Assignment 1 (SOLUTION from Textbook Manual Solution)

Text: *Calculus for the Life Sciences, S. Schreiber, K. Smith and W. Getz, Wiley, 2014*

Section 1.1

38. The x mg decreases to $0.32x$ during the first 24 hours; then 30 mg is added. After another 24 hours, the total $30 + 0.32x$ will decrease to $0.32(30 + 0.32x)$.

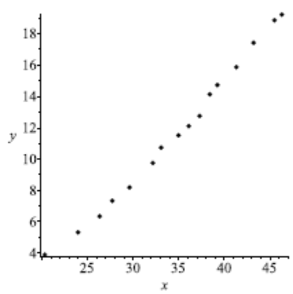
42. a. $D: [0, a]$.

Section 1.2

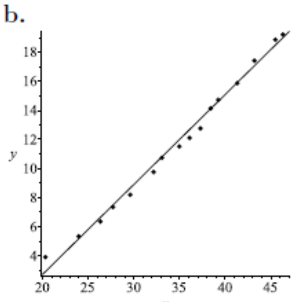
38. a. The slope is $(110-97)/(500-100) = 13/400$, and the equation is given by $N = 13x/400 + (97 - 13/4) = 13x/400 + 375/4$.

b. We obtain $N = 103.5$ for $x = 300$; we get $x = 2500/13 \approx 192.3$.

42. a. The data is close to linear.



b.



44. a. $t = A/10$ (hours).

b. Here $A = 1000 \cdot 0.03 = 30$ (mL), and we know $t = A/10$, thus $t = 3$ hours.

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Section 1.4

34. a. Once a day: $N = 20(1+5)^{365}$, twice a day: $N = 20(1+5/2)^{730}$, four times a day: $N = (1+5/4)^{1460}$

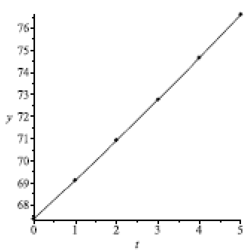
b. n times a day: $20(1+5/n)^{365n}$.

c. The values approach $20e^{1825}$.

40. The size of the bacteria population is given by $20(2)^{t/9.3}$, where t is measured in hours. Thus after three days, the size is $20(2)^{72/9.3} \approx 4281$ individuals.

42. a. If $f(t) = b\,a^t$, then substituting $t = 0$, we obtain $67.38 = b$. At $t = 1$, $69.13 = 67.38a$, so $a = 69.13/67.38$. Thus $f(t) = 67.38(69.13/67.38)^t$.

b. The quality of the fit is excellent.



c. The estimate is $67.38(69.13/67.38)^{24} \approx$ 124.68 (millions).

d. The population size was 104.96 million.

Section 1.6

38. The doubling time can be found by solving $2 = (1.026)^T$. Take the natural logarithm of both sides and divide to obtain $T = \ln 2/\ln 1.026 \approx 27$ years.

42. a. We solve the equation $Q_0/2 = Q_0(0.85)^t$. Taking natural logarithms of

both sides (after dividing them by Q_0) gives $t = \ln(1/2)/\ln 0.85 \approx 4.27$ years.

b. We have to solve the equation $Q_0/2 = Q_0 r^{100}$, so $r = \sqrt[100]{1/2} \approx 0.993$, which means the depletion rate is 0.7%.

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Section 1.7

32. a. $a_1 = 500$, $a_n = 0.2a_{n-1} + 500$.

b. The values are 500, $0.2 \cdot 500 + 500 = 600$, $0.2 \cdot 600 + 500 = 620$, $0.2 \cdot 620 + 500 = 624$, $0.2 \cdot 624 + 500 = 624.8$.

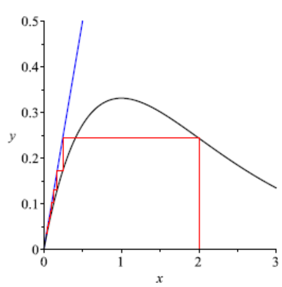
c. The equilibrium is given by $x = 0.2x + 500$, which gives $x = 500/0.8 = 625$ mg.

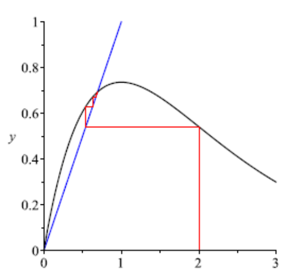
34. a. First, $a_1 = A$. Then $a_2 = (1-c)a_1 + A$. Continuing, $a_3 = (1-c)a_2 + A$. We obtain that $a_n = (1-c)a_{n-1} + A$.

b. The equilibrium is the solution of $x = (1-c)x + A$, which is $x = A/c$.

c. The equilibrium value is bigger than $2A$ when $A/c > 2A$; i.e. when $c < 1/2$.

36. The equilibria are given by the equation $x = bxe^{-cx}$, which is the same as $x(1 - be^{-cx}) = 0$. The product is zero if either $x = 0$ or $1 - be^{-cx} = 0$. The second equation gives $x = \ln b/c$. This is positive when $b > 1$. The figures show the cobweb diagrams for $b = 0.9$, $b = 2.0$, $b = 8.0$ and $b = 20.0$, if $a_1 = 2$, $c = 1.0$.





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