

Problem 2 (34 points)

A particle is moving in three dimensions. Its position vector is given by:

$$\mathbf{r} = 6\hat{x} + (3 + 4t)\hat{y} - (3 + 2t - t^2)\hat{z}.$$

Distances are in meters, and the time, t , in seconds.

- a) (6) What is the velocity vector at $t = +3$?
 - b) (6) What is the speed (in m/sec) at $t = +3$?
 - c) (6) What is the acceleration vector and what is its magnitude (in m/sec²) at $t = +3$?
-

Now the particle is moving only along the z-axis, and its position is given by

$$(t^2 - 2t - 3)\hat{z}.$$

- d) (6) At what time does the particle stand still?
- e) (10) Make a plot (a sketch) of z versus time covering $t = -2$ to $+4$ sec.

Problem 2 34 points

6 pts a) $\vec{v} = \frac{d\vec{r}}{dt} = 4\hat{y} - (2 - 2t)\hat{z}$
at $t = 3$, $\vec{v} = 4\hat{y} + 4\hat{z}$

6 pts b) $|\vec{v}| = \sqrt{16 + 16} = 4\sqrt{2} \text{ m/sec}$

6 pts c) $\vec{a} = 2\hat{z}$, $|\vec{a}| = 2 \text{ m/sec}$

6 pts d) $v = (2t - 2)\hat{z} \Rightarrow v = 0$ when $t = 1 \text{ sec}$

10 pts e) $z = t^2 - 2t - 3$, at $t = 0$, $z = -3$
 $z = 0 \rightarrow t = \frac{+2 \pm \sqrt{4 + 12}}{2} = 1 \pm 2 \Rightarrow t = -1$ and $t = +3$
 $v = 0$ at $t = 1 \Rightarrow z = 1 - 2 - 3 = -4$
at $t = -2$, $z = 4 + 4 - 3 = +5$

