1. $-\sin x$

2. 0

3. 5

4. $4x^3$

5. $\sqrt{x} = x^{1/2}$

$(x^{1/2})' = \boxed{\frac{1}{2}x^{-1/2}}$

$= \frac{1}{2\sqrt{x}}$

6. 0

7. $\frac{1}{x} = x^{-1}$

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

8. $f'(x) - g'(x)$

9. $f'(x)g(x) + f(x)g'(x)$

10. $\frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$

$f^2(x) = [f(x)]^2 \neq f(x)^2$; ~~$f(x)^2$~~

11. $f(x) = 3x^2 - 1$ @ $(1, 2)$

$f'(x) = 6x$

$m = f'(1) = 6 \cdot 1 = \boxed{6}$

12. $V = x^3$

$V' = 3x^2$

$V'(2) = 3(2)^2 = \boxed{12 \text{ cm}^2}$

13. $\frac{V(4)-V(1)}{4-1} = \frac{4^3-1^3}{4-1} = \frac{64-1}{3} =$

$\frac{63}{3} = \boxed{21\ cm^2}$

14. $f'(c) = \lim_{x\to c} \frac{f(x)-f(c)}{x-c}$

$f(x) = |x-5|+3$ @ $(5,3)$

$\lim_{x\to 5^-} \frac{|x-5|+3-3}{x-5} = \lim_{x\to 5^-} \frac{|x-5|}{x-5} = -1$

$\lim_{x\to 5^+} \frac{|x-5|+3-3}{x-5} = \lim_{x\to 5^+} \frac{|x-5|}{x-5} = 1$

because left- and right-hand limits are not equal, limit in general does not exist & hence derivative is undefined

$f(x) = \cos\left(\sqrt{\tan^2 x - 2x}\right)$

$= \cos\left[\left([\tan x]^2 - 2x\right)^{1/2}\right]$

$f'(x) = -\sin\left(\sqrt{\tan^2 x - 2x}\right) \cdot \frac{1}{2}\left(\tan^2 x - 2x\right)^{-1/2} \cdot$

$\left(2\tan x \cdot \sec^2 x \quad -2\right)$

average rate of change of $f(x)$ as x changes from a to b

= slope of secant line through the points $(a, f(a))$ & $(b, f(b))$

$$= \frac{f(b)-f(a)}{b-a}$$

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instantaneous rate of change of $f(x)$ at $x=c$

= slope of the tangent line to f at the point $(c, f(c))$

$$= \lim_{x\to c} \frac{f(x)-f(c)}{x-c} = f'(c) = \lim_{h\to 0} \frac{f(c+h)-f(c)}{h}$$

1. $f(x) = \cot(5x^2-3x)$

$(\cot x)' = -\csc^2 x$

$(\csc x)' = -\csc x \cot x$

$f'(x) = [-\csc^2(5x^2-3x)] \cdot (10x-3)$

$-\csc^2(5x^2-3x)(10x-3)$ ← too ambiguous

2. $f(x) = \sqrt[3]{\csc(4x)} = [\csc(4x)]^{1/3}$

$f'(x) = \frac{1}{3}[\csc(4x)]^{-2/3} \cdot (-\csc(4x)\cot(4x)) \cdot 4$

3. $f(x) = \frac{\sin(2x)}{x^3} = (\sin 2x)(x^{-3})$

$f'(x) = \frac{x^3 \cdot (\cos 2x) \cdot 2 - (\sin 2x)(3x^2)}{(x^3)^2}$

OR

$f'(x) = (\sin 2x)(-3x^{-4}) + (\cos 2x)(2)(x^{-3})$

$$\frac{d}{dx}\left[2^x\right] = 2^x \cdot \ln 2$$

$$\frac{d}{dx}\left[\log_2 x\right] = \frac{1}{x \cdot \ln 2}$$

$$\log_2 8 = 3 \iff 2^3 = 8$$

$$\log_a b = c \iff a^c = b$$

$$[e^x]' = e^x \cdot \ln e = \boxed{e^x}$$

$$[\ln x]' = \frac{1}{x \ln e} = \boxed{\frac{1}{x}}$$

$\ln x = \log_e x$

$$[2^{f(x)}]' = 2^{f(x)} \cdot \ln 2 \cdot f'(x)$$

$$[\log_2 f(x)]' = \frac{1}{f(x) \cdot \ln 2} \cdot f'(x)$$

$$= \frac{f'(x)}{f(x) \cdot \ln 2}$$

$\sqrt{x}$ v. $\sqrt{f(x)}$

2^x v. $2^{f(x)}$

$$(\sin(f(x)))' = \cos[f(x)] \cdot f'(x)$$

$$f(x) = \ln\left[\sin\left(5x^3+2x\right)\right]$$

$$f'(x) = \frac{1}{\sin(5x^3+2x)} \cdot \cos\left(5x^3+2x\right) \cdot \left(15x^2+2\right)$$

$$= (15x^2+2)\cot(5x^3+2x)$$

$$f(x) = (\sec x)\left(5^{\sin x}\right)$$

$$f'(x) = (\sec x)'\left(5^{\sin x}\right) + (\sec x)\left(5^{\sin x}\right)'$$

$$= (\sec x \tan x)\left(5^{\sin x}\right) + (\sec x)\left(5^{\sin x} \cdot \ln 5 \cdot \cos x\right)$$

$$f(x) = \frac{(x^2 \ln x)}{\sin x} = (x^2 \ln x) \cdot (\sin x)^{-1}$$
$$= (x^2 \ln x) \cdot \csc x$$

$$f'(x) = \frac{(\sin x)(x^2 \ln x)' - (x^2 \ln x)(\sin x)'}{\sin^2 x}$$
$$= \frac{\sin x \left(2x \ln x + x^2 \cdot \frac{1}{x}\right) - x^2 \ln x \cos x}{\sin^2 x}$$

Homework for Test #2 on Derivatives

HW #4 (submitted Fri 12/05)

- 2.1 #1-23 odd Find the derivative by the limit process #29-32 all find the equation of the tangent line #61-69 odd use the alternate form to find the derivative #71-79 odd Describe x-values where the function is differentiable (given graph)
- 2.2 #3-51 odd Find the derivative using the basic derivative rules #91-94 all; 101, 102 use the derivative to solve rate of change word problems

HW #5 (due Fri 12/12)

- 2.3 #1-53 odd, 63-69 odd, 75-81 all, 83-91 odd, 109-115 all — Product and quotient rules
- 2.4 #7-33 odd, #47-81 odd — Chain rule
- 5.1 #45-61, 71 — Logarithmic functions
- 5.4 #39-57 — Exponential functions
- 5.5 #41-55 — Log and exp functions with other bases
- 5.8 #41-59 — Inverse trig functions