

Problem 2

The vector position of a particle varies in time according to the expression:

$\mathbf{r} = (3.00\hat{\mathbf{i}} - 6.00t^2\hat{\mathbf{j}})\text{m}$. (a) Find expressions for the velocity and acceleration as functions of time. (b) Determine the particle's position and velocity at $t = 1.00$ s.

$$a) \quad \vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}\{3\hat{\mathbf{i}} - 6t^2\hat{\mathbf{j}}\}\text{m} = -12t\hat{\mathbf{j}}\text{m/s}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = -12\text{m/s}^2\hat{\mathbf{j}}$$

$$b) \quad \vec{r}(t) = (3\hat{\mathbf{i}} - 6t^2\hat{\mathbf{j}})\text{m} = \vec{r}(t=1) = [3\hat{\mathbf{i}} - 6(1)\hat{\mathbf{j}}]\text{m} = (3\hat{\mathbf{i}} - 6\hat{\mathbf{j}})\text{m}$$

$$|\vec{r}| = \sqrt{(3)^2 + (-6)^2} = \sqrt{9+36} = \sqrt{45}$$

$$\vec{v} = -12\text{m/s}\hat{\mathbf{j}}$$