3.5

Exponential Growth $y = ae^{bx}$

$b > 0$

Exponential Decay $y = ae^{bx}$

$b < 0$

① $A = Pe^{rt}$

$10{,}000 = 5000e^{.07t}$

Double 500
$= 1000$

$\frac{10000}{5000} = \frac{5000e^{.07t}}{5000}$

$2 = e^{.07t}$

$\ln 2 = \ln e^{.07t}$

$.693 = \frac{.07t}{.07}$

$9.9 = t$

10yrs $A = 5000e^{.07(10)}$

$A = 5000\,(2.014)$

$A = \$10{,}068.76$

3 $A = Pe^{rt}$

$1000 = 500e^{10r}$

$\frac{1000}{500} \quad \frac{500e^{10r}}{500}$

$2 = e^{10r}$

$\ln 2 = \ln e^{10r}$

$.693 = 10r$

$\frac{.693}{10} \quad \frac{10r}{10}$

$.0693 = r$ $\quad 6.93\%$

10yrs $A = 500e^{.0693(10)}$

$A = 500(1.9997)$

$A = \$999.85$

$A = 500(2) = \$1000$

5 $2281.88 = 1000e^{10r}$

$\frac{}{1000} \quad \frac{}{1000}$

$2.28188 = e^{10r}$

$\ln 2.28188 = \ln e^{10r}$

$.825 = 10r$

$\frac{}{10} \quad \frac{}{10}$

$.0825 = r$ 8.25%

$2000 = 1000e^{.0825t}$

$\frac{}{1000} \quad \frac{}{1000}$

$2 = e^{.0825t}$

$\ln 2 = \ln e^{.0825t}$

$.693 = .0825t$

$\frac{}{.0825} \quad \frac{}{.0825}$

$8.40 = t$ 8.4 yrs

7 $19205 = Pe^{.11(10)}$

$19205 = P(3.004)$

$\frac{}{3.004}$ $\frac{}{3.004}$

$\$6393.14 = P$

$2 = e^{.11t}$

$\ln 2 = \ln e^{.11t}$

$.693 = .11t$

$\frac{}{.11}$ $\frac{}{.11}$

$6.3 = t$ 6.3 yrs

11. $2 = 4e^{k(1599)}$

$\frac{2}{4} \quad \frac{}{4}$

$\frac{1}{2} = e^{1599k}$

$\ln \frac{1}{2} = \ln e^{1599k}$

$-.693 = 1599k$

$\frac{}{1599} \quad \frac{}{1599}$

$-.0004334 = k$

$A = 4e^{-.00043349(1000)}$

$A = 4(.6482)$

$A = 2.59\ g$

$\frac{1}{2}$ life

$\frac{1}{2}$ of 4g

$= 2g$

12 $\frac{1}{2}a = ae^{k(5715)}$

$\frac{1}{2} = e^{k(5715)}$

$\ln \frac{1}{2} = \ln e^{5715k}$

$-.693 = 5715k$

$\frac{-.693}{5715} \quad \frac{5715k}{5715}$

$-.00012129 = k$

$3.5 = ae^{-.00012129(1000)}$

$3.5 = ae^{-.1219}$

$3.5 = a(.8858)$

$\frac{3.5}{.8858} \quad \frac{.8858a}{.8858}$

$3.95 = a$

21 $(0,1)$ $(4,10)$

(t,y) (t,y)

$y = Ce^{kt}$

$1 = Ce^{k(0)}$

$1 = Ce^{0}$

$1 = C(1)$

$1 = C$

$y = 1e^{kt}$

$10 = e^{k(4)}$

$10 = e^{4k}$

$\ln 10 = \ln e^{4k}$

$2.303 = 4k$

$\frac{}{4} \quad \frac{}{4}$

$.5756 = k$

25

$$P = 105{,}300\,e^{.015t}$$

$$150{,}000 = 105{,}300\,e^{.015t}$$

$$\frac{150{,}000}{105{,}300} = \frac{105{,}300}{105{,}300}e^{.015t}$$

$$1.4245 = e^{.015t}$$

$$\ln 1.4245 = \ln e^{.015t}$$

$$.3538 = .015t$$

$$\frac{.3538}{.015} = \frac{.015t}{.015}$$

$$23.59 = t$$

$$24 \approx t$$

$$2000 + 24 = 2024$$

during 2024

27 $N = 100e^{kt}$

$225 = 100e^{8k}$

$\frac{225}{100} = \frac{100e^{8k}}{100}$

$2.25 = e^{8k}$

$\ln 2.25 = \ln e^{8k}$

$.8109 = 8k$

$\frac{.8109}{8} = \frac{8k}{8}$

$.1014 = k$

Double

$200 = 100e^{.1014t}$

$\frac{200}{100} = \frac{100e^{.1014t}}{100}$

$2 = e^{.1014t}$

$\ln 2 = \ln e^{.1014t}$

$.693 = .1014t$

$\frac{.693}{.1014} = \frac{.1014t}{.1014}$

$6.83 = t$

6.83 h

Triple

$300 = 100e^{.1014t}$

$\frac{300}{100} = \frac{100e^{.1014t}}{100}$

$3 = e^{.1014t}$

$\ln 3 = \ln e^{.1014t}$

$1.0986 = .1014t$

$\frac{1.0986}{.1014} = \frac{.1014t}{.1014}$

$10.84 = t$

10.84 h

29. $R = \frac{1}{8^{14}}$

$$\frac{1}{8^{14}} = \frac{1}{10^{12}} e^{-t/8223}$$

$$.2274 = e^{-t/8223}$$

$$\ln .2274 = \ln e^{-t/8223}$$

$$-.8223 \cdot -1.4812 = \frac{-t}{8223} \cdot -8223$$

$$12179.58 = t$$

$$12,179.58 \text{ y}$$

33 $\frac{1}{2} = e^{k(30)}$

$\ln \frac{1}{2} = \ln e^{30k}$

$-.693 = 30k$

$\frac{-}{30} \quad \frac{-}{30}$

$-.0231 = k$

Original Amt $a = 1$

$A = 1e^{-.0231(100)}$

$A = .0992$

9.92%

49 $L = 10 \log \frac{I}{I_0}$

or $L = 10(\log I - \log I_0)$

a) $L = 10(\log 10^{-10} - \log 10^{-12})$

$L = 10(-10 - -12)$

$L = 10(2)$

$L = 20$ decibels

b) $L = 10(\log 10^{-5} - \log 10^{-12})$

$L = 10(-5 - -12)$

$L = 10(7)$

$L = 70$ decibels

53 $pH = -\log_{10}[H^+]$

$5.8 = -\log_{10}[H^+]$

$=1 \qquad =1$

$-5.8 = \log_{10}[H^+]$

$10^{-5.8} = 10^{\log_{10}[H^+]}$

$1.58 \times 10^{-5} = H^+$