

Problem 1 (22 points)

At time $t = 0$ sec we throw a stone from the ground level straight up with a speed of 20 m/sec (ignore airdrag, and assume $g = 10 \text{ m/sec}^2$).

- a) (6) At what time (in sec) will this stone reach its highest point, and how high is it then above the ground?
- b) (6) We now throw a second stone straight up 2 sec after the first. How many meters above the ground is the first stone at that moment?
- c) (10) At what speed should we throw this second stone from the ground if it is to hit the first stone 1 second after the second stone is thrown?

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 $t = +3$?
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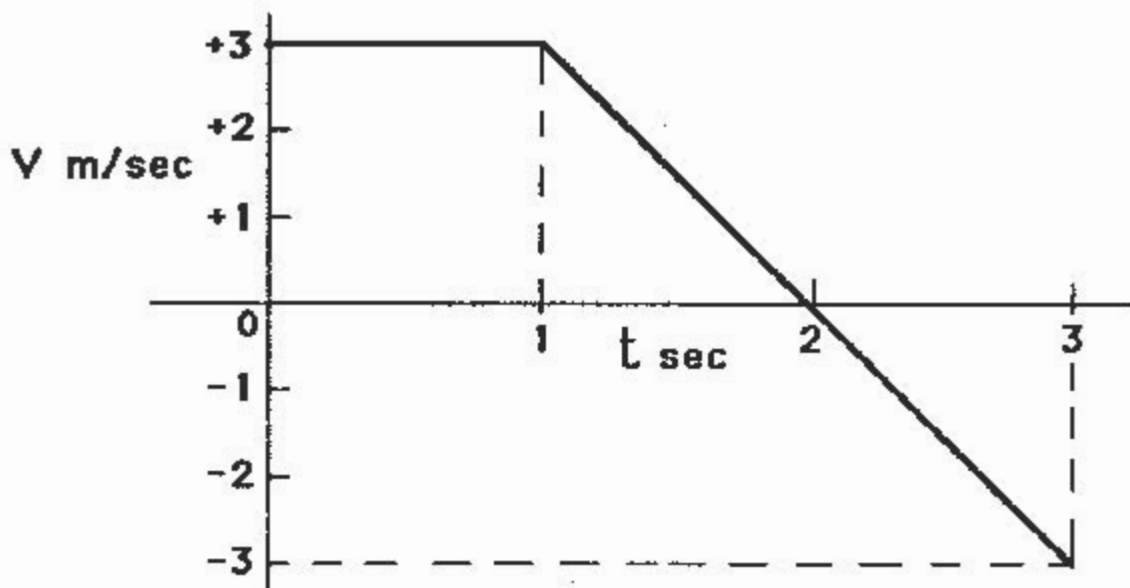
Now the particle is moving only along the z-axis, and its position is given by

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

- 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 3 (44 points)

A particle moves along a straight line, x . At time $t = 0$, its position is at $x = 0$. The velocity, V , of the object changes as a function of time, t , as indicated in the figure; t is in seconds, V in m/sec and x in meters.



- a) (6) What is x at $t = 1 \text{ sec}$?
- b) (6) What is the acceleration (in m/sec^2) at $t = 2 \text{ sec}$?
- c) (6) What is x at $t = 3 \text{ sec}$?
- d) (6) What is the average velocity (in m/sec) between $t = 0$ and $t = 3 \text{ sec}$?
- e) (10) What is the average speed (in m/sec) between $t = 0$ and $t = 3 \text{ sec}$?
- f) (10) Make a plot (a sketch) of x versus time between $t = 0$ and $t = 3 \text{ sec}$. Indicate clearly in your plot at $t = 0, 1, 2, 3 \text{ sec}$ what exactly the x positions are (be quantitative).