

2-4 Videos Guide

2-4a

- Describing motion
 - Position: $\mathbf{r}(t)$
 - Velocity: $\mathbf{v}(t) = \mathbf{r}'(t)$
 - Speed: $|\mathbf{r}'(t)|$
 - Acceleration: $\mathbf{a}(t) = \mathbf{r}''(t)$
- Equations for the motion of a projectile in \mathbb{R}^2 with initial velocity v_0 and angle α with the horizontal
 - $x = (v_0 \cos \alpha)t, \quad y = h_0 + (v_0 \sin \alpha)t - \frac{1}{2}gt^2$

Exercises:

2-4b

- Find the velocity, acceleration, and speed of a particle with the given position function. Sketch the path of the particle and draw the velocity and acceleration vectors for the specified value of t .

$$\mathbf{r}(t) = \langle t^2, \frac{1}{t^2} \rangle, \quad t = 1$$

2-4c

- Find the velocity and position vectors of a particle that has the given acceleration and the given initial velocity and position.

$$\mathbf{a}(t) = \sin t \mathbf{i} + 2 \cos t \mathbf{j} + 6t \mathbf{k}, \quad \mathbf{v}(0) = -\mathbf{k}, \quad \mathbf{r}(0) = \mathbf{j} - 4\mathbf{k}$$

2-4d

- Tangential and normal components of acceleration
 - $\mathbf{a} = a_T \mathbf{T} + a_N \mathbf{N}$, where $a_T = \frac{\mathbf{r}' \cdot \mathbf{r}''}{|\mathbf{r}'|}$ and $a_N = \frac{|\mathbf{r}' \times \mathbf{r}''|}{|\mathbf{r}'|^2}$

Exercises:

2-4e

- Find the tangential and normal components of the acceleration vector.
 $\mathbf{r}(t) = t \mathbf{i} + 2e^t \mathbf{j} + e^{2t} \mathbf{k}$

2-4f

- A projectile is fired from a tank with initial speed 400 m/s. Find two angles of elevation that can be used to hit a target 300 m away.