3) \( x = \sqrt{t} \quad y = 2t + 1 \)

<table>
<thead>
<tr>
<th>( t )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x )</td>
<td>0</td>
<td>1</td>
<td>( \sqrt{2} )</td>
<td>2</td>
</tr>
<tr>
<td>( y )</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>

6) \( x = e^t \quad y = e^{2t} \)

<table>
<thead>
<tr>
<th>( t )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x )</td>
<td>1</td>
<td>( e )</td>
<td>( e^2 )</td>
<td>( e^3 )</td>
<td>( e^4 )</td>
</tr>
<tr>
<td>( y )</td>
<td>1</td>
<td>( e )</td>
<td>( e^2 )</td>
<td>( e^3 )</td>
<td>( e^4 )</td>
</tr>
</tbody>
</table>

10) \( x = 2\cos t \quad y = 2\sin t \)

\[ x^2 + y^2 = r^2 \]

\[ (2\cos t)^2 + (2\sin t)^2 = r^2 \]

\[ 4\cos^2 t + 4\sin^2 t = r^2 \]

\[ 4(\cos^2 t + \sin^2 t) = r^2 \]

\[ 4(1) = r^2 \rightarrow x^2 + y^2 = 4 \]

14) \( @ t = 0 \)

<table>
<thead>
<tr>
<th>( t )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x )</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>( y )</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
</tbody>
</table>

Starting at \((0, 1)\) it traces out a square in a clockwise direction through \((1, 0), (0, -1), (-1, 0),\) and returning to \((0, 1)\) at \( t = 4. \)
21) All 3 pairs of parametric equations start @ \((0,0)\) at \(t=0\) and trace the right-side (positive) branch of the parabola \(y = x^2\) for \(x \geq 0\). The equations in (c) describe faster motion along the parabola than \(c\) and \(b\) is faster than \(a\). \(b\) moves faster than \(a\) by a factor of time squared. \(c\) moves faster than \(a\) by a factor of time cubed.

23) a) \(\begin{align*}
&1) \quad x = t, \quad y = t^2 \\
&2) \quad x = t^2, \quad y = t^4 \\
&3) \quad x = t + 1, \quad y = (t+1)^2
\end{align*}\)

b) in function mode: \(y = (x+2)^2 + 1\)

in parametric mode: \(\begin{align*}
&1) \quad x = t, \quad y = (t+2)^2 + 1 \\
&2) \quad x = t + 1, \quad y = (t+1+2)^2 + 1 \\
&\quad y = (t+3)^2 + 1
\end{align*}\)

24) \(\text{Graph}\)

29. a) \(y = x\) from \((0,0)\) @ \(t=0\) toward \((t,t)\)

b) \(x^2 + y^2 = 1\) (circle of radius 1 centered @ the origin, moving counterclockwise from \((1,0)\) @ \(t=0\), completing the circle @ \(t = 2\pi\) @ \((1,0)\))

c) \(\frac{x^2}{1} + \frac{y^2}{4} = 1\) (an ellipse centered at the origin, with the y-axis as major axis, starting @ \((1,0)\) and moving counterclockwise through \((0,2)\), \((-1,0)\), \((0,-2)\) and returning to \((1,0)\) @ \(t = 2\pi\))
30. Vertical line $x = -2$  
   \[ (-\infty, \infty) \]
   
   Parametric equations:
   \[ x = -2, \quad y = t, \quad -\infty < t < \infty \]

31. \[ y - 3 = -4(x - 1) \]

35. \[ y = -4x + 7 \quad \rightarrow \quad x = \frac{t}{4}, \quad y = -4t + 7 \]

   \[ a) \quad x = t, \quad y = -16t^2 + 48t + 6 \]

   \[ b) \quad \text{release} \]

   \[ c) \quad t = 0, \; h(t) = 6 \text{feet} \]

   \[ d) \quad 6 = -16t^2 + 48t + 6 \]

   \[ 0 = -16t^2 + 48t + 6 \]

   \[ 16t^2 - 48t = 0 \]

   \[ 16t(t - 3) = 0 \]

   \[ t = 0, 3 \quad \text{3 seconds} \]

   \[ e) \quad \text{max at 1.5 sec} \quad \text{axis of symmetry} \]

   \[ h(1.5) = 42 \text{ feet} \]

31. (additional answer)

   If the line is at locus \((2, -1)\) at \(t = 0\),
   and at locus \((1, 3)\) at \(t = 1\),
   then parametric equations for the line could be:

   \[ x(t) = 2 - 1t, \; y(t) = -1 + 4t \]

   for \(-\infty < t < \infty\)
Functions Modeling Change, Connally (3rd ed.)
§12.2 Implicitly Defined Curves and Circles pp. 528-29
Exercises

3) \(2(x+1)^2 + 2(y+3)^2 = 32 \rightarrow (x+1)^2 + (y+3)^2 = 16\)
   a circle centered at \((-1, -3)\) of radius 4

5) \(x = 3 \cos t, y = 3 \sin t\) is a circle centered at
   the origin of radius 3
   when \(t = 0\), \(x = 3 \cos 0, y = 3 \sin 0\), so circle
   starts at \((3, 0)\) & moves counterclockwise
   to generate a similar circle starting at
   \((0, 3)\) we need \(x = 0 \Leftrightarrow t = 0 \& y = 3 \Leftrightarrow t = 0\)
   so switch func \(x = 3 \cos t, y = 3 \sin t\)

Sometimes to change starting positions or reverse
   direction of motion, we can add a negative
   sign to the amplitude or argument of the trig func
   
   e.g. \(x = -3 \cos t, y = 3 \sin t\) starts the circle
   on the negative x-axis at \((-3, 0)\) and
   moves in a clockwise direction
   e.g. \(x = -3 \cos (-t), y = 3 \sin (-t)\) starts the
   circle at \((-3, 0)\) and moves counterclockwise
   \(x = -3 \cos (-t), y = 3 \sin (-t)\) does the same.

12) \((-2, 1+\sqrt{5})\) is \(\sqrt{5}\) up from the center of
the circle at \((-2, 1)\)
   \(x = \sqrt{5} \sin (-t) - 2 \lor -2 + \sqrt{5} \sin (-t)\)
   \(y = \sqrt{5} \cos t + 1 \lor 1 + \sqrt{5} \cos t\)
136) \((x+1)^2 + (y-2)^2 = 11\) (completing the square)

16) \(x = 2 + \cos t\) \(y = 2 - \sin t\)
\[t = 0 \quad \frac{\pi}{3} \quad \frac{\pi}{4} \quad \frac{3\pi}{2} \quad 2\pi\]
\[\frac{y}{x} = \frac{1}{3}\quad 1\quad 2\quad 2\quad 1\]
\(1 \leq x \leq 3\)
\(1 \leq x \leq 3\)
\(x + y = 4\)

19) \(xy = 1\), for \(x > 0\) (implicit equation for \(y = \frac{1}{x}\) or \(x = \frac{1}{y}\), \(x > 0\))(explicit equations for \(x = t\), \(y = \frac{1}{t}\)) \(t > 0\) (parametric equations for \(x = \frac{1}{t}\), \(t > 0\))

20) \(x = e^t\), \(y = e^{2t}\) (parametric equations for \(x^2 - y = 0\)) \(x > 0\) (explicit equations for implicit equation for)

24) a) \(X = 5 \cos t\) \(y = 5 \sin t\)

b) \(X = 5 \cos t\) \(y = 5 + 5 \sin t\)

c) \(X = 10 \sqrt{2} \cos t + 10\) or \(10 + 10 \sqrt{2} \cos t\)
\(y = 10 \sqrt{2} \sin t - 10\) or \(-10 + 10 \sqrt{2} \sin t\)