1. \((x,y) = (\sin t, 4\cos t), \ t: 0 \ldots 2\pi:\)

   This is much like polar coordinates, but with \(t\) fixed, \(x + y\) switched, and \(y\) scaled by a factor of 4; so we'll get an ellipse centered at the origin, with vertical radius 4 units and horizontal radius 1, traversed clockwise from \((0,4)\).

2. \((x,y) = (2\sin t, 4\cos t), \ t: 0 \ldots 2\pi:\)

   Same as above, but stretched horizontally by a factor of 2 along the \(x\)-axis.

7. \(c(t) = (6t, 3t^3, t^3) \Rightarrow\) velocity is \(c'(t) = \langle 6, 9t^2, 3t^2 \rangle\)

8. \(c(t) = (\sin 3t, \cos 3t, 2t^2):\)

   \(\Rightarrow\) velocity is \(c'(t) = \langle 3\cos 3t, -3\sin 3t, 4t \rangle\)

17. Line tangent to \((\sin 3t, \cos 3t, 2t^2)\) @ \(t = 1:\)

   - Point: Evaluate the position at \(t = 1:\) \(p_0 = (\sin 3, \cos 3, 2)\).

   - Vector: Evaluate the velocity at \(t = 1:\)

     \[
     \vec{v} = \langle 3\cos 3t_1 - 3\sin 3t_1, 5t^2_1 \rangle
     \]

     @\(t = 1:\) \(\vec{v} = \langle 3\cos 3, -3\sin 3, 5 \rangle\).

     The line is given by \(p = p_0 + t\vec{v}, \ t \in \mathbb{R}, \ i.e.,\)

     \(p = (\sin 3, \cos 3, 2) + t\langle 3\cos 3, -3\sin 3, 5 \rangle\)

     \(= (\sin 3 + 3t\cos 3, \cos 3 - 3t\sin 3, 2 + 5t)\).

18. Line tangent to \((\cos^2 t, 3t - t^3, t)\) @ \(t = 0:\)

   - Point: Evaluate the position at \(t = 0:\) \(p_0 = (\cos 0, 3\cdot 0 - 0^3, 0)\)

     \(= (1, 0, 0)\).

   - Vector: Evaluate the velocity at \(t = 0:\)

     \(\Rightarrow\) Derivative: \(\langle -2\sin t\cos t, 3 - 3t^2, 1 \rangle\)

     @\(t = 0:\) \(\vec{v} = \langle -2\sin 0\cos 0, 3 - 3\cdot 0^2, 1 \rangle = \langle 0, 3, 1 \rangle\).

     The line is given by \(p = p_0 + t\vec{v}, \ t \in \mathbb{R}, \ i.e.,\)

     \(p = (1, 0, 0) + t\langle 0, 3, 1 \rangle\)

     \(= (1, 3t, t)\).
19. \( c(t) = (t^3, t^5 - 4t, 0) \) flies off at time \( t = 2 \):
- **Point:** \( c(2) = (2^3, 2^5 - 4 \cdot 2, 0) = (4, 0, 0) \)
- **Vector:** \( c'(t) = \langle 2t, 3t^2 - 4, 0 \rangle \)
- \[ c'(2) = \langle 2 \cdot 2, 3 \cdot 2^2 - 4, 0 \rangle = \langle 4, 8, 0 \rangle \]

\( -> \) **Equation of the tangent line**: \[ p = p_0 + (t-t_0) \vec{v} = (4, 0, 0) + (t-2)(4, 8, 0) \]

So at time \( t = 3 \), it's at \( (4, 0, 0) + (3-2)(4, 8, 0) = (8, 8, 0) \).

20. \( c(t) = (e^t, e^{-t}, \cos t) \) flies off at time \( t = 1 \):
- **Point:** \( c(1) = (e^1, e^{-1}, \cos 1) = (e, \frac{1}{e}, \cos 1) \)
- **Vector:** \( c'(t) = \langle e^t, -e^{-t}, -\sin t \rangle \)
- \[ c'(1) = \langle e^1, -e^{-1}, -\sin 1 \rangle = \langle e, -\frac{1}{e}, -\sin 1 \rangle \]

\( -> \) **Equation of the tangent line**: \[ p = p_0 + (t-t_0) \vec{v} = (e, \frac{1}{e}, \cos 1) + (t-1)\langle e, -\frac{1}{e}, -\sin 1 \rangle \]

So at time \( t = 2 \), it's at \( (e, \frac{1}{e}, \cos 1) + (2-1)\langle e, -\frac{1}{e}, -\sin 1 \rangle = \langle 2e, 0, \cos 1 - \sin 1 \rangle \).