}{6}} - 5t^{-5/7}$

$v'(t) = \frac{7}{6}t^{1/6} + \frac{25}{7}t^{-\frac{12}{7}}$

$v'(t) = \frac{7\sqrt[6]{t}}{6} + \frac{25}{7\sqrt[7]{t^{12}}}$

$v'(1) = \frac{7\sqrt[6]{(1)}}{6} + \frac{25}{7\sqrt[7]{(1)^{12}}}$

$= \frac{7}{6(1)} + \frac{25}{7(1)}$

$= \frac{7}{6}\frac{\cdot 7}{\cdot 7} + \frac{25}{7}\frac{\cdot 6}{\cdot 6}$

$= \frac{49}{42} + \frac{150}{42}$

$v'(1) = \frac{199}{42}$

C: Find each equation in slope-intercept form.

#1) Find the equation of the tangent line to the function $f(x) = 3x^2 - x + 8$ at x = -5

Point @ x=-5	Slope @ x=-5
$f(-5) = 3(-5)^2 - (-5) + 8$	$f'(x) = 6x - 1$
$= 3(25) + 5 + 8$	$f'(-5) = 6(-5) - 1$
$= 75 + 13$	$= -30 - 1$
$f(-5) = 88$	$f'(-5) = -31$

Point-slope form @ (-5,88)

$y - y_1 = m(x - x_1)$

$y - (88) = -31(x - (-5))$

$y - 88 = -31x - 155$

$y = -31x - 67$