Problem 1: A particle in the plane travels along the curve traced out by

$$\vec{r}(t) = t\vec{i} + (\cos(t) + 3)\vec{j}.$$

Find:

(a) The velocity function $\vec{v}(t)$.

(b) The acceleration function $\vec{a}(t)$.

(c) The speed of the particle at time t.

Problem 2: A particle in space travels along the curve traced out by

$$\vec{r}(t) = t\vec{i} + t^3\vec{j} + 3t\vec{k}.$$

Find:

(a) The velocity function $\vec{v}(t)$.

(b) The acceleration function $\vec{a}(t)$.

(c) The speed of the particle at time t.

Problem 3: A particle starts at position $\vec{r}(0) = \vec{i}$ with initial velocity $\vec{v}(0) = \vec{i} - \vec{j} + \vec{k}$, and has acceleration $\vec{a}(t) = 4t\vec{i} + 6t\vec{j} + \vec{k}$. Find its velocity and position at time t.

Problem 4: The position of a particle is given by

$$\vec{r}(t) = t^2\vec{i} + 5t\vec{j} + (t^2 - 16t)\vec{k}.$$

When is the speed of the particle a minimum?

Problem 5: If a particle is moving according to

$$\vec{r}(t) = (t^2 - 6t)\vec{i} + (t^3 - 3t)\vec{j},$$

then find all times when the particle is moving parallel to the x-axis. Then find the times when it's moving parallel to the y-axis.

Problem 6: A particle moves according to

$$\vec{r}(t) = (1 + t)\vec{i} + (5 + 2t)\vec{j} + (t - 7)\vec{k}.$$

When and where does it hit the plane $x + y + z = 1$?