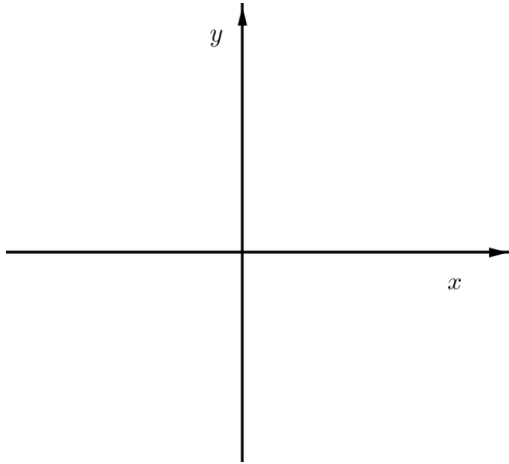


- 1) Given the vector function $\mathbf{r}(t) = \langle \cos t, \sin t \rangle$ find the following:
- Sketch the plane curve.
 - Find $\mathbf{r}'(t)$
 - Sketch the position vector $\mathbf{r}(t)$ and the tangent vector $\mathbf{r}'(t)$ for $t = \frac{\pi}{4}$



- 2) Find the derivative of the vector function
- $\mathbf{r}(t) = \langle t^3, -3t \rangle$
 - $\mathbf{r}(t) = \langle a \cos^3 t, a \sin^3 t, 1 \rangle$
 - $\mathbf{r}(t) = e^{t^2} \mathbf{i} - \mathbf{j} + \ln(1+3t) \mathbf{k}$
 - $\mathbf{r}(t) = t\mathbf{a} \times (\mathbf{b} + t\mathbf{c})$

3) Find the unit tangent vector $\mathbf{T}(t)$ at the point with the given value of the parameter t .

a) $\mathbf{r}(t) = \langle 6t^5, 4t^3, 2t \rangle, t = 1$

b) $\mathbf{r}(t) = \langle \cos t, 3t, 2 \sin 2t \rangle, t = 0$

4) Find the open interval(s) on which the curve given by the vector function is smooth.

a) $\mathbf{r}(t) = (t-1)\mathbf{i} + \frac{1}{t}\mathbf{j} - t^2\mathbf{k}$

b) $\mathbf{r}(t) = (t^3 + t)\mathbf{i} + t^4\mathbf{j} + t^5\mathbf{k}$

5) If $\mathbf{r}(t) = \langle t, t^2, t^3 \rangle$, find the following:

a) $\mathbf{r}'(t)$

b) $\mathbf{T}(1)$

c) $\mathbf{r}''(t)$

d) $\mathbf{r}'(t) \times \mathbf{r}''(t)$

6) Find parametric equations for the tangent line to the curve with the given parametric equations:

$$x = \ln t, \quad y = 2\sqrt{t}, \quad z = t^2 \quad \text{at the point } (0, 2, 1).$$

7) Use the definition of the derivative to find $\mathbf{r}'(t)$ given that $\mathbf{r}(t) = \langle t^2, 0, 2t \rangle$.

8) At what point do the curves $\mathbf{r}(t) = \langle t, 1-t, 3+t^2 \rangle$ and $\mathbf{u}(s) = \langle 3-s, s-2, s^2 \rangle$ intersect? Also find their angle of intersection correct to the nearest degree.

9) Find the indefinite integral:

a) $\int (4t^3 \mathbf{i} + 6t \mathbf{j} - 4\sqrt{t} \mathbf{k}) dt$

b) $\int (e^t \mathbf{i} + 2t \mathbf{j} + \ln t \mathbf{k}) dt$

10) Evaluate the definite integral:

a) $\int_0^{\pi/2} (3\sin^2 t \cos t \mathbf{i} + 3\sin t \cos^2 t \mathbf{j} + 2\sin t \cos t \mathbf{k}) dt$

b) $\int_0^3 \|t\mathbf{i} + t^2\mathbf{j}\| dt$

11) Find $\mathbf{r}(t)$ if $\mathbf{r}'(t) = t^2\mathbf{i} + 4t^3\mathbf{j} - t^2\mathbf{k}$ and $\mathbf{r}(0) = \mathbf{j}$

12) If $\mathbf{u}(t) = \mathbf{i} - 2t^2\mathbf{j} + 3t^3\mathbf{k}$ and $\mathbf{v}(t) = t\mathbf{i} + \cos t\mathbf{j} + \sin t\mathbf{k}$ find $\frac{d}{dt}[\mathbf{u}(t) \cdot \mathbf{v}(t)]$.