

Homework Sheet 2, available online October 11th, **online delivery October 18th before 4:00 pm UK time.**

(Vector-Valued Functions and Motion in Space)

Problem 1. (2+1+1=4 points) Given the position $r(t) = (2 \ln(t+1))\mathbf{i} + t^2\mathbf{j} + \frac{t^2}{2}\mathbf{k}$ of a particle in space at time t .

- a) Find the particle's velocity and acceleration vectors.
- b) Then find the particle's speed and direction of motion at the $t = 1$.
- c) Write the particle's velocity at that time $t = 1$ as the product of its speed and direction.

Solution:

Problem 2. (4 points) Find the value(s) of t so that the tangent line to the curve $\mathbf{r}(t) = t\mathbf{i} + 3\mathbf{j} + 2/3 t^{3/2}\mathbf{k}$ contains the point $(0, 3, -8/3)$.

Solution:

Problem 3. (4 points) A particle traveling in a straight line is located at the point $(1, -1, 2)$ and has speed 2 at time $t = 0$. The particle moves toward the point $(3, 0, 3)$ with constant acceleration $2\mathbf{i} + \mathbf{j} + \mathbf{k}$. Find its position vector $\mathbf{r}(t)$ at time t .

Solution:

Problem 4. (4 points) Find the point on the curve

$$\mathbf{r}(t) = (5 \sin t)\mathbf{i} + (5 \cos t)\mathbf{j} + 12t\mathbf{k}$$

at a distance 26π units along the curve from the point $(0, 5, 0)$ in the direction of increasing arc length.

Solution:

Problem 5. (4 points) The position of a particle moving in space at time $t \geq 0$ is

$$\mathbf{r}(t) = 2\mathbf{i} + \left(4 \sin \frac{t}{2}\right)\mathbf{j} + \left(3 - \frac{t}{\pi}\right)\mathbf{k}.$$

Find the first time \mathbf{r} is orthogonal to the vector $\mathbf{i} - \mathbf{j}$.

Solution: