

10.4 – Motion in Space: Velocity and Acceleration

Velocity, Acceleration, and Speed

Example 1

The position vector of an object moving in a plane is given by $\vec{r}(t) = \ln t \vec{i} + t^2 \vec{j}$. Find its velocity, speed and acceleration when $t = 1$ and illustrate geometrically.

Example 2

Find the velocity, acceleration and speed of a particle with position vector $\vec{r}(t) = \langle t^3, \sin(t), te^t \rangle$.

Example 3

An object with mass m that moves in a circular path with constant angular speed ω has position vector $\vec{r}(t) = a \cos \omega t \vec{i} + a \sin \omega t \vec{j}$. Find the force acting on the object and show that it is directed towards the origin.

Parametric Equations for Trajectory of Fired Projectile

Example 4

A projectile is fired with a muzzle speed of 250 m/s and angle of elevation 40° from a position 5 m above ground level. Where does the projectile hit the ground and with what speed?

Tangential and Normal Components of Acceleration

Example 5

A particle moves with position function $\vec{r}(t) = \langle \cos t, \sin t, t \rangle$. Find the tangential and normal components of the acceleration vector.