hw solutions
section 5.5

1. $f(x) = 5\ln x$

$f'(x) = 5 \cdot \frac{1}{x} = \frac{5}{x}$

2. $f(x) = \ln 5x$

$f'(x) = \frac{5}{5x} = \frac{1}{x}$

4. $g(x) = \ln(2x+1)$

$g'(x) = \frac{2}{2x+1}$

5. $f(x) = \ln x^8$

way 1:

$f'(x) = \frac{8x^7}{x^8} = \frac{8}{x}$

way 2:

$f(x) = 8\ln x$

$f'(x) = 8/x$

12. $f(x) = \ln(3x^2-2x+1)$

$f'(x) = \frac{6x-2}{3x^2-2x+1}$

14. $f(x) = \ln\left(\frac{x+1}{x-1}\right)$

way 1: $f(x) = \ln(x+1) - \ln(x-1)$

$f'(x) = \frac{1}{x+1} - \frac{1}{x-1}$

way 2:

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

$= \frac{-2}{(x-1)(x+1)}$

27. $f(x) = e^x \ln x$

$f'(x) = e^x \ln x + e^x \cdot \frac{1}{x}$

$= e^x \left[\ln x + 1/x\right]$

34. $g(x) = \ln(e^x + \ln x)$

$g'(x) = \frac{e^x + 1/x}{e^x + \ln x}$ OR $\frac{xe^x+1}{xe^x + x\ln x}$

39. $f(x) = x^2 \ln x$

$f'(x) = 2x\ln x + x$

$= x(1+2\ln x)$

$f''(x) = 1 + 2\ln x + x(2/x)$

$= 3 + 2\ln x$

45. $y = \frac{(2x^2-1)^5}{\sqrt{x+1}}$

$\ln y = \ln\left[\frac{(2x^2-1)^5}{\sqrt{x+1}}\right]$

$\ln y = 5\ln(2x^2-1) - \frac{1}{2}\ln(x+1)$

$\frac{y'}{y} = 5 \cdot \frac{4x}{2x^2-1} - \frac{1}{2} \cdot \frac{1}{x+1} = \frac{20x}{2x^2-1} - \frac{1}{2(x+1)}$

$y' = \left[\frac{20x}{2x^2-1} - \frac{1}{2(x+1)}\right] \cdot \frac{(2x^2-1)^5}{\sqrt{x+1}}$

50. $y = x^{\ln x}$

$\ln y = \ln x^{\ln x}$

$\ln y = (\ln x)^2$

$\frac{y'}{y} = 2\ln x \cdot \frac{1}{x}$

$y' = \frac{2\ln x}{x} \cdot x^{\ln x}$

$= 2\ln x \cdot x^{\ln x - 1}$

51. $\ln y - x\ln x = -1$

$\ln y = x\ln x - 1$

$\frac{y'}{y} = \ln x + 1$

$y' = (\ln x + 1)y$

54. find tangent line of $y = \ln x^2$ at $(2, \ln 4)$

$y' = 2/x$

$m = 2/2 = 1$

$y = mx + b \Rightarrow \ln 4 = 1(2) + b,\ b = \ln 4 - 2$

$y = x + \ln 4 - 2$

57. $f(x) = x^2 + \ln x^2$ find concavity

$f'(x) = 2x + 2/x$

$f''(x) = 2 - 2/x^2 = 0$

$x^2 = 1 \Rightarrow x = \pm 1$

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-1   0   1

CU: $(-\infty,-1) \cup (1,\infty)$

CD: $(-1,0) \cup (0,1)$

65. $f(x) = 7.2956\ln(.0645012x^{.95}+1)$

find $f'(100)$ & $f'(500)$

$f'(x) = \frac{.447046207x^{-.05}}{.0645012x^{.95}+1}$

$f'(100) = .0579898266$

$f'(500) = .0139989486$