
1. (a) Find the equation of the line through (1,6) and (3,10).
   (b) If (5,w) is on the line, what is w?
   (c) If (v,7) is on the line, what is v?
   (d) What is the slope of the line? What is the intercept?
   (e) Sketch the graph of the line. Be sure to label the axes. Is the graph increasing or decreasing?
   Ans: (a) y = 2x+4, (b) w=14, (c) v = 3/2,
   (d) slope = 2, intercept = 4, (e) increasing

2. (a) Find the equation of the line through (4,2) and (7,-4).
   (b) If (5,w) is on the line, what is w?
   (c) If (v,8) is on the line, what is v?
   (d) What is the slope of the line? What is the intercept?
   (e) Sketch the graph of the line. Is it increasing or decreasing?
   Ans: (a) y = -2x + 10, (b) w = 0, (c) v = 1, (d) slope = -2, intercept = 10,
   (e) decreasing

3. It has been found that crickets chirp 87 times per minute when the temperature is 61 °F, while they chirp 152 times per minute when the temperature is 74 °F. Let T be the temperature in degrees Fahrenheit, while C is the frequency of chirping. Assume that the relationship is given by a straight line.
   (a) Find the equation of the line for C in terms of T.
   (b) Sketch the graph. Be sure to label the axes.
   (c) What is the slope? Does the graph go up or down?
   (d) What is the C-intercept?
   (e) If the temperature is 66 °F, what chirping rate do you expect?
   (f) If you hear crickets chirp 122 times per minute, what temperature do you expect it to be outside?
   (g) If the temperature is 81 °F, what chirping rate do you expect?
   (h) If you hear crickets chirp 137 times per minute, what is likely to be the outdoor temperature?
   (i) If you hear crickets chirp 37 times in 15 seconds, what is likely to be the outdoor temperature?
   (j) If you hear crickets chirp 45 times in 20 seconds, what is the temperature?
   (k) If the temperature outside is 212 °F, what chirping rate do you expect? What goes wrong biologically? What goes wrong mathematically?
   Ans: (a) C = 5T - 218 chirps/ min, (c) 5 chirps/min °F, up
   (d) -218 chirps/min, (e) 112 chirps/min, (f) 68 °F, (g) 187 chirps/min
   (h) 71 °F, (i) 73.2 °F, (j) 70.6 °F, (k) 0 chirps/min. The crickets are dead. The formula only works for a limited range of numbers.

4. In a biological experiment, bacteria are growing in a nutritious medium inside a glass beaker. Let t be the number of minutes since the experiment started. Let B be the number of milligrams of bacteria in the beaker. Suppose that we observe the following data

<table>
<thead>
<tr>
<th>t</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>55</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
</tr>
</tbody>
</table>

(a) Tell the equation of the line for the amount of bacteria t minutes after the start of the experiment. Ans: B= 41.67 + 1.333 t milligrams
(b) Tell the slope of the line. Ans: 1.333 mg/ min
(b) If this trend continues, how many milligrams of bacteria will be in the beaker 2 hours after the start of the experiment? Ans: 201.63 mg
1. Consider the data in the following table:

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

(a) Plot the data, and by eye draw an approximate line of best fit.
(b) Use your calculator to find the line of best fit (the regression line) through the data.
   (Ans. \( y = 51.5 - 9.5x \))
(c) Plot the regression line together with the approximate line of best fit from (a). Compare the lines.
(d) For each x value, tell the predicted value and the residual. Is there a good fit?
   Ans: | x | y | y(predicted) | residual |
     |---|---|-------------|----------|
     | 1 | 41| 42          | -1       |
     | 2 | 34| 32.5        | 1.5      |
     | 3 | 23| 23          | 0        |
     | 4 | 13| 13.5        | -0.5     |
     | 5 | 4 | 4           | 0        | yes     |

2. (a) Use your calculator to find the line of best fit (the regression line) through

<table>
<thead>
<tr>
<th>u</th>
<th>v</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>2.5</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>22.2</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>6.1</td>
<td>-8</td>
</tr>
<tr>
<td>9.2</td>
<td>-35</td>
</tr>
</tbody>
</table>

   (Ans. \( v = 49.9 - 9.3u \))
(b) For each u value, tell the predicted value and the residual. Is the line a good fit?
   Ans: | u | v | v(predicted) | residual |
     |---|---|-------------|----------|
     | 1 | 41| 40.6        | 0.4      |
     | 2.5| 29| 26.65       | 2.35     |
     | 3 | 22.2| 22.0    | 0.2      |
     | 3 | 19 | 22.0        | -3.0     |
     | 6.1| -8| -6.83       | -1.17    |
     | 9.2| -35| -33.66     | -1.34    | so-so   |

3. In a biological experiment, bacteria are growing in a nutritious medium inside a glass beaker. Let t be the number of minutes since the experiment started. Let B be the number of milligrams of bacteria in the beaker. Suppose that we observe the following data

<table>
<thead>
<tr>
<th>t</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>55</td>
</tr>
<tr>
<td>15</td>
<td>63</td>
</tr>
<tr>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>30</td>
<td>78</td>
</tr>
</tbody>
</table>

(a) Tell the equation of the regression line for the amount of bacteria at time t.
   (Ans: \( B = 45.0 + 1.16 \ t \) milligrams)
(b) If this trend continues, how much bacteria will be in the beaker 2 hours after the start of the experiment? (Ans 184.2 mg)
(c) How much bacteria were initially in the beaker, if the trend can be believed?
   (Ans: 45.0 mg)
(d) Sketch the data and the line. Is there a good fit?

1. Solve
\[2x + y = 1\]
\[x - 2y = 8\]  
(Ans. \(x = 2, y = -3\))

2. Solve
\[2y - 3x = -1\]
\[x + 2y = 11\]  
(Ans. \(x = 3, y = 4\))

3. Solve
\[3x - y = 2\]
\[y - x = 1\]  
(Ans. \(x = 3/2, y = 5/2\))

4. Solve
\[x + y + 2z = 0\]
\[2x + y + z = 3\]
\[x - y + 3z = -8\]  
(Ans. \(x = 1, y = 3, z = -2\))

5. Solve
\[3a - 2b + c = 11\]
\[2a + 3b + 2c = 4\]
\[2a - 5b - 2c = 4\]  
(Ans: \(a = 1, b = -2, c = 4\))

6. The variables \(x\) and \(y\) are related by a formula \(y = ax + 2c\) where \(a\) and \(c\) are parameters. If the points (1,3) and (4,-15) are on the graph,
   (i) find \(a\) and \(c\)
   (ii) find the formula for \(y\) in terms of \(x\).
   (iii) When \(x = 5\), find \(y\).
   (iv). Sketch the graph. What kind of shape is it?
   Answers:  
   (i) \(a = -6, c = 4.5\)
   (ii) \(y = -6x + 9\)
   (iii) \(y = -21\)
   (iv) a line

7. Suppose \(y = ax^2 + bx\), where \(a\) and \(b\) are parameters. Suppose you are given the following data:
   \[
   \begin{array}{|c|c|}
   \hline
   x & y \\
   \hline
   1 & 5 \\
   3 & 27 \\
   \hline
   \end{array}
   \]
   (i) Find \(a\) and \(b\)
   (ii) Find the formula for \(y\) in terms of \(x\).
   (iii) Find \(y\) when \(x=2\).
   (iv) Find \(y\) when \(x = -1\)
   (v) Use your calculator to find the graph. What range of \(y\) is needed to include all the points for \(x\) between -3 and 5?
   (vi) Trace the graph on your calculator and tell the coordinates of the lowest point.
   Ans:  
   (i) \(a = 2, b = 3\)
   (ii) \(y = 2x^2 + 3x\)
   (iii) \(y = 14\)
   (iv) \(y = -1\)
   (v) \(y\) should include at least -1.2 through 65.
   (vi) (-0.75, -1.125)

8. The variables \(x\) and \(y\) are related by a formula
   \[y = ax^2 + bx + c\]
   Suppose the following data are given:
   \[
   \begin{array}{|c|c|c|}
   \hline
   x & y \\
   \hline
   0 & 1 & 3 \\
   5 & 4 & 20 \\
   \hline
   \end{array}
   \]
   (i) Find \(a, b,\) and \(c\).
   (ii) Find the formula for \(y\) in terms of \(x\).
   (iii) Tell \(y\) if \(x = 4\).  
   (iv) If \(x = 5\), tell \(y\).
   (v) Use your calculator to graph the function and trace the graph. What approximately are the coordinates of the lowest point on the graph?
   Ans:  
   (i) \(a = 3, b = -4, c = 5\)
   (ii) \(y = 3x^2 - 4x + 5\)
   (iii) \(y = 37\)
   (iv) \(y = 60\)
   (v) approximately (.67, 3.7)

1. Solve \( x^2 - 10x + 21 = 0 \).
   Ans: \( x = 3 \) or \( x = 7 \)

2. Solve \( x^2 + x - 12 = 0 \).
   Ans: \( x = 3 \) or \( x = -4 \)

3. Solve \( 2x^2 - 5x - 3 = 0 \).
   Ans: \( x = 3 \) or \( x = -1/2 \)

4. Solve \( 6x^2 - x - 1 = 0 \).
   Ans: \( x = -1/3 \) or \( x = 1/2 \)

5. Solve \( x^2 - 5.51x + 7.4178 = 0 \).
   Ans: \( x = 2.34 \) or \( x = 3.17 \)

6. Solve \( x^2 + 6x + 4 = 0 \). Tell your answers to 5 decimal places.
   Ans: \( x = -3+\sqrt{5} = -3.76393 \) or \( x = -3 - \sqrt{5} = -5.23607 \)

7. Solve \( 2x^2 + 5x + 1 = 0 \). Tell your answers to 5 decimal places.
   Ans: \( x = (-5 + \sqrt{17})/4 = -0.21922 \) or \( x = (-5 - \sqrt{17})/4 = -2.28078 \)

8. Solve \( x^2 + x + 4 = 0 \). Give your answers to 5 decimal places.
   Ans: \( x = (-1+i\sqrt{15})/2 = -0.50000 +1.93649i \)
   or \( x = (-1-i\sqrt{15})/2 = -0.50000 - 1.93649i \)

9. Solve \( x^2 - 2x + 10 = 0 \).
   Ans: \( x = 1+3i \) or \( x = 1-3i \)

10. A man stands on the edge of a steep cliff and drops a rock over the edge, so that the rock falls to the ground below the cliff. The height \( H \) of the rock (in feet) above the ground at time \( t \) seconds after the rock is dropped are given by the following data:

<table>
<thead>
<tr>
<th>( t ) (sec)</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H ) (feet)</td>
<td>160</td>
<td>144</td>
<td>96</td>
</tr>
</tbody>
</table>

The height is given by a quadratic equation of the form

\[ H = at^2 + bt + c. \]

(i) Tell the equations for \( a, b, \) and \( c. \)
(ii) Find the formula for the height of the rock.
(iii) Tell the height of the rock after 3 seconds.
(iii) Tell the time when the rock hits the ground. Give your answer to 4 decimal places.

Ans: \( c = 160, a+b+c=144, 4a+2b+c = 96 \)
\( i \) \( ii \) \( iii \) \( (iii) t = \sqrt{10} \) sec = 3.1623 sec

11. Mold grows in a circular colony on a Petri dish containing an agar gel with the appropriate nutriment. The area \( A \) of the mold colony (in \( mm^2 \)) is a quadratic function of the number \( t \) of days since the start of the experiment, so that it has the form

\[ A = at^2 + bt + c. \]

Students measure the area of the colony at the beginning (midnight) of different days as follows:

<table>
<thead>
<tr>
<th>( t ) (days)</th>
<th>0</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A ) (mm^2)</td>
<td>1</td>
<td>21</td>
<td>73</td>
</tr>
</tbody>
</table>

(i) Tell the equations for \( a, b, \) and \( c. \)
(ii) Find the formula for the area of the colony on the \( t \)th day.
(iii) Predict the area of the colony on the 5th day.
(iii) According to the formula, what is \( t \) when the area is exactly 150 \( mm^2 \)? Give your answer to 3 significant figures.

(v) Tell the time of the day when the area is exactly 150 \( mm^2 \).

Ans: \( c = 1, 4a+2b+c = 21, 16a+4b+c = 73 \)
\( i \) \( ii \) \( iii \) \( (iii) 111 \) mm^2
\( (iii) t = 5.86 \) days \( (v) 8:38 \) pm for the usual clock, or 20:38 for the 24-hour clock

1. Mold grows in a circular colony on a Petri dish containing an agar gel with the appropriate nutriment. The area $A$ of the mold colony (in $\text{mm}^2$) is a quadratic function of the number $t$ of days since the start of the experiment, so that it has the form

$$A = at^2 + bt + c.$$ 

Students measure the area of the colony at the beginning (midnight) of different days as follows:

<table>
<thead>
<tr>
<th>$t$</th>
<th>$A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.35</td>
</tr>
<tr>
<td>1</td>
<td>7.20</td>
</tr>
<tr>
<td>4</td>
<td>31.90</td>
</tr>
</tbody>
</table>

(i) Find the formula for the area of the colony on the $t$th day. Give numbers to three significant figures.
(ii) Predict the area of the colony on the 5th day.
(iii) According to the formula, what is $t$ when the area is exactly $100 \text{ mm}^2$? Give your answer to 3 significant figures.

Ans: (i) $A = 2.17t^2 + 3.68t + 1.35$  
(ii) $74.0 \text{ mm}^2$  
(iii) $t = 5.95$ days

2. Mold grows in a circular colony on a Petri dish containing an agar gel with the appropriate nutriment. The area $A$ of the mold colony (in $\text{mm}^2$) is a quadratic function of the number $t$ of hours since the start of the experiment, so that it has the form

$$A = at^2 + bt + c.$$ 

Students measure the area of the colony at the beginning of different hours since the start of the experiment as follows:

<table>
<thead>
<tr>
<th>$t$</th>
<th>$A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.35</td>
</tr>
<tr>
<td>18</td>
<td>5.30</td>
</tr>
<tr>
<td>48</td>
<td>23.85</td>
</tr>
</tbody>
</table>

(i) Find the formula for the area of the colony on the $t$th hour. Give numbers to three significant figures.
(ii) Predict the area of the colony on the 60th hour. (Give your answer to 3 significant figures.)
(iii) According to the formula, what is $t$ when the area is exactly $80 \text{ mm}^2$? Give your answer to 3 significant figures.

Ans: (i) $A = 0.00831t^2 + 0.0699t + 1.35$  
(ii) $35.5 \text{ mm}^2$  
(iii) $t = 93.2$ hours

3. Some large birds cannot start flight on land, but instead must begin flight by diving off a cliff. Suppose a cliff is 200 feet high above the ocean. A bird dives so that its height $H$ (in feet) above the water below the cliff at time $t$ (in seconds) after beginning the dive is given by the following data:

<table>
<thead>
<tr>
<th>$t$ (sec)</th>
<th>0</th>
<th>1</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H$ (feet)</td>
<td>200</td>
<td>180</td>
<td>44</td>
</tr>
</tbody>
</table>

The height is given by a quadratic equation of the form

$$H = at^2 + bt + c.$$ 

(i) Tell the equations for $a$, $b$, and $c$.
(ii) Find the formula for the height of the bird.
(iii) Tell the height of the bird after 2 seconds.
(iii) How much time does the bird have to begin flying, before hitting the water? Give your answer to 4 decimal places.

Ans: (i) $c = 200$, $a+b+c=180$, $9a+3b+c = 44$
(ii) $H = 200 -4t - 16 t^2$  
(iii) $128$ feet  
(iii) $t = 3.4127$ sec

1. (i) Find the quadratic equation, \( y = ax^2 + bx + c \) whose graph contains the following points

\[
\begin{array}{cc}
\text{x} & \text{y} \\
0 & 0 \\
2 & 5 \\
-4 & -10 \\
\end{array}
\]

(ii) What word describes the curve in (i)?
(iii) How can this situation occur?

Ans: (i) \( y = 2.5 \times x \)

2. Mold grows in a circular colony on a Petri dish containing an agar gel with the appropriate nutriment. The area \( A \) of the mold colony (in mm\(^2\)) is a quadratic function of the number \( t \) of hours since the start of the experiment, so that it has the form

\[ A = at^2 + bt + c. \]

Students measure the area of the colony at the beginning of different hours since the start of the experiment as follows:

\[
\begin{array}{cc}
\text{t} & \text{A} \\
3 & 3.92 \\
12 & 5.74 \\
24 & 9.95 \\
36 & 16.51 \\
48 & 24.83 \\
72 & 48.75 \\
84 & 64.97 \\
\end{array}
\]

They use quadratic regression to find the quadratic formula that best fits the data.

(i) Find the quadratic regression formula for the area of the colony on the \( t \)th hour. Give numbers to four significant figures.
(ii) Predict the area of the colony on the 60th hour. (Give your answer to 4 significant figures.)
(iii) According to the formula, what is \( t \) when the area is exactly 55 mm\(^2\)? Give your answer to 4 significant figures.

Ans: (i) \( A = 0.007889 t^2 + 0.06193 t + 3.812 \)  
(ii) 35.93 mm\(^2\)  
(iii) \( t = 76.72 \) hours

3. A man stands on the edge of a deep pit in the ground. He stoops and throws a stone upward, so that it first rises and then drops into the pit. The height \( H \) of the stone (in feet) above the ground at time \( t \) seconds after the rock is dropped is given by the following data:

\[
\begin{array}{cc}
\text{t (sec)} & \text{H (feet)} \\
0 & 0 \\
0.5 & 5 \\
1 & 2 \\
\end{array}
\]

The height is given by a quadratic equation of the form

\[ H = at^2 + bt + c. \]

(i) Tell the equations for a, b, and c.
(ii) Find the formula for the height of the rock above the ground.
(iii) Tell the height of the rock after 0.25 seconds.
(iii) Tell the time when the stone passes the ground level. Give your answer to 4 significant figures.
(v) The stone hits the bottom of the pit after 6.13 seconds. How deep is the pit? Give your answer to 4 significant figures.

Ans: (i) \( H = -16 t^2 + 18 t \)  
(ii) 3.50 feet  
(iii) \( t = 1.125 \) sec  
(v) 490.9 feet

1. A population of bacteria is growing in a beaker filled with water containing nutriments. Let $P(t)$ be the number of mg of bacteria in the beaker at the beginning of the $t$th hour. When the experiment begins, at $t = 0$, the population is 45.0 mg. The population satisfies the difference equation $P(t+1) - P(t) = 0.3 \ P(t)$. Give answers to 3 significant figures.
   (a) Find $P(0)$.
   (b) Find $P(1)$.
   (c) Find $P(2)$.
   (d) Find $P(4)$.
   (e) Find $P(6)$.
   Ans: (a) 45.0 mg (b) 58.5 mg (c) 76.1 mg (d) 129 mg (e) 217 mg

2. A population of $P(t)$ rabbits at time $t$ satisfies the difference equation $P(t+1) = P(t) + 2 \ P(t-1)$. When $t = 0$ there is just one (pregnant) rabbit, while when $t = 1$ there are 2 rabbits.
   (a) Find the number of rabbits when $t = 2$.
   (b) Find the number of rabbits when $t = 3$.
   (c) Find the number of rabbits when $t = 5$.
   Ans: (a) 4 rabbits (b) 8 rabbits (c) 32 rabbits

3. A population of $P(t)$ gerbils at time $t$ satisfies the difference equation $P(t+1) = P(t) + 2 \ P(t-1)$. When $t = 0$ there is just one gerbil while when $t = 1$ there is still just one gerbil.
   (a) Find the number of gerbils when $t = 2$.
   (b) Find the number of gerbils when $t = 3$.
   (c) Find the number of gerbils when $t = 5$.
   Ans: (a) 3 gerbils (b) 5 gerbils (c) 21 gerbils

4. A population of $P(t)$ gerbils at time $t$ satisfies the difference equation $P(t+1) = 2P(t) + P(t-1)$. When $t = 0$ there is just one gerbil while when $t = 1$ there is still just one gerbil.
   (a) Find the number of gerbils when $t = 2$.
   (b) Find the number of gerbils when $t = 3$.
   (c) Find the number of gerbils when $t = 5$.
   Ans: (a) 3 gerbils (b) 7 gerbils (c) 41 gerbils

5. Suppose $F(t+1) = 2 \ F(t)$ and $F(0) = 3$.
   (a) Find $F(1)$
   (b) Find $F(2)$
   (c) Find $F(4)$
   (d) Find $F(t)$
   (e) Find $F(10)$
   Ans: (a) 6 (b) 12 (c) 48 (d) $3(2)^t$ (e) 3072

6. Suppose $G(t+1) = 1.04 \ G(t)$ and $G(0) = 5.2$.
   (a) Find $G(1)$
   (b) Find $G(2)$
   (c) Find $G(25)$
   Ans: (a) 5.408 (b) $G(t) = 5.2(1.04)^t$ (c) 13.86

7. Suppose $F(t) - F(t+1) = 0.4 \ F(t)$ and $F(0) = 205$.
   (a) Find $F(t)$
   (b) Find $F(10)$.
   (c) Find $F(20)$.
   Ans (a) $205(0.6)^t$ (b) 1.24 (c) 0.007495

8. Suppose $F(t) - F(t+1) = -0.4 \ F(t)$ and $F(0) = 205$.
   (a) Find $F(t)$
   (b) Find $F(10)$.
   (c) Find $F(20)$.
   Ans (a) $205(1.4)^t$ (b) 5929.7 (c) 171520

9. Suppose $F(t+1) - F(t) = -0.3 \ F(t)$ and $F(0) = 300$.
   (a) Find $F(t)$
   (b) Find $F(10)$.
   (c) Find $F(20)$.
   Ans (a) $300(0.7)^t$ (b) 8.47 (c) 0.239

10. Suppose $F(t+1) - F(t) = 1.3 \ F(t)$ and $F(0) = 30$.
    (a) Find $F(t)$
    (b) Find $F(10)$.
    (c) Find $F(20)$.
    Ans: (a) $30(2.3)^t$ (b) 124280 (c) $5.148 \times 10^8$

1. A bacterial population $P(t)$ satisfies $P(t+1) - P(t) = 0.15 P(t)$ where $t$ is in hours and $P$ is in mg. Suppose that initially when $t = 0$, the population is 4.17 mg.
   (a) Find a formula for $P(t)$.
   (b) Find the population 20 hours after the start of the experiment. Give your answer to 2 decimal places.
   Ans: (a) $P(t) = 4.17 (1.15)^t$  
   (b) 68.25 mg

2. A bacterial population $P(t)$ satisfies $P(t+1) = 1.0356 P(t)$ where $t$ is in hours and $P$ is in mg. Suppose that initially when $t = 0$, the population is 2.15 mg.
   (a) Find a formula for $P(t)$.
   (b) Find the population 25 hours after the start of the experiment. Give your answer to 2 decimal places.
   Ans: (a) $P(t) = 2.15 (1.0356)^t$  
   (b) 5.16 mg

3. A bacterial population of size $P(t)$ satisfies that in each time period of 2 hours, the population increases by 16%. Initially the population is 4.61 mg.
   (a) Find the difference equation for $P(t)$.
   (b) Tell a formula for $P(t)$.
   (c) Predict the population after 6 hours.
   (d) Predict the population after 18 hours.
   Ans: (a) $P(t+1) - P(t) = 0.16 P(t)$  
   (b) $P(t) = 4.61 (1.16)^t$  
   (c) $P(3) = 7.20$ mg  
   (d) $P(9) = 17.53$ mg

4. A bacterial population of size $P(t)$ satisfies that in each time period of 1.5 hours, the population increases by 13%. Initially the population is 5.24 mg.
   (a) Find the difference equation for $P(t)$.
   (b) Tell a formula for $P(t)$.
   (c) Predict the population after 6 hours.
   (d) Predict the population after 18 hours.
   Ans: (a) $P(t+1) - P(t) = 0.13 P(t)$  
   (b) $P(t) = 5.24 (1.13)^t$  
   (c) $P(4) = 8.54$ mg  
   (d) 18 hours means $t = 12$, so $P(12) = 22.7$ mg

5. A bacterial population with $P(t)$ mg at time $t$ satisfies $P(t+1) - P(t) = r P(t)$. Suppose $P(0) = 5.147$ and $P(1) = 5.2242$.
   (a) Find $r$.
   (b) Find $P(t)$.
   Ans: (a) $r = 0.015$  
   (b) $P(t) = 5.147 (1.015)^t$

6. A bacterial population consisting of $P(t)$ mg at time $t$ satisfies $P(t+1) - P(t) = r P(t)$. Suppose $P(0) = 7.300$ and $P(2) = 7.60982$. (a) Find $r$. (b) Find $P(t)$.
   Ans: (a) $r = 0.021$  
   (b) $P(t) = 7.300 (1.021)^t$

7. A bacterial population consisting of $P(t)$ mg at time $t$ satisfies $P(t+1) - P(t) = r P(t)$. Suppose $P(1) = 6.951$ and $P(3) = 7.682$.
   (a) Find $r$.  
   (b) Find $P(t)$.  
   (c) Predict $P(7)$.
   Ans: (a) $r = 0.05127$  
   (b) $P(t) = 6.612 (1.05127)^t$  
   (c) $P(9) = 9.383$ mg

8. The intensity $I$ of light in water decreases with the depth $d$ of the water in such a manner that $I(d+1) - I(d) = -0.15 I(d)$ when $d$ is measured in meters. At the surface of the water over a certain coral reef the intensity is 6.75 mW/cm$^2$.
   (a) Tell a formula for the intensity at depth $d$ meters.
   (b) Predict the intensity of light 7 meters below the surface.
   Ans: (a) $I(d) = 6.75 (0.85)^d$  
   (b) $I(7) = 2.16$ mW/cm$^2$

9. The intensity $I$ of light in water decreases with the depth $d$ of the water in such a manner that $I(d+1) - I(d) = -0.085 I(d)$ when $d$ is measured in feet. At the surface of the water over a certain coral reef the intensity is 5.75 mW/cm$^2$.
   (a) Tell a formula for the intensity at depth $d$ feet.
   (b) Predict the intensity of light 6 feet below the surface.
   Ans: (a) $I(d) = 5.75 (0.915)^d$  
   (b) $I(6) = 3.37$ mW/cm$^2$
1. A newspaper says that the world population is increasing at 1.8% per year. Let \( P(t) \) be the number of humans on earth in the \( t \)-th year.
   (a) Write the difference equation for \( P(t) \).
   (b) If the population this year is 6.0 billion, tell a formula for \( P(t) \).
   (c) Predict the human population 50 years from now.
   Ans: 
   (a) \( P(t+1) - P(t) = 0.018 \ P(t) \)
   (b) \( P(t) = 6.0 \ (1.018)^t \) billions
   (c) 14.6 billion

2. A lemming population is increasing at the rate of 12% per month. Let \( L(t) \) be the number of lemmings in the \( t \)-th month.
   (a) Write the difference equation for \( L(t) \).
   (b) If population of lemmings is 20000 when \( t = 0 \) at the beginning of March, tell the solution for \( L(t) \).
   (c) Predict the number of lemmings at the beginning of September.
   Ans: 
   (a) \( L(t+1) - L(t) = 0.12 \ L(t) \)
   (b) \( L(t) = 20000 \ (1.12)^t \)
   (c) \( L(6) = 39476 \) lemmings

3. The intensity \( I \) of light in water decreases with the depth \( d \) of the water in such a manner that with every meter the water absorbs 32\% of the light. At the surface of the water over a certain coral reef the intensity is 6.94 mW/cm\(^2\).
   (a) Tell a formula for the intensity at depth \( d \) meters.
   (b) Predict the intensity of light 7 meters below the surface to 4 significant figures.
   Ans: 
   (a) \( I(d) = 6.94(0.68)^d \)
   (b) 0.4666 mW/cm\(^2\)

4. Simplify the following exactly, without using a calculator:
   (a) \( 10^{(2/3)} \ 10^{(4/3)} \)
   (b) \( x^y \ x^{(2z)} / x^z \)
   (c) \( 3^8 / 3^5 \)
   (d) \( 3^7 \ 3^{-8} \)
   (e) \( 2^3 \ / \ 2^{-2} \)
   (f) \( (2^3)^2 \)
   (g) \( (4^2)^{1/2} \)
   (h) \( 9^{3/2} \)
   (i) \( 16^{1/4} \)
   (j) \( (x^y)^{(2z)} \)
   (k) \( \log_2(16) \)
   (l) \( \log_{10}(1000) \)
   (m) \( \log_{10}(1/100) \)
   (n) \( \log_2(32) \)
   (o) \( 2^{\log_2(35)} \)
   (p) \( \log_3(3^5) \)
   (q) \( 5^{\log_5(17)} \)
   (r) \( \log_{10}(5 \ (3^t)) \)
   Ans: 
   (a) 100
   (b) \( x^{(y+z)} \)
   (c) 27
   (d) 1/3
   (e) 32
   (f) 64
   (g) 4
   (h) 27
   (i) 2
   (j) \( x^{(2yz)} \)
   (k) 4
   (l) 3
   (m) -2
   (n) 5
   (o) 35
   (p) 5
   (q) 17
   (r) \( \log_{10}(5) + t \log_{10}(3) \)

1. Simplify
   (a) \( \log_a \left( \frac{a^3 \cdot a^5}{a^2} \right) \)
   (b) \( \log_a \left( \frac{a^{2/3}}{a^2} \right) \)
   (c) \( \log_a \left( \frac{a^5}{a^{-4}} \right) \)
   Ans: (a) 6   (b) -4/3  (c) 9

2. (a) Solve for \( x \) exactly if \( 4.1 \cdot (2^x) = 19 \)
    (b) Solve for \( x \) if \( 4.1 \cdot (2^x) = 19 \). Give your answer to 5 significant figures.
    (c) Tell the exact \( t \) such that \( 3.5 \cdot (1.05)^t = 7.9 \)
    (d) Tell the solution of (c) to 5 significant figures.
   Ans:  (a) \( x = \frac{\log(19) - \log(4.1)}{\log(2)} \)  (b) 2.2123
   (c) \( t = \frac{\log(7.9) - \log(3.5)}{\log(1.05)} \)  (d) 16.686

3. (a) Solve for \( x \) exactly if \( 2.5 \cdot (3.1)^{2x} - 1.4 = 7.9 \)
    (b) Tell the solution to (a) to 5 significant figures.
   Ans:  (a) \( x = \frac{\log(9.3) - \log(2.5)}{2 \log(3.1)} \)  (b) 0.58057

4. The intensity \( I \) of light in water decreases with the depth \( d \) of the water in such a manner that with every meter the water absorbs 28% of the light. At the surface of the water over a certain coral reef at noon the intensity is 7.46 mW/cm².
   (a) Tell a formula for the light intensity at depth \( d \) meters.
   (b) A certain species of coral can grow as long as the noon intensity is at least 0.25 mW/cm². How deep can the coral grow at this location?
   (c) A different species of coral can grow as long as the noon intensity is at least 0.79 mW/cm². How deep can this second kind of coral grow at this location?
   Ans:  (a) \( I(d) = 7.46(0.72)^d \)  (b) 10.34 m.  (c) 6.83 m

5. A bacterial population \( P(t) \) satisfies \( P(t+1) - P(t) = 0.0356 \cdot P(t) \) where \( t \) is in hours and \( P \) is in mg. Suppose that initially when \( t = 0 \), the population is 3.15 mg.
   (a) Find a formula for \( P(t) \).
   (b) Tell \( t \) when the population reaches 120 mg.
   Ans:  (a) \( P(t) = 3.15 \cdot (1.0356)^t \)  (b) 104 hours

6. A newspaper says that the world population is increasing at 1.8% per year. Let \( P(t) \) be the number of humans on earth in the \( t \)-th year.
   (a) If the population this year is 6.0 billion, tell a formula for \( P(t) \).
   (b) In how many years will the population reach 20 billion people? Give your answer to 3 significant figures.
   Ans:  (a) \( P(t) = 6.0 \cdot (1.018)^t \) billions  (b) 67.5 years

7. The intensity \( I \) of light in water decreases with the depth \( d \) of the water in such a manner that with every foot the water absorbs 13% of the light. At the surface of the water over a certain coral reef at noon the intensity is 6.46 mW/cm².
   (a) Tell a formula for the light intensity at depth \( d \) feet.
   (b) A certain species of coral can grow as long as the noon intensity is at least 0.80 mW/cm². How deep can the coral grow at this location?
   Ans:  (a) \( I(d) = 6.46(0.87)^d \)  (b) 15 feet

8. A population of fish consists of \( P(t) \) fish at the beginning of month \( t \). \( P(t) \) satisfies the difference equation \( P(t+1) - P(t) = 0.35 \cdot P(t) \cdot (1 - 0.00005 \cdot P(t)) \), while \( P(0) = 50,000 \).
   (a) Find \( P(1) \)
   (b) Find \( P(2) \)
   Ans: (a) 23,750 fish   (b) 22,191 fish

1. Solve the equation
   (a) 2.1 (1.032)^t = 4.5  
   (b) 3.5 (1.175)^t = 43.1  
   (c) 12.3 (1.061)^t = 37.3  
   (d) 4.7 (1.23)^t = 512  
   (e) 12.0 (0.85)^t = 7.3  
   (f) 13.1 (0.79)^t = 18.3
   Ans: (a) 24.196  (b) 15.57  (c) 18.736  (d) 22.66  (e) 3.0583  (f) -1.4181

2. Suppose \( P(t) = a b^t \) for constants \( a \) and \( b \). Suppose \( P(2) = 5 \) while \( P(6) = 100 \).
   (a) Find \( a \) and \( b \) exactly.
   (b) Find an exact formula for \( P(t) \).
   (c) Find \( a \) and \( b \) to 5 significant figures.
   (d) Find a formula for \( P(t) \) with constants to 5 significant figures.
   Ans: (a) \( a = 5 (20)^{-1/2} \) and \( b = 20 (1/4) \).  (b) \( P(t) = 5 (20)^{-1/2} (20)^{t/4} \)
   (c) \( a = 1.1180 \) and \( b = 2.1147 \)  (d) \( P(t) = 1.1180 (2.1147)^t \).

3. Suppose \( F(t) = u v^t \) for constants \( u \) and \( v \). Suppose \( F(3) = 5 \) while \( F(8) = 150 \).
   (a) Find \( u \) and \( v \) exactly.
   (b) Find an exact formula for \( F(t) \).
   (c) Find \( u \) and \( v \) to 5 significant figures.
   (d) Find a formula for \( F(t) \) with constants to 5 significant figures.
   Ans: (a) \( u = 5 (30)^{-3/5} \) and \( v = 30 (1/5) \).  (b) \( F(t) = 5 (30)^{-3/5} (30)^{t/5} \)
   (c) \( u = 0.64968 \) and \( v = 1.9744 \)  (d) \( F(t) = 0.64968 (1.9744)^t \).

4. A pond holds 100,000 gallons. Initially it contains 200 pounds of nitrogen fertilizer.
   Pure water enters the pond at the rate of 100 gallons per hour, and a well-mixed mixture
   leaves the pond at the same rate. Let \( F(t) \) denote the number of pounds of fertilizer in the
   pond \( t \) hours after the initial time.
   (a) Find a difference equation for \( F(t) \)
   (b) Tell \( F(t) \) at all times \( t \).
   (c) After how many hours will the pond have only 1 pound of fertilizer?
   (d) After how many days will the pond have only 1 pound of fertilizer?
   Ans: (a) \( F(t+1) - F(t) = -(0.001) F(t) \)  (b) \( F(t) = 200 (0.999)^t \)
   (c) 5296 hours  (d) 221 days

5. A pond holds 300,000 gallons. Initially it contains 500 pounds of arsenic waste. Pure
   water enters the pond at the rate of 200 gallons per hour, and a well-mixed mixture leaves
   the pond at the same rate. Let \( A(t) \) denote the number of pounds of arsenic in the pond \( t \)
   hours after the initial time.
   (a) Find a difference equation for \( A(t) \).
   (b) Tell \( A(t) \) at all times.
   (c) After how many hours will the pond contains only 10 pounds of waste?
   Ans: (a) \( A(t+1) - A(t) = -(1/1500) A(t) \)  (b) \( A(t) = 500 (1499/1500)^t \)  
   or \( A(t) = 500 (0.999333)^t \)  (c) 5866 hours

6. A mass of a colony of bacteria is \( P(t) = 3 (1.34)^t \) grams after \( t \) hours. After how many
   hours will the mass be 7 grams?
   Ans: 2.895 hours

7. When \( t = 0 \), 400 mg of penicillin are injected into a woman's body. Her kidneys
   gradually remove the penicillin from her blood stream. Each hour the kidneys remove 20%
   of the penicillin. Let \( P(t) \) be the number of mg of penicillin in the woman's body \( t \) hours
   after the injection.
   (a) Find a difference equation for \( P(t) \).
   (b) Tell \( P(t) \) at all times.
   (c) After how many hours will there only be 3 mg of penicillin left in her body?
   Ans: (a) \( P(t+1) - P(t) = -0.2 \ P(t) \)  (b) \( P(t) = 400 (0.8)^t \)  (c) 21.9 hours
1. Solve the equations for $P$ in terms of $t$, writing $P$ in the form $a b^t$:
   (a) $\log_{10} P = 0.137 t + 2.84$
   (b) $\log_{10} P - 0.031 t = 1.77$
   (c) $3.000 \log_2 P - 1.412 t = 6.357$
   (d) $2.29 - \log_{10} P + 0.35 t = 0$
   Ans: (a) $P = 697.83 (1.37088)^t$  
      (b) $P = 58.884 (1.07899)^t$
      (c) $P = 4.3439 (1.38575)^t$  
      (d) $P = 194.98 (2.2387)^t$

2. At noon, 1350 mg of a drug are injected into a man's body. His kidneys gradually remove the drug from his bloodstream. Each hour the kidneys remove 26% of the penicillin. Let $D(t)$ be the number of mg of the drug in the man's body $t$ hours after the injection.
   (a) Find a difference equation for $D(t)$.
   (b) Tell $D(t)$ at all times.
   (c) The drug is pharmacologically effective as long as the body contains 10 mg of the drug. After how many hours will the pharmacological effectiveness end?
   (d) According to the model, how many hours will it take for all the drug to be eliminated from the man's body? Explain.
   Ans: (a) $D(t+1) - D(t) = -0.26 D(t)$  
      (b) $D(t) = 1350 (0.74)^t$
      (c) 16.3 hours
      (d) It will take forever.

3. The population $P(t)$ of a bacterial colony at time $t$ hours is expected to be given by a formula $P(t) = a b^t$. In an experiment, the following data are given:
   $t$ in hours 0 1 3 4 5
   $P$ in mg 6.152 5.751 5.007 4.696 4.356
   Find the formula that best fits the data, giving constants to 4 significant figures.
   Ans: $P(t) = 6.157 (0.9336)^t$

4. Find all the equilibria:
   (a) $F(t+1) - F(t) = 100 - 0.05 F(t)$
   (b) $F(t+1) - F(t) = 0.2 F(t) - 30$
   (c) $P(t+1) = P(t) + 0.3 P(t) - 0.00005 (P(t))^2$
   (d) $F(t+1) = 1.06 F(t) - 45$
   (e) $F(t+1) = 3F(t) - F(t-1) - 1000$
   (f) $F(t+1) = 1.4 F(t) - 0.000002 (F(t))^2$
   (g) $F(t+1) = 2 F(t) - 5 F(t-1) + 1000$
   (h) $F(t+1) = F(t) + 17$
   Ans: (a) 2000  
      (b) 150  
      (c) 6000 and 0  
      (d) 750  
      (e) 1000  
      (f) 0 and 200,000  
      (g) 250  
      (h) There are none.

5. The "logistic" model of population growth for a particular population of sea urchins suggests that if the population one year is $P$ sea urchins, then the population next year will be $1.5 P - 0.0005 P^2$ sea urchins.
   (a) If $P(t)$ is the population of sea urchins in the $t$-th year, write the difference equation for $P(t)$
   (b) What are the equilibrium populations?
   (c) Which positive population of sea urchins this year will lead to extinction of the sea urchins next year?
   Ans: (a) $P(t+1) = 1.5 P(t) - 0.0005 P(t)^2$
   (b) 0 and 1000 sea urchins  
      (c) 3000 sea urchins
Math 181. S 2004. Problem Sheet M.

1. Solve the equation. Give numerical answers.
   (a) \[ 2 + 2.1 (1.032)^t = 6.5 \]  
   (b) \[ 4 - 3.5 (1.175)^t = -39.1 \]  
   (c) \[ 38.3 - 12.3 (1.061)^t = 1 \]  
   (d) \[ 4.7 (1.23)^t + 6 = 518 \]  
   (e) \[ 3.2 + 12.0 (0.85)^t = 10.5 \]  
   (f) \[ 18.3 - 13.1 (0.79)^t = 0 \]  
   (g) \[ 5 - 2 (1.56)^{3t} = -8 \]  
   (h) \[ 2.1 (1.46)^{2t} + 7 = 1.3 (1.46)^{2t} + 12 \]  
   (i) \[ 2.5 + 4 (3)^t (5)^t = 26 \]  
   Ans: (a) 24.196  (b) 15.57  (c) 18.736  (d) 22.66  (e) 3.0583  (f) -1.4181  
   (g) 1.403  (h) 2.4213  (i) 0.65387

2. Solve the equation exactly.
   (a) \[ 3.5 + 7 (1.14)^{2t} = 12 \]  
   (b) \[ 6 - 2 (1.56)^{3t} = -7 \]  
   Ans: (a) \[ t = \frac{(\log 8.5 - \log 7)}{(2 \log 1.14)} \]  
   (b) \[ \frac{(\log 13 - \log 2)}{(3 \log 1.56)} \]  

3. The logistic model of population growth for a particular population of snails suggests that if the population one year is \( P \) snails, then the population next year will be \[ 1.7 P - 0.00005 P^2 \]  snails.
   (a) Find the difference equation for \( P(t) \).
   (b) What are the equilibria?
   (c) Which positive population of snails this year will lead to extinction of the snails next year?
   Ans: (a) \[ P(t+1) = 1.7 P(t) - 0.00005 P(t)^2 \]  
   (b) 0 or 14,000 snails  (c) 34,000 snails

4. An aquarium holds 10,000 gallons. Initially it contains 20 pounds of waste. Pure water enters the aquarium at the rate of 15 gallons per hour, and a well-mixed mixture leaves the aquarium at the same rate. Let \( W(t) \) denote the number of pounds of waste in the aquarium \( t \) hours after the initial time.
   (a) Find a difference equation for \( W(t) \).
   (b) Tell \( W(t) \) at all times \( t \).
   Ans: (a) \[ W(t+1) - W(t) = -(3/2000) W(t) \]  
   (b) \[ W(t) = 20 (0.9985)^t \]

5. Solve the difference equation, telling exact answers:
   (a) \[ F(t+1) - F(t) = 15 - 0.25 F(t) \]  \( F(0) = 73 \)  
   (b) \[ F(t+1) - F(t) = 25 - 0.3 F(t) \]  \( F(0) = 100 \)  
   (c) \[ P(t+1) = 10 + 7 P(t) \] \( P(0) = 10 \)  
   (d) \[ F(t) - F(t+1) - 8 = 0.40 F(t) \] \( F(0) = 130 \)  
   (e) \[ F(t+1) = 0.7 F(t) + 15 \] \( F(0) = 22 \)  
   Ans: (a) \[ F(t) = 13(0.75)^t + 60 \]  
   (b) \[ F(t) = 250/3 + (50/3) (0.7)^t \]  
   (c) \[ P(t) = (35/3) 7^t -5/3 \]  
   (d) \[ F(t) = 150 (0.6)^t - 20 \]  
   (e) \[ F(t) = 50 - 28 (0.7)^t \]

6. A pond holds 100,000 gallons. Initially it contains 200 pounds of nitrogen fertilizer. Polluted water containing 1/2 pound of fertilizer per gallon enters the pond at the rate of 100 gallons per hour, and a well-mixed mixture leaves the pond at the same rate. Let \( F(t) \) denote the number of pounds of fertilizer in the pond \( t \) hours after the initial time.
   (a) Find a difference equation for \( F(t) \).
   (b) Tell \( F(t) \) at all times \( t \).
   (c) The pond will be "dead" when it contains 10000 pounds of fertilizer. When will it become "dead"?
   Ans: (a) \[ F(t+1) = 50 + (0.999) F(t) \]  
   (b) \[ F(t) = 50,000 - 49,800 (0.999)^t \]  
   (c) after 219 hours
1. A drug is being administered intravenously to a patient in the hospital. Each minute the patient receives 0.3 mg of the drug, while the kidneys remove 0.6% of the drug from the blood. In addition, when \( t = 0 \), an injection puts 9 mg of the blood into the patient's blood. Let \( D(t) \) be the number of mg of the drug in the patient's blood \( t \) minutes after the injection.

(a) Find a difference equation for \( D(t) \).

(b) Tell \( D(t) \) for all times \( t \).

(c) The drug is therapeutically effective when the blood contains 20 mg of the drug. After how many minutes (to the nearest minute) will the drug first become therapeutically effective?

Ans: (a) \( D(t+1) - D(t) = 0.3 - 0.006 D(t) \)  
(b) \( D(t) = -41 (0.994)^t + 50 \)  
(c) 52 minutes

2. A pond holds 100,000 gallons. Initially it is "dead" and contains 20,000 pounds of nitrogen fertilizer. Polluted water containing \( 1/100 \) pound of fertilizer per gallon enters the pond at the rate of 80 gallons per hour, and a well-mixed mixture leaves the pond at the same rate. Let \( F(t) \) denote the number of pounds of fertilizer in the pond \( t \) hours after the initial time.

(a) Find a difference equation for \( F(t) \).

(b) Tell \( F(t) \) at all times \( t \).

(c) The pond will stop being "dead" when it contains just 10000 pounds of fertilizer. When will it stop being "dead"?

Ans: (a) \( F(t+1) = 0.8 + 0.9992 F(t) \)  
(b) \( F(t) = 1000 + 19,000 (0.9992)^t \)  
(c) after 933.6 hours

3. A ditch holds 500,000 gallons. Initially it contains 4000 pounds of nitrogen fertilizer. Polluted water containing \( 1/20 \) pound of fertilizer per gallon enters the ditch at the rate of 10 gallons per hour, and a well-mixed mixture leaves the ditch at the same rate. Let \( F(t) \) denote the number of pounds of fertilizer in the ditch \( t \) hours after the initial time.

(a) Find a difference equation for \( F(t) \).

(b) Tell \( F(t) \) at all times \( t \).

(c) After how many hours will the ditch contain 10,000 pounds of fertilizer?

Ans: (a) \( F(t+1) = 0.5 + 0.99998 F(t) \)  
(b) \( F(t) = 25,000 - 21,000 (0.99998)^t \)  
(c) after 16,823 hours

4. A pond holds 200,000 gallons. Initially it contains 300 pounds of fertilizer. Pure water enters the pond at the rate of 200 gallons per hour, and a well-mixed mixture leaves the pond at the same rate. Let \( F(t) \) denote the number of pounds of fertilizer in the pond \( t \) hours after the initial time.

(a) Find a difference equation for \( F(t) \).

(b) Tell \( F(t) \) at all times \( t \).

(c) After how many hours will the pond contain only 10 pounds of fertilizer?

Ans: (a) \( F(t+1) - F(t) = -0.001 F(t) \)  
(b) \( F(t) = 300 (0.999)^t \)  
(c) 3399 hours

5. A lake holds 2,000,000 gallons. Initially it contains 300 pounds of fertilizer. Polluted water carrying \( 1/4 \) pound of fertilizer per gallon enters the lake at the rate of 200 gallons per hour, and a well-mixed mixture leaves the lake at the same rate. Let \( F(t) \) denote the number of pounds of fertilizer in the lake \( t \) hours after the initial time.

(a) Find a difference equation for \( F(t) \).

(b) Tell \( F(t) \) at all times \( t \).

(c) After how many hours will the lake contain 100,000 pounds of fertilizer? Give your answer to the nearest hour.

(d) After how many days will the lake contain 100,000 pounds of fertilizer? Give your answer to the nearest day

Ans: (a) \( F(t+1) - F(t) = 50-0.0001 F(t) \)  
(b) \( F(t) = -499,700 (0.9999)^t + 500,000 \)  
(c) 2225 hours  
(d) 93 days