2.1 #29, 31, 89

2.2 #19, 27, 29, 35, 37, 43, 45, 51
57, 61, 63, 67, 95, 97, 115

2.3 #35, 41-53 odd, 73, 83

$$f(x) = \begin{cases} g(x), & x < c \\ h(x), & x \geq c \end{cases}$$

$g(c) = h(c)$ ← guartees continuity

$g'(c) = h'(c)$ ← guarantees differentiability

$$f(x) = \begin{cases} \overset{2ax}{ax^2+7}, & x<5 \\ \overset{b}{bx-2}, & x \geq 5 \end{cases}$$

$a(5)^2+7 = b(5)-2$ $\qquad$ $2a(5) = b$

$25a+7 = 5b-2$ $\qquad$ $10a = b$

$25a - 5b = -9$ $\qquad$ $10a - b = 0$

$-50a + 5b = 0$ $\qquad$ mult. by -5 $\qquad$ $10a = b$

$-25a = -9$

$a = 9/25$ $\qquad \Rightarrow b = 90/25 = \frac{18}{5}$

$$\begin{cases} ax^3, & x \leq 2 \\ x^2+b, & x>2 \end{cases}$$

Power Rule:
$$\frac{d}{dx}[x^n] = nx^{n-1}$$

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

Constant Multiple Rule:
$$\frac{d}{dx}[cf(x)] = c\frac{d}{dx}[f(x)]$$

Quotient Rule:
$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$$

Sum & Difference:
$$\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$$

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

Trig Functions:

$$\frac{d}{dx}[\sin x] = \cos x \qquad \frac{d}{dx}[\tan x] = \sec^2 x \qquad \frac{d}{dx}[\sec x] = \sec x \tan x$$
$$\frac{d}{dx}[\cos x] = -\sin x \qquad \frac{d}{dx}[\cot x] = -\csc^2 x \qquad \frac{d}{dx}[\csc x] = -\csc x \cot x$$

2.4 - The Chain Rule

$f(x) = x+1$
$g(x) = x^2$

$g(f(x)) = (x+1)^2$

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

$$[h(g(f(x)))]' = h'(g(f(x))) \cdot g'(f(x)) \cdot f'(x) \cdot x'$$

$x' = 1$

$f(x) = \sin(x^5 - 3x^2)$

$f'(x) = \boxed{\left[\cos(x^5 - 3x^2)\right] \cdot (5x^4 - 6x)}$

$f(x) = \cos[5\sin(7x)]$

$f'(x) = \boxed{\left[-\sin[5\sin(7x)]\right] \cdot [5\cos(7x)] \cdot 7}$

$= -35\sin(5\sin 7x)\cos 7x$

$$f(x) = [5x][\sin(x^2)]$$

$$f'(x) = (5x)'(\sin(x^2)) + (5x)(\sin(x^2))'$$

$$= 5\sin(x^2) + 5x(\cos(x^2)) \cdot 2x$$

$$= 5\sin(x^2) + 10x^2\cos(x^2)$$

$$f(x) = 5\sin(3\cos 2x^5)$$

$$f'(x) = 5\cos(3\cos 2x^5) \cdot (-3\sin 2x^5) \cdot 10x^4$$

$$= -150x^4\cos(3\cos 2x^5)\sin(2x^5)$$

$$f(x) = [(x)(\sin x)][(\sqrt{x-1})]$$

$$f'(x) = [x \cdot \sin x]' \sqrt{x-1} + (x\sin x)\underbrace{[(x-1)^{1/2}]'}_{\text{power \& chain rule}}$$

$$= \underbrace{[1 \cdot \sin x + x \cdot \cos x]}_{\text{product rule}} \sqrt{x-1} + (x\sin x) \cdot \frac{1}{2}(x-1)^{-1/2} \cdot 1$$

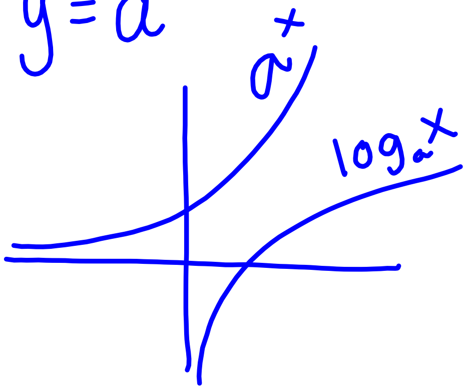
$$= \boxed{(\sin x + x\cos x)\sqrt{x-1} + \frac{x\sin x}{2\sqrt{x-1}}}$$

$$f(x) = \sec^2(\sin(3x)) = [\sec(\sin(3x))]^2$$

$$f'(x) = 2\sec(\sin(3x)) \cdot \sec(\sin(3x))\tan(\sin(3x)) \cdot \cos(3x) \cdot 3$$

$$= \boxed{6\sec^2(\sin 3x) \cdot \tan(\sin 3x)\cos(3x)}$$

$y = a^x$



$$\frac{d}{dx}[a^x] = a^x \ln a$$

$$\frac{d}{dx}[e^x] = e^x$$

$$\frac{d}{dx}[\log_a x] = \frac{1}{x \ln a}$$

$$\frac{d}{dx}[\ln x] = \frac{1}{x}$$