Ch. 8

Pre-Review Logarithms

Exercise 2 Pg 352

1. a) $2^6 = 64$
   c) $10^{-2} = .01$
   e) $8^3 = 512$

2. a) $\log_2 8 = 3$
   c) $\log .0001 = -4$
   e) $\log_4 .125 = -3/2$

3. a) $\log_6 6^4 = 4$
   c) $\log_4 64 = 3$
   e) $\log_9 9 = 1$
   g) $\log_3 \left(\frac{1}{27}\right) = -3$
   6
   i) $\log_8 \left(\frac{1}{4}\right) = -2/3$

4. a) $\log_2 x = 10$

$$2^{10} = x$$
$$x = 1024$$

   c) $\log_{10}(3x+5) = 2$

$$10^2 = 3x+5$$
$$95 = 3x$$
$$x = \frac{95}{3}$$

d)

Exercise 3 Pg 354

1. a) $\log_2 x(x-1) = \log_2 x + \log_2 (x-1)$

c) $\log_2 (AB^2) = \log_2 A + 2\log_2 B$

e) $\log_3 (x \cdot y^{1/2}) = \log_3 x + \frac{1}{2}\log y$

g) $\log_5 (x^2+1)^{1/3} = \frac{1}{3}\log_5 (x^2+1)$

i) $\log_{10} \frac{x^3 y^4}{z^6} = 3\log x + 4\log y - 6\log z$

2. a) $\log_5 \sqrt{125} = \log_5 5^{3/2} = \frac{3}{2}$.

c) $\log 2 + \log 5 = \log 10 = 1$

e) $\log_4 192 - \log_4 3 = \log_4 \frac{192}{3} = \log_4 64 = 3$

3. a) $\log \frac{12 \cdot 7^{1/2}}{2} = \log 6\sqrt{7}$

b) $\log \frac{AB}{C^2}$

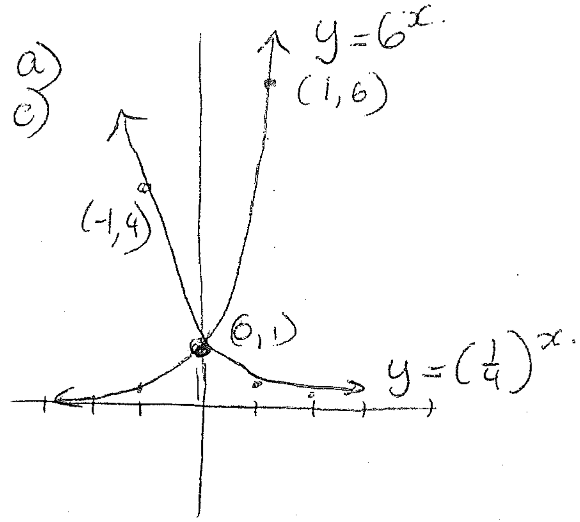
c) $\log_5 \frac{x^2-1}{x-1} = \log_5 (x+1)$

d) $\log_2 x^4 - \log_2 (x^2+1)^{1/3} + \log_2 (x-1)$

$= \log_2 \left[\frac{x^4(x-1)}{\sqrt[3]{x^2+1}}\right]$

8.1 Exponential f^{n}'s Pg. 361

1. a)
c)



5. (a) $\lim_{x \to -\infty} 4^x = 0$

(b) $\lim_{x \to \infty} (.9)^x = 0$

(c) $\lim_{x \to \infty} 10^{2x-1} = \infty$

(d) $\lim_{x \to \infty} 3^{-x} = 0$

☆ (e) $\lim_{x \to 0^+} 5^{\frac{1}{x}} = \infty$ $\cancel{\lim_{x \to 0^+} 5^{x^{-1}}}$

as $x \to 0^+$, $\frac{1}{x}$ becomes a larger & larger #
so $5^{\frac{1}{x}} \to \infty$

f) $\lim_{x \to 0^-} 5^{\frac{1}{x}} = 0$ as $x \to 0^-$, $\frac{1}{x}$ becomes a larger (smaller!) negative number

g) $\lim_{x \to \infty} 10^{-x^2} = 0$

h) $\lim_{x \to \infty} 4^{\frac{1}{x}} = 1$

8.2 Derivatives of Exp. F^n's Pg 366

1. a) $2e^x$
   b) e^{4x}
   c) e^{1+2x}
   d) 1
   e) $e^{2x} - 5e^{5x}$
   f) $6e^{5x}$

4. a) $y = 2e^{-x}$
   $y' = -2e^{-x}$

   b) $y = x^4e^x$
   $y' = x^4e^x + 4x^3e^x$
   $= x^3e^x(x+4)$

   c) $y = e^{2x}\sin 3x$
   $y' = e^{2x} \cdot 3\cos 3x + 2e^{2x}\sin 3x$
   $= 3e^{2x}\cos 3x + 2e^{2x}\sin 3x$
   $= e^{2x}(3\cos 3x + 2\sin 3x)$

   d) $y = e^{\sqrt{x}}$
   $y' = \frac{1}{2}x^{-1/2} \cdot e^{\sqrt{x}}$
   $= \dfrac{e^{\sqrt{x}}}{2\sqrt{x}}$

   e) $y = e^{\tan x}$
   $y' = e^{\tan x} \cdot \sec^2 x.$

   f) $y = \tan(e^x)$
   $y' = \sec^2(e^x) \cdot e^x$

g) $y = \dfrac{e^x}{x}$

$y' = \dfrac{xe^x - e^x}{x^2} = \dfrac{e^x(x-1)}{x^2}$

h) $y = \dfrac{e^x}{1-e^{2x}}$

$y' = \dfrac{(1-e^{2x})e^{x} - e^x \cdot -2e^{2x}}{(1-e^{2x})^2}$

$= \dfrac{e^x[(1-e^{2x}) + 2e^{2x}]}{(1-e^{2x})^2}$

$= \dfrac{e^x[1+e^{2x}]}{(1-e^{2x})^2}$

i) $y = e^{\sin(x^2)}$

$y' = e^{\sin(x^2)} \cdot \cos x^2 \cdot 2x$

$y' = 2x\cos(x^2)e^{\sin(x^2)}$

j) $y = xe^{\cot 4x}$

$y' = x\, e^{\cot 4x}(-4\csc^2 4x) + e^{\cot 4x}$

$= e^{\cot 4x}[-4x\csc^2 4x + 1]$

k) $y = (1+5e^{-10x})^4$

$y' = 4(1+5e^{-10x})^3 \cdot -50e^{-10x}$

$= -200e^{-10x}(1+5e^{-10x})^3$

e) $y = \sqrt{x + e^{1-x^2}}$

$y' = \frac{1}{2}(x + e^{1-x^2})^{-1/2} \cdot (1 + e^{1-x^2} \cdot -2x)$

$= \dfrac{1 - 2xe^{1-x^2}}{2\sqrt{x + e^{1-x^2}}}$

5. $y = 1 + xe^{2x}$ at $x = 0$
$y = 1 + 0$ $y = 1$
$= 1$

$y' = x \cdot 2e^{2x} + e^{2x}$
$y'(0) = 0 + e^{0} = 1$

$y - 1 = 1(x - 0)$

$\boxed{x - y + 1 = 0}$

6. $e^{xy} = 2x + y$
$\frac{d}{dx} e^{xy} = \frac{d}{dx} 2x + \frac{d}{dx} y$

$e^{xy} \cdot [xy' + y] = 2 + y'$
$e^{xy} \cdot xy' + ye^{xy} = 2 + y'$

$y' - e^{xy} \cdot xy' = -2 + ye^{xy}$

$y'(1 - xe^{xy}) = ye^{xy} - 2$
$y' = \dfrac{ye^{xy} - 2}{1 - xe^{xy}}$

7. $f(x) = e^{2x} \cdot 2$

$f'(x) = 2e^{2x}$
$f''(x) = 4e^{2x}$
$f'''(x) = 8e^{2x}$
$f^{IV}(x) = 16e^{2x}$
$f^{V}(x) = 32e^{2x}$
$f^{(6)}(x) = 64e^{2x}$
$f^{6}(0) = 64e^{0} = \underline{\underline{64}}$

11. a) $\lim_{x \to \infty} e^{-x} = \lim_{x \to \infty} \left(\frac{1}{e}\right)^{x} = 0$

b) $\lim_{x \to -\infty} e^{-x} = \infty$

$e^{-(-1)} = e^{1}$
$e^{-(-2)} = e^{2}$

8.3 Logarithmic Fn's. Pg 375

3. a) $e^{\ln 5} = 5$
   b) $\ln e^2 = 2$
   c) $2\ln e = 2$
   d) $e^{5\ln 2} = e^{\ln 2^5} = 2^5 = 32.$
   e) $\ln\sqrt{e} = \frac{1}{2}$
   ~~f)~~
   f) $\ln 2 + 2\ln 3 - \ln 18 = \ln\frac{2\cdot 3^2}{18} = \ln 1 = 0$

4. a) $\ln e^x = \ln 4$

$x = \ln 4$

b) $\ln x = 6$

$e^6 = x$

c) $\ln(2x-1) = 1$

$e^1 = 2x-1$

$x = \frac{e+1}{2}$

5. (a) $\ln(x+1) = 3.$

$e^3 = x+1$

$x = e^3 - 1$

$x = 19.085537$

(b) $e^{-x} = \frac{1}{2}$

$\ln e^{-x} = \ln(1/2)$

$-x = \ln(1/2)$

$x = -\ln(1/2)$

$x = 0.693147$

5. c) $e^{5x+3} = 10$

$\ln e^{5x+3} = \ln 10$

$5x+3 = \ln 10$

$5x = (\ln 10) - 3$

$x = \frac{(\ln 10)-3}{5}$

$x = -0.139483$

d) $2^{x-5} = 3$

$\ln 2^{x-5} = \ln 3$

$x-5 = \frac{\ln 3}{\ln 2}$

$x = \frac{\ln 3}{\ln 2} + 5$

$x = 6.584963$

6. a) $\ln x^{\frac{1}{3}} \cdot (3x-5)^2$

b) $\ln \left[\frac{x^2 (x^2+1)^3}{\sqrt{x^2-1}} \right]$

9. (a) $\lim_{x \to -4^+} \ln(x+4) = \lim_{x+4^+ \to 0} \ln(x+4) = -\infty$

b) $\lim_{x \to \infty} \ln(x+4) = \infty$

c) $\lim_{x \to 1^+} \log(x^2 - x) = -\infty$

$\log(x^2-x) = \frac{\ln(x^2-x)}{\ln 10} = \frac{1}{\ln 10} \ln x(x-1) = \frac{1}{\ln 10}\left[\ln x + \ln(x-1)\right]$

$\frac{1}{\ln 10}\left\{\lim_{x\to\infty} \ln x + \lim_{x \to \infty} \ln(x-1)\right.$

$-\infty + -\infty = -\infty$

8.4 Pg 383

1. a) $f(x) = x^2 \ln x$

$$f'(x) = x^2 \cdot \frac{1}{x} + 2x \ln x$$

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

b) $f(x) = (\ln x)^{1/2}$

$$= \frac{1}{2}(\ln x)^{-1/2} \cdot \frac{1}{x}$$

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

c) $g(x) = \ln(x^3+1)$

$$g'x) = \frac{3x^2}{(x^3+1)}$$

d) $g(x) = \ln(5x)$

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

e) $y = \sin(\ln x)$

$$y' = \cos(\ln x) \cdot \frac{1}{x}$$

$$y' = \frac{\cos(\ln x)}{x}$$

f) $y = \ln(\sin x)$

$$y' = \frac{\cos x}{\sin x} = \cot x$$

g) $y = \frac{\ln x}{x^3}$

$$y' = \frac{x^{3} \cdot \frac{1}{x} - 3x^2 \cdot \ln x}{x^6}$$

$$= \frac{x^2(1 - 3\ln x)}{x^6}$$

$$= \frac{1 - 3\ln x}{x^4}$$

h) $y = (x + \ln x)^3$

$$y' = 3(x + \ln x)^2 \cdot \left(1 + \frac{1}{x}\right)$$

i) $y = \ln|2x+1|$

$$y' = \frac{2}{2x+1}$$

j) $y = \ln\left(\frac{x+1}{x-1}\right)$

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

$$= \frac{\cancel{(x-1)}}{(x+1)} \cdot \frac{[x-1-x-1]}{(x-1)^{\cancel{2}}} = \frac{-2}{(x+1)(x-1)} = \frac{-2}{x^2-1}$$

k. $y = \ln\sqrt{\dfrac{x}{2x+3}}$

$= \ln x^{1/2} \cdot (2x+3)^{-1/2}$

$= \frac{1}{2}\ln x^{1/2} + \left(-\frac{1}{2}\right)\ln(2x+3)$

$y' = \dfrac{1}{2}\cdot\dfrac{1}{x} - \dfrac{1}{\cancel{2}}\dfrac{\cancel{2}}{(2x+3)}$

$= \dfrac{1}{2x} - \dfrac{1}{2x+3}$

$= \dfrac{2x+3-2x}{2x(2x+3)} = \dfrac{3}{4x^2+6x}$

l. $y = \ln\dfrac{x}{(x^2+1)^{1/2}} = \ln x - \frac{1}{2}\ln x^2+1$

$y' = \dfrac{1}{x} - \dfrac{2x}{2(x^2+1)}$

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

m. $y = \ln(\sec x + \tan x)$

$y' = \dfrac{\sec x\tan x + \sec^2 x}{\sec x + \tan x}$

~~[illegible]~~

Sheesh.

~~See next page~~

$= \dfrac{\sec x(\cancel{\tan x + \sec x})}{(\cancel{\sec x + \tan x})} = \sec x$

n. $y = \tan[\ln(1-3x)]$

$$y' = \sec^2[\ln(1-3x)] \cdot \frac{-3}{(1-3x)}$$

$$= \frac{-3\sec^2[\ln(1-3x)]}{(1-3x)}$$

3. a) $f(x) = \log_2(x^2+1)$

$$f'(x) = \frac{1}{(x^2+1)(\ln 2)} \cdot 2x$$

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

b) $g(x) = x \log x$

$$g'(x) = \cancel{x} \cdot \frac{1}{\cancel{x} \ln 10} + \log x$$

$$= \frac{1}{\ln 10} + \log x$$

c) $F(x) = \log_5(3x-8)$

$$F'(x) = \frac{1}{(3x-8)\ln 5} \cdot 3 = \frac{3}{(3x-8)\ln 5}$$

d) $G(x) = \dfrac{1 + \log_3 x}{x}$

$$G'(x) = \frac{\cancel{x}\left(\frac{1}{\cancel{x}\ln 3}\right) - 1(1 + \log_3 x)}{x^2}$$

$$= \frac{(\ln 3)^{-1} - 1 - \log_3 x}{x^2}$$

$$= \frac{\frac{1}{\ln 3} - \frac{\ln 3}{\ln 3} - \frac{\ln 3 \log_3 x}{\ln 3}}{x^2}$$

$$= \frac{1 - \ln 3 - \ln 3 \log_3 x}{x^2 \ln 3} \rightarrow = \cancel{\ln 3} \cdot \frac{\ln x}{\cancel{\ln 3}}$$

$\frac{\log x}{\log 3}$

$$= \frac{1 - \ln 3 - \ln x}{x^2 \ln 3}$$

4. a) $y = x^3 + 3^x$

$y' = 3x^2 + 3^x \ln 3$

b) $y = 2^{x^4 - x}$

$y' = (2^{x^4 - x})(\ln 2)(4x^3 - 1)$

c) $y = x\, 5^{\sqrt{x}}$

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

$= \dfrac{5^{\sqrt{x}}(x \ln 5 + 2\sqrt{x})}{2\sqrt{x}}$ or $\frac{1}{2}5^{\sqrt{x}}(\sqrt{x}\ln 5 + 2)$

d) $y = 10^{\tan \pi x}$

$y' = 10^{\tan \pi x} \cdot \ln 10 \cdot \sec^2 \pi x \cdot \pi$

5. a) $y = \ln(x-1)$, $(2,0)$

$y' = \frac{1}{x-1}$

$y'(2) = \frac{1}{2-1} = 1$

$y - 0 = 1(x-2)$

$\boxed{x - y - 2 = 0}$

6. $\ln(x+y) = y-1$

$\frac{d}{dx}[\ln(x+y)] = \frac{d}{dx}(y-1)$

$\frac{1}{x+y} \cdot (1+y') = y' - 0$

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

$1 + y' = xy' + yy'$

$1 = xy' + yy' - y'$

$1 = y'(x+y-1)$

$\rightarrow y' = \frac{1}{x+y-1}$

8.6

#1 a) $\ln y = \ln(x^2+1)^2 + \ln(x^2+x+1)^3$

$\ln y = 2\ln(x^2+1) + 3\ln(x^2+x+1)$

$$\frac{1}{y}\cdot y' = \frac{2(2x)}{x^2+1} + \frac{3(2x+1)}{(x^2+x+1)}$$

$$y' = \left[\frac{4x}{x^2+1} + \frac{6x+3}{x^2+x+1}\right]\cdot y$$

$$y' = \left[\frac{4x}{x^2+1} + \frac{6x+3}{x^2+x+1}\right](x^2+1)^2(x^2+x+1)^3$$

OR. $= 4x(x^2+1)(x^2+x+1)^3 + (6x+3)(x^2+1)^2 \cdot (x^2+x+1)^2$

b) $\ln y = 4\ln(x-1) + 5\ln(2x+3) + 3\ln(x^2-2x+3)$

$$\frac{1}{y}\cdot y' = \frac{4}{x-1} + \frac{5(2)}{2x+3} + \frac{3(2x-2)}{x^2-2x+3}$$

$$y' = \left[\frac{4}{x-1} + \frac{10}{2x+3} + \frac{6x-6}{x^2-2x+3}\right]\cdot y$$

d) $\ln y = 3\ln(x+1) - 5\ln(x+2) - 7\ln(x+3)$

$$\frac{1}{y}\cdot y' = \frac{3}{x+1} - \frac{5}{x+2} - \frac{7}{x+3}$$

$$y' = \left[\frac{3}{x+1} - \frac{5}{x+2} - \frac{7}{x+3}\right]\frac{(x+1)^3}{(x+2)^5(x+3)^7}$$

8.6

#2 a) $y = x^{x^2}$

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

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

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

$y' = y \cdot (x + 2x \ln x)$

$y' = x^{x^2} \cdot x (1 + 2 \ln x)$

or $x^{x^2+1} (1 + 2 \ln x)$

b) $y = x^{\sqrt{x}}$

$\ln y = x^{1/2} \ln x$

$\frac{1}{y} \cdot y' = x^{1/2} \cdot \frac{1}{x} + \frac{1}{2} x^{-1/2} \ln x$

$\frac{1}{y} y' = x^{-1/2} + \frac{1}{2} x^{-1/2} \ln x \Rightarrow \frac{2}{2} \cdot \frac{1}{\sqrt{x}} + \frac{\ln x}{2\sqrt{x}}$

$y' = y \left(\frac{2 + \ln x}{2\sqrt{x}} \right)$

$= x^{\sqrt{x}} \left(\frac{2 + \ln x}{2\sqrt{x}} \right)$ or $\frac{1}{2} x^{\sqrt{x} - 1/2} (2 + \ln x)$

f) $\ln y = \sin x \ln \cos x$

$$\frac{1}{y} y' = \sin x \cdot \frac{1}{\cos x} \cdot -\sin x + \cos x \ln \cos x$$

$$\frac{1}{y} y' = \cos x \ln \cos x - \frac{\sin^2 x}{\cos x}$$

$$y' = (\cos x)^{\sin x} \left(\cos x \ln x - \frac{\sin^2 x}{\cos x} \right)$$

$\downarrow$

$$\sin x \cdot \frac{\sin x}{\cos x}$$

Could also be written as $\sin x \tan x$

8.7 Review Exercise Pg 396.

2. a) $\lim_{x \to -\infty} (1+2^x) = 1+0 = 1$

b) $\lim_{x \to 1^+} \log(x-1) = \lim_{x-1 \to 0^+} \log(x-1) = -\infty$

c) $\lim_{x \to \infty} \ln(x^2+x+1) = \infty$

d) $\lim_{x \to -1^-} e^{\frac{2}{x+1}} = \lim_{x+1 \to 0^-} e^{\frac{2}{x+1}}$

let $t = \frac{2}{x+1}$ then $t \to -\infty$ as $x \to -1^-$

so $\lim_{t \to -\infty} e^t = 0$

4. a) $\ln 1 = 0$

b) $e^{\ln 10} = 10$

c) $e^{3\ln 2} = e^{\ln 2^3} = 2^3 = 8$

d) $\ln\left(\frac{1}{e}\right) = -1$

5. (a) $\ln x = \frac{1}{2}$

$e^{1/2} = x$

$x = 1.648721$

(b) $e^x = 7$

$\ln e^x = \ln 7$

$x = \ln 7$

$x = 1.945910$

(c) $e^{5-3x} = 2$

$\ln e^{(5-3x)} = \ln 2$

$5 - 3x = \ln 2$

$-3x = (\ln 2) - 5$

$x = \frac{(\ln 2) - 5}{-3}$

$= 1.435618$

(d) $\ln(4x+7) = 4$

$e^4 = 4x+7$

$x = \frac{e^4 - 7}{4}$

$x = 11.899538$

6. a) $\ln x^2 + \ln(1+x)^3 - \ln(2+x)^4$

$= \ln\left[\frac{x^2(1+x)^3}{(2+x)^4}\right]$

(b) $\ln\left[\frac{\sqrt{x}}{(x^2+x+1)^2}\right]$

7. a) $f(x) = \ln(x^2+1)$

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

(b) $f(x) = e^{x^3}$

$f'(x) = 3x^2 e^{x^3}$

(c) $f(x) = x^{1/2} \cdot e^x$

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

$= \cancel{e^x x\left(\frac{2+1}{\sqrt{x}}\right)}$ oops!

$= e^x x^{-1/2}\left(x + \frac{1}{2}\right)$

$= \frac{e^x(2x+1)}{2\sqrt{x}}$

(d) $f(x) = \frac{\ln x}{x^2}$ $\quad f'(x) = \frac{x^2 \cdot \frac{1}{x} - 2x \ln x}{x^4}$

$= \frac{x - 2x\ln x}{x^4} = \frac{1 - 2\ln x}{x^3}$

e) $y = x^4 - 4^x$

$y' = 4x^3 - 4^x \ln 4$

f) $y = \ln \sqrt{\dfrac{2x+3}{4x-5}}$

$= \ln (2x+3)^{1/2} - \ln (4x-5)^{1/2}$

$y' = \frac{1}{2} \frac{(2)}{2x+3} - \frac{1}{2} \frac{4}{(4x-5)}$

$= \frac{1}{(2x+3)} - \frac{2}{(4x-5)} = \frac{4x-5-4x-6}{(2x+3)(4x-5)}$

$= \frac{-11}{(2x+3)(4x-5)}$

(g) $y = \sin(e^{2x})$

$y' = \cos(e^{2x}) \cdot e^{2x} \cdot 2$

$= 2e^{2x} \cos e^{2x}$

(h) $y = e^{2\sin x}$

$y' = e^{2\sin x} \cdot 2\cos x$

i. $y = \log_{10}(1 - x + x^3)$

$$y' = \frac{1}{(1 - x + x^3)\ln 10} \cdot -1 + 3x^2$$

$$= \frac{(3x^2 - 1)}{(1 - x + x^3)\ln 10}$$

j $y = e^x \ln x$

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

$$= e^x\left(\ln x + \frac{1}{x}\right) \quad \text{or} \quad e^x\left(\frac{x\ln x + 1}{x}\right)$$

k. $y = \dfrac{e^{x^2}}{x^2}$

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

$$= \frac{2x^3 e^{x^2} - 2x e^{x^2}}{x^4} = \frac{2e^{x^2}(x^2 - 1)}{x^3}$$

= [illegible]

l $y = (1 + (\ln x)^4)^{1/2}$

$$y' = \frac{1}{2}(1 + (\ln x)^4)^{-1/2} \cdot 4(\ln x)^3 \cdot \frac{1}{x}$$

$$= \frac{2(\ln x)^3}{x\sqrt{1 + (\ln x)^4}}$$

8(a) $y = 2^x \quad (0,1)$

$y' = 2^x \ln 2$

$y'(0) = 2^0 \ln 2 = \ln 2$

$y - 1 = \ln 2(x - 0)$

$(\ln 2)x - y + 1 = 0$

(b) $y = \frac{\ln x}{x} \quad (1,0)$

$y' = \frac{x \cdot \frac{1}{x} - (1)\ln x}{x^2}$

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

$y'(1) = \frac{1 - \ln 1}{1} = \frac{1 - 0}{1} = 1$

$y - 0 = 1(x - 1)$

$\boxed{x - y - 1 = 0}$

9. $\cancel{y} = f(x) = e^{-x}\cos 2x$ find $y''(0)$.

$f' = e^{-x} \cdot -\sin 2x \cdot 2 + -e^{-x}\cos 2x$

$= -2e^{-x}\sin 2x - e^{-x}\cos 2x$

$f'' = -2[e^{-x} \cdot \cos 2x \cdot 2 + -e^{-x}\sin 2x] - [e^{-x} \cdot 2\sin 2x$

$- e^{-x}\cos$

$= -4e^{-x}\cos 2x + 2e^{-x}\sin 2x + 2e^{-x}\sin 2x + e^{-x}\cos$

$= -3e^{-x}\cos 2x + 4e^{-x}\sin 2x$

$f''(0) = -3e^0\cos 0 + 4e^0\sin 0 = -3 \cdot 1 \cdot 1 + 4 \cdot 1 \cdot 0 = -3$