#51) The half life of silicon-32 is 710 years. If 40 grams is present now, how much will be present in 200 years?

$$A = A_0 e^{Kt}$$

$\updownarrow$

$$\frac{1}{2}(40) = 40 e^{(K)(710)}$$ Divide both sides by 40

$$\frac{1}{2} = e^{710K}$$ take "ln" of Both sides

$$\ln\frac{1}{2} = \ln e^{710K} = 710K \ln e$$ "and recall $\ln e = 1$"

$$-0.693 = 710K \implies K = \frac{-0.693}{710} = -9.763 \times 10^{-4}$$

How much will be present in 200 years?

$$A = 40 e^{-9.763 \times 10^{-4} * 200} = \boxed{32.905 \text{ grams}}$$

#52)

$$A = A_0 e^{Kt}$$

$\updownarrow$

$$50\% = 100\% e^{K(5600)}$$

$$\frac{1}{2} = e^{5600K}$$

$$\ln\frac{1}{2} = 5600K \cancel{\ln e}^{1}$$

$$-1.2378 \times 10^{-4} = K$$

$$0.14 = 1.00 e^{-1.2378 \times 10^{-4} t}$$

$$\ln 0.14 = -1.2378 \times 10^{-4} t \cancel{\ln e}^{1}$$

$$\frac{\ln 0.14}{-1.2378 \times 10^{-14}} = t$$

$$\boxed{15884 \text{ years} \cong t}$$

#53)

$$P = P_0 e^{-0.0244t}$$

$$\updownarrow \quad \updownarrow$$

$$5 = 15 e^{-0.0244t}$$

$$\frac{5}{15} = e^{-0.0244t}$$

$$\ln\left(\frac{5}{15}\right) = \ln e^{-0.0244t}$$

$$\ln\left(\frac{5}{15}\right) = -0.0244t \, \cancel{\ln e}^{\,1}$$

$$\frac{\ln\left(\frac{5}{15}\right)}{-0.0244} = t \implies \boxed{t = 45.03 \text{ years}}$$

#54)

$$y = y_0 e^{-0.40t}$$

$$\updownarrow \quad \updownarrow$$

$$1 = 10 e^{-0.40t}$$

$$\frac{1}{10} = e^{-0.40t}$$

$$\ln\left(\frac{1}{10}\right) = \ln e^{-0.40t}$$

Recall:

$$\ln\left(\frac{1}{10}\right) = -0.40t \ln e \quad \text{and} \quad \boxed{\ln e = 1}$$

$$\frac{\ln\left(\frac{1}{10}\right)}{-0.40} = t \implies t = 5.76$$

$$10{:}00\text{ AM} + 5.76\text{ HR} = \boxed{3{:}45\text{ pm}}$$

#55

$$U = T + (U_0 - T)e^{Kt}$$

$$74 = 35 + (79-35)e^{13K}$$

$$\underline{-35 \qquad -35}$$

$$39 = 44e^{13K}$$

$$\frac{39}{44} = e^{13K} \Rightarrow \frac{\ln\left(\frac{39}{44}\right)}{13} = K$$

$$\boxed{-0.0093 = K}$$

How long before it reaches 57°f?

$$57 = 35 + (79-35)e^{-0.0093t}$$

$$\underline{-35 \qquad -35}$$

$$22 = 44\, e^{-0.0093t}$$

$$\frac{22}{44} = e^{-0.0093t}$$

$$\frac{1}{2} = e^{-0.0093t}$$

$$\ln\frac{1}{2} = \ln e^{-0.0093t}$$

$$\ln\frac{1}{2} = -0.0093t \cancelto{1}{\ln e}$$

$$\frac{\ln 1/2}{-0.0093} = t \Rightarrow t = 74.53 \approx \boxed{75 \text{ minutes}}$$

#56)

$$U = T + (U_0 - T)e^{kt}$$

$$140 = 72 + (194 - 72)e^{(k)(11)}$$

Initial temperature $= 194\,°F$

Surrounding temperature $= 72$

$$\begin{array}{l} 140 = 72 + (122)e^{11k} \\ -72 \quad -72 \\ \hline 68 = 122e^{11k} \end{array}$$

$$\frac{68}{122} = e^{11k} \implies k = \frac{\ln\left(\frac{68}{122}\right)}{11} = -0.05314$$

Find the time needed for the coffee to cool to a temperature of 102°F.

$$102 = 72 + (194 - 72)e^{-0.05314t}$$

$$30 = 122e^{-0.05314t}$$

$$\ln\left(\frac{30}{122}\right) = -0.05314t$$

$$\boxed{26.4 = t \text{ minutes}}$$

#57 $P(t) = \dfrac{1240}{1+40.33e^{-0.325t}}$

To find the initial amount of bacteria, let $t=0$

$$P(0) = \frac{1240}{1+40.33e^{0}} = \frac{1240}{41.33} = \boxed{30.\ \text{Bacteria}}$$

#58

$$P(t) = \frac{180}{1+44e^{-0.188t}}$$

$$80 = \frac{180}{1+44e^{-0.188t}}$$

$$80(1+44e^{-0.188t}) = 180$$

$$1+44e^{-0.188t} = \frac{180}{80}$$

$$\boxed{t = 18.94 \text{ years}}$$

Stat Calc 0 Enter

#59

L_1	L_2
35	103
40	133
45	190
50	255
55	360
60	503
65	818

$y = 8.9442(1.0703)^t$

$A = A_0 e^{Kt}$

$e^K = 1.0703$

$K = \ln 1.0703 = 0.0679$

$\boxed{y = 8.94e^{0.068x}}$

Now let $x = 70$

$y = 8.94\, e^{0.068 * 70} \cong \boxed{\$1044}$

Stat Calc 9 Enter

#60

L_1	L_2
2	77.4
3	60.8
4	54.5
5	45.8
8	30
10	24.3
15	10.5

$y = a + b\ln x$

$y = 98.75 - 32.66 \ln x$

after 20 HRS let $x = 20$

$y = 98.75 - 32.66 \ln 20$

$\boxed{y = 0.91}$

#61

L_1	L_2
5	100
10	180
15	270
20	300
25	305

$\boxed{\text{Stat}}$ $\boxed{\text{EDIT}}$ and plug in the Data.

$\boxed{\text{2nd}}$ $\boxed{\text{MODE}}$

$\boxed{\text{Stat}}$ $\boxed{\text{CALC}}$ $\boxed{\text{B}}$ Logistic $\boxed{\text{Enter}}$

$$y = \frac{c}{1+ae^{-bx}}$$

$$y = \frac{314.79}{1+7.86e^{-0.25x}}$$

So, the carrying capacity is $\boxed{314.79 \approx 315°F}$

For Solutions see attached pages please ⇒

53) Strontium 90 decays at a constant rate of 2.44% per year. Therefore, the equation for the amount P of strontium 90 after t years is $P = P_0\, e^{-0.0244t}$. How long will it take for 15 grams of strontium to decay to 5 grams? Round answer to 2 decimal places.

54) The amount of a certain drug in the bloodstream is modeled by the function $y = y_0\, e^{-0.40t}$, where y_0 is the amount of the drug injected (in milligrams) and t is the elapsed time (in hours). Suppose that 10 milligrams are injected at 10:00 A.M. If a second injection is to be administered when there is 1 milligram of the drug present in the bloodstream, approximately when should the next dose be given? Express your answer to the nearest quarter hour.

55) A thermometer reading 79°F is placed inside a cold storage room with a constant temperature of 35°F. If the thermometer reads 74°F in 13 minutes, how long before it reaches 57°F? Assume the cooling follows Newton's Law of Cooling:

$$U = T + (U_0 - T)e^{kt}.$$

(Round your answer to the nearest whole minute.)

56) A cup of coffee is heated to 194°and is then allowed to cool in a room whose air temperature is 72°. After 11 minutes, the temperature of the cup of coffee is 140°. Find the time needed for the coffee to cool to a temperature of 102°.

57) The logistic growth model $P(t) = \dfrac{1240}{1 + 40.33e^{-0.325t}}$ represents the population of a bacterium in a culture tube after t hours. What was the initial amount of bacteria in the population?

58) The logistic growth model $P(t) = \dfrac{180}{1 + 44e^{-0.188t}}$ represents the population of a species introduced into a new territory after t years. When will the population be 80?

59) A life insurance company uses the following rate table for annual premiums for women for term life insurance. Use a graphing utility to fit an exponential function to the data. Predict the annual premium for a woman aged 70 years.

Age	35	40	45	50	55	60	65
Premium	\$103	\$133	\$190	\$255	\$360	\$503	\$818

60) After introducing an inhibitor into a culture of luminescent bacteria, a scientist monitors the luminosity produced by the culture. Use a graphing utility to fit a logarithmic function to the data. Predict the luminosity after 20 hours.

Time, hrs	2	3	4	5	8	10	15
Luminosity	77.4	60.8	54.5	45.8	30.0	24.3	10.5

61) A mechanic is testing the cooling system of a boat engine. He measures the engine's temperature over time. Use a graphing utility to fit a logistic function to the data. What is the carrying capacity of the cooling system?

time, min	5	10	15	20	25
temperature, °F	100	180	270	300	305