1. (a) The initial amount is 100 units. We have growth at the rate of 7%.
(b) The initial amount is 5.3 units. We have growth at the rate of 5.4%.
(c) The initial amount is 3500 units. We have decay at the rate of \((1 - 0.93) = 0.07\), or 7%.
(d) The initial amount is 12 units. We have decay at the rate of \((1 - 0.88) = 0.12\), or 12%.

2. (a) Town (i) has the largest percent growth rate at 12%.
(b) Town (ii) has the largest initial population at 1000 people.
(c) Town (iv) is the only one decreasing in size; it is decreasing by 10% each year.

3. (a) This is a constant rate, so the function is linear with an intercept of 1000 and a slope of 50:
\[ P(t) = 1000 + 50t. \]
(b) This is exponential growth with an initial population of 1000 and a relative growth rate of 5%:
\[ P(t) = 1000(1.05)^t. \]

4. (a) This is a linear decrease from 30 with a slope of \(-2\):
\[ Q(t) = 30 - 2t. \]
(b) This is exponential decrease from 30 with a relative growth rate of \(-0.12\):
\[ Q(t) = 30(0.88)^t. \]

5. (a) We have an initial amount of 50 mg and a growth (decay) factor of \(1 - 0.06 = 0.94\), so \(A(t) = 50(0.94)^t\).
(b) \(A(24) = 50 \times (0.94)^{24} \approx 11.32\) mg, so there are about 11.32 mg of quinine left in the patient’s body after 24 hours.
(c) See below.
(d) It appears from the graph that there will be 5 mg of quinine left after about 32 hours.

6. (a) We have \(W(t) = 45(1.047)^t\).
(b) \(W(10) = 45(1.047)^{10} \approx 71.23\) trillion dollars.
(c) See below.
(d) It looks like the GWP will pass 50 trillion dollars around 2003. (Did it?)

7. (a) We should have slow exponential growth; this matches II.
(b) This is slightly faster exponential growth; it matches I.
(c) This is constant linear growth; it matches III.
(d) This is neither growth nor decay; it matches V.

(e) IV indicates an exponential decay of perhaps 10%. VI gives a constant rate of decay of perhaps 5000 people per year.

8. (a) The population is growing by about 1.26% per year.
(b) The population in 2000 was about 6.1 billion people \((P(0))\). In 2005, it is predicted to be about \(P(5) = 6.1(1.0126)^5 \approx 6.5\) billion people.
(c) The average rate of change is \(\frac{6.5 - 6.1}{5} = 0.08\) billion people per year, or 80 million people per year.

10. This is clearly not linear, so we should check whether it is exponential: \(6.02/4.3 = 1.4, 8.43/6.02 \approx 1.4\), and \(11.8/8.43 \approx 1.4\), so we seem to have a nearly exponential growth pattern. We have \(f(x) = 4.3(1.4)^x\).

11. This is also not linear; however, \(4.4/5.5 = 0.8, 3.52/4.4 = 0.8\), and \(2.82/3.52 \approx 0.8\), so we have an exponential decay pattern. We have \(g(t) = 5.5(0.8)^t\).

12. The graph looks exponential, so the function should have the form \(y(t) = 500b^t\), where \(b\) is the base. Since \(y(3) = 2000\), we must have \(2000 = 500b^3\), or \(4 = b^3\). Thus, \(b = \sqrt[3]{4} \approx 1.587\), and \(y(t) = 500(1.587)^t\).

13. Here we know that \(y(t) = 30b^t\) and \(y(25) = 6\), so \(6 = 30b^{25}\), \(0.2 = b^{25}\), and \(b = \sqrt[25]{0.2} \approx 0.9377\). This gives \(y(t) = 30(0.9377)^t\).

14. (a) Only \(h\) could be linear; its slope would be \(-3\) and its \(y\)-intercept 31, so \(h(x) = -3x + 31\).
(b) Only \(g\) could be exponential; the growth factor is 1.5, so \(g(x) = 36(1.5)^x\).

18. Let \(P(t)\) be the number of passengers for year \(t\), and let \(d\) be the percentage decrease each year. Then we have \(P(t) = 190,205(1 - d)^t\) and \(P(5) = 174,989 = 190,205(1 - d)^5\). Thus
\[
\frac{174,989}{190,205} = (1 - d)^5
\]
\[
0.92 = (1 - d)^5
\]
\[
\sqrt[5]{0.92} = 1 - d
\]
\[
0.983 \approx 1 - d
\]
\[
d \approx 0.0165.
\]
Thus, the percentage decrease is about 1.65% per year.

20. (a) \[
\begin{array}{cccc}
x & e^x & 0 & 1 & 2 & 3 \\
\hline
0 & 1 & 2.718 & 7.389 & 20.086
\end{array}
\]
(b) I’ll let you plot these points; the result does look like an exponential growth function.
(c) \[
\begin{array}{cccc}
x & e^{-x} & 0 & 1 & 2 & 3 \\
\hline
0 & 1 & 0.368 & 0.135 & 0.498
\end{array}
\]
(d) This looks like an exponential decay function. (You can plot the points.)

27. (a) If it was originally \(x\) inches long, after reduction it is 0.8\(x\) inches long. To return it to its original size, we must multiply by some enlargement factor \(n\): \(n(0.8x) = x\). Solving for \(n\) gives \(n = 1.25\), so we will need to enlarge by 25%.
(b) The first reduction gives us 0.8\(x\), the second 0.64\(x\), the third 0.512\(x\), the fourth 0.41\(x\), the fifth 0.33\(x\), the sixth 0.26\(x\), then seventh 0.21\(x\), the eighth 0.17\(x\), the ninth 0.13\(x\), the tenth 0.11\(x\), and the eleventh 0.086\(x\), so it takes eleven reductions.

28. (a) Niki’s investment has value \(V(t) = 10000(0.9)^t\) dollars after \(t\) years. After 10 years, it was worth \(V(10) = 10000(0.9)^{10} \approx 3486.78\).
(b) Regaining 10% per year, the investment has a value of $V(t) = 3486.78(1.1)^t$ dollars after $t$ years. We want to know when this is equal to $10000$ again. That is, we want to know the value of $t$ when $3486.78(1.1)^t = 10000$.

This gives $1.1^t \approx 2.868$. We can solve this graphically on our calculators or using logarithms (from the next section). Either way gives $t \approx 11.05$ years, or a little over 11 years. It took an extra year to get back!