1. Consider the following parametric curves:

$$\mathbf{x}_1(t) = \begin{pmatrix} \cos t \\ \sin t \end{pmatrix}, \quad \mathbf{x}_2(t) = \begin{pmatrix} e^t \cos t \\ e^t \sin t \end{pmatrix}, \quad \mathbf{x}_3(t) = \begin{pmatrix} t \cos t \\ t \sin t \end{pmatrix}, \quad \mathbf{x}_4(t) = \begin{pmatrix} t - \sin t \\ 1 - \cos t \end{pmatrix},$$

$$\mathbf{x}_5(t) = \begin{pmatrix} t \\ t \end{pmatrix}, \quad \mathbf{x}_6(t) = \begin{pmatrix} t \\ t^2 \end{pmatrix}, \quad \mathbf{x}_7(t) = \begin{pmatrix} t^2 \\ t^2 \end{pmatrix}, \quad \mathbf{x}_8(t) = \begin{pmatrix} t^2 \\ t \end{pmatrix},$$

$$\mathbf{x}_9(t) = \begin{pmatrix} \cos t \\ \sin t \\ t \end{pmatrix}, \quad \mathbf{x}_{10}(t) = \begin{pmatrix} e^t \cos t \\ e^t \sin t \\ e^t \end{pmatrix}, \quad \mathbf{x}_{11}(t) = \begin{pmatrix} t \cos t \\ t \sin t \\ t \end{pmatrix}, \quad \mathbf{x}_{12}(t) = \begin{pmatrix} \cos t \\ \sin t \\ \cos^2 t \end{pmatrix}.$$

On the next page, pictures for these are given. For each one, match the parametrization with the picture.

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2. For each of the following curves, find the velocity vector, the speed, the unit tangent vector, the linear acceleration, and the angular acceleration.

$$\mathbf{r}_1(t) = \begin{pmatrix} 3 + 2t \\ -1 - t \\ 5 - 2t \end{pmatrix}, \ \mathbf{r}_2(t) = \begin{pmatrix} 3 \cos t \\ 3 \sin t \\ 4t \end{pmatrix}, \ \mathbf{r}_3(t) = \begin{pmatrix} e^t \cos t \\ e^t \sin t \\ e^t \end{pmatrix},$$

$$\mathbf{r}_4(t) = \begin{pmatrix} t \sin t + \cos t \\ t \cos t - \sin t \\ t^2 \end{pmatrix} \ (t > 0).$$

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3. Consider the parametric curve given by:

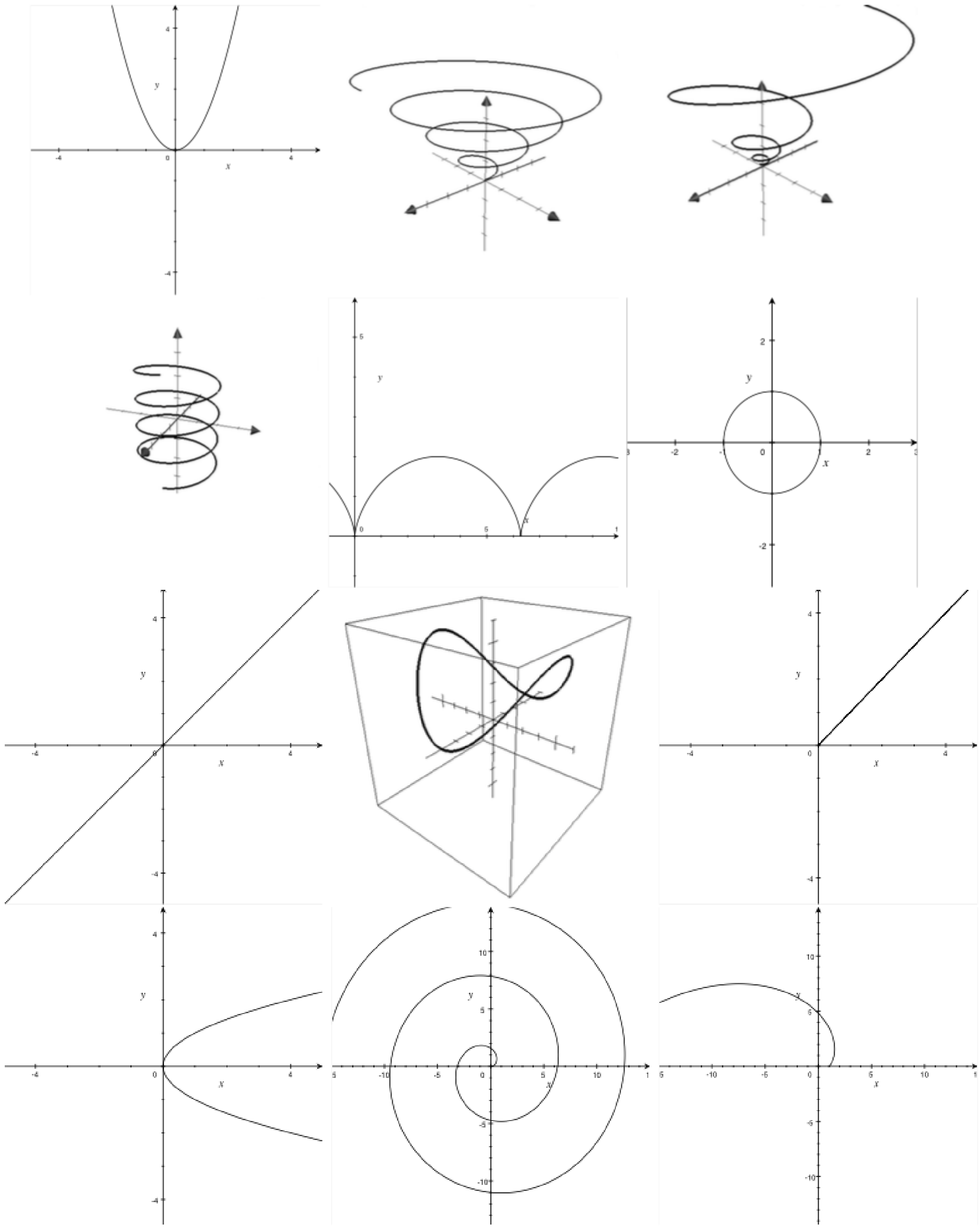
$$\mathbf{x}(t) = \begin{pmatrix} e^t \cos t \\ e^t \sin t \\ e^t \end{pmatrix}$$

(a) Find the unit tangent, normal, and binormal vectors.

(b) Find the arc length from $t = 0$ to $t = \pi$.

(c) Parametrize the line that is tangent to $\mathbf{x}(t)$ at the point t_0.

(d) Find the point where the above tangent line intersects the xy-plane. Let $\mathbf{y}(t_0)$ be the position vector for this point. As t_0 varies, sketch the curve that $\mathbf{y}(t_0)$ traces.



4.

5. C