3.9

22. $\log_5 \sqrt{x} = \frac{1}{2}\log_5 x$

$\frac{1}{2}\left(\frac{1}{x \cdot \ln 5} \cdot 1\right)$

54. $\ln(kx)$ $\ln k + \ln x$

$\frac{1}{kx} \cdot k = \frac{1}{x}$ $0 + \frac{1}{x}$

24. $y = \frac{1}{\log_2 x} = (\log_2 x)^{-1}$

$y' = -1(\log_2 x)^{-2} \cdot \frac{1}{x \ln 2} \cdot 1$

$\frac{-1}{x \ln 2 (\log_2 x)^2}$

29.

$y = 3^x + 1$ $\quad y' = 3^x \ln 3 \cdot 1$

$y = 5x - 1$

$3^x \ln 3 = 5$

$3^x = \frac{5}{\ln 3}$

$\log_3\left(\frac{5}{\ln 3}\right) = x$

$(1.379, 5.551)$

51.

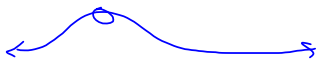
$P(t) = \frac{300}{1 + 2^{4-t}}$

a. $t = 0$ $\quad \frac{300}{1+2^{4-0}} = \frac{300}{17} = 18$ people

$P' = \frac{(\cancel{0}) - 300(2^{4-t} \cdot \ln 2 \cdot -1)}{(1+2^{4-t})^2}$ $\Big|_{t=4}$

$\frac{300(\ln 2)}{4} = 52 \frac{\text{people}}{\text{day}}$

$P' = \frac{300(2^{4-t} \ln 2)}{(1+2^{4-t})^2}$



53.

$A = 20\left(\frac{1}{2}\right)^{\frac{t}{140}}$

$\frac{+}{140} = \frac{1}{140}\,t$

$\frac{140(1) - t(0)}{(140)^2}$

$A' = 20\left(\left(\frac{1}{2}\right)^{\frac{t}{140}} \cdot \ln\left(\frac{1}{2}\right) \cdot \frac{1}{140}\right)\Big|_{t=2}$

$A' = \frac{20}{140}\ln\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)^{\frac{2}{140}}$

$= -.098 \frac{g}{day}$

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

27. $y = \log_{10} e^x$ $y' = \frac{1}{e^x \ln 10} \cdot e^x = \frac{1}{\ln 10}$

28 $y = \ln 10^x$

$y' = \frac{1}{10^x} \cdot 10^x \ln 10 \cdot 1 = \ln 10$

$y = x \ln 10$ $y' = \ln 10$

49.

51c.

45

$$\ln y = \ln\sqrt[5]{\frac{(x-3)^4(x^2+1)}{(2x+5)^3}}$$

$$\ln y = \frac{1}{5}\ln\left(\frac{(x-3)^4(x^2+1)}{(2x+5)^3}\right)$$

$$\ln y = \left(\frac{4}{5}\ln(x-3) + \frac{1}{5}\ln(x^2+1) - \frac{3}{5}\ln(2x+5)\right)$$

$$\frac{1}{y}\frac{dy}{dx} = \frac{4}{5}\cdot\frac{1}{x-3}\cdot 1 + \frac{1}{5}\cdot\frac{1}{x^2+1}\cdot 2x - \frac{3}{5}\cdot\frac{1}{2x+5}\cdot 2$$

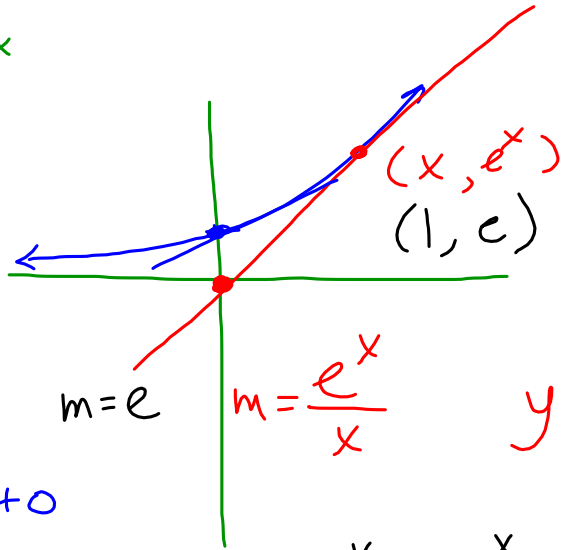
$$\frac{dy}{dx} = \left(\frac{4}{5(x-3)} + \frac{2x}{5(x^2+1)} - \frac{6}{5(2x+5)}\right)\cdot y$$

$$\frac{dy}{dx} = \sqrt[5]{\frac{(x-3)^4(x^2+1)}{(2x+5)^3}}\left(\frac{4}{5(x-3)} + \frac{2x}{5(x^2+1)} - \frac{6}{5(2x+5)}\right)$$

49.

$y = e^x$

5c.



$y = e^1(x-0) + 0$

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

$y = ex$

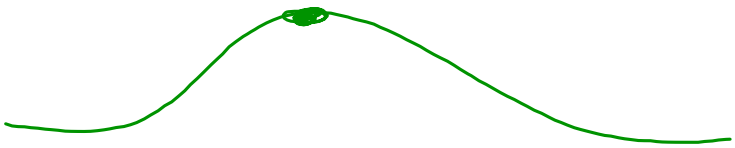
$\frac{e^x}{x} = e^x$

$x = 1$

51.

$$P = \frac{300}{1+2^{4-t}}$$

$$P = \frac{300\left(2^{4-t}\ln 2\right)}{\left(1+2^{4-t}\right)^2}$$



Quiz:

$$\frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{16t^3}{4t}$$

$$y = x^3 \tan 2x$$

$$y' = x^3 \sec^2 2x \cdot 2 + \tan(2x) \cdot 3x^2$$

3.

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

$$2y\frac{dy}{dx} = \frac{(x+1)(1) - x(1)}{(x+1)^2}$$

$$2y\frac{dy}{dx} = \frac{1}{(x+1)^2} \cdot \frac{1}{2y}$$

$$\frac{dy}{dx} = \frac{\frac{1}{(x+1)^2} \cdot \frac{1}{2y}}{2y \cdot \frac{1}{2y}} = \frac{1}{2y(x+1)^2}$$

$$32x - \left(16x \frac{dy}{dx} + y \cdot 16\right) + 2y \frac{dy}{dx} = 0$$

$$32x - 16x \frac{dy}{dx} - 16y + 2y \frac{dy}{dx} = 0$$