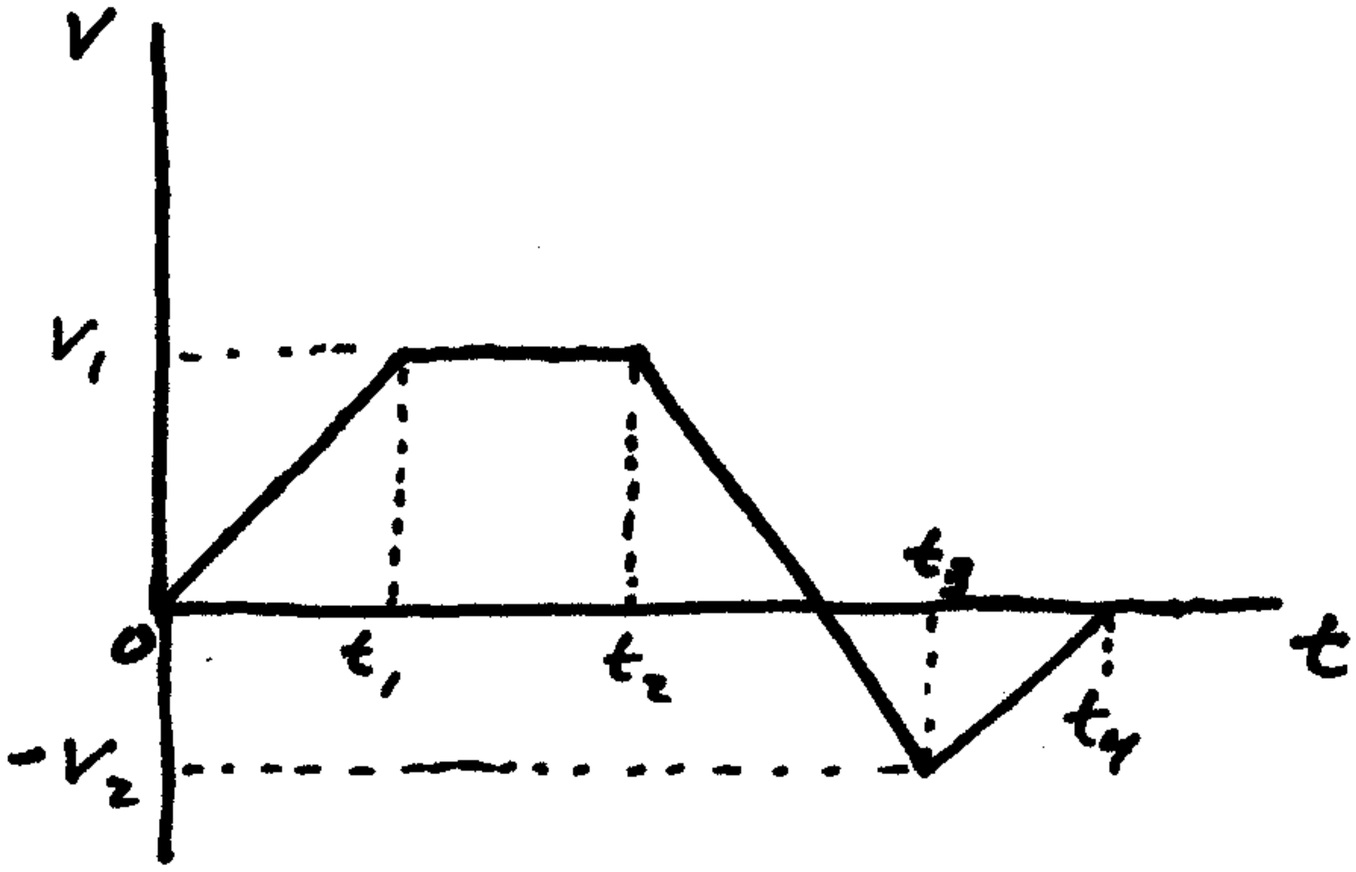
This is a 1-D problem involving average velocity and average speed.



The above graph shows velocity vs. time for a particle moving along a straight line. What is the average velocity and average speed for the particle for the entire time the particle is in motion.

Solution:

The total distance travelled by the particle is the area under the graph above the t-axis plus the area under the graph below the t-axis.

First find the intersection point of the graph between t_2 and t_3. Let t_p be this intersection point.

By similar triangles,

$$\frac{t_p - t_2}{v_1} = \frac{t_3 - t_p}{v_2}$$

$$t_p = \frac{v_1 t_3 + v_2 t_2}{v_1 + v_2}$$

Now, the area under the graph above the t-axis is:

$$A_1 = \frac{1}{2}(t_1)(v_1) + (t_2 - t_1)(v_1) + \frac{1}{2}(t_p - t_2)(v_1)$$

$$A_1 = -\frac{1}{2}(t_1)(v_1) + \frac{1}{2}(t_2)(v_1) + \frac{1}{2}(t_p)(v_1)$$

The area under the graph below the t-axis is:

$$A_2 = \frac{1}{2}(t_4 - t_p)v_2$$ (we're using a positive value of area here)

The total distance travelled is: $A_1 + A_2$

The average speed of the particle is $\bar{s} = \frac{A_1 + A_2}{t_4}$, where t_4 is the total time interval (Δt)

(answer)

The displacement of the particle is: $A_1 - A_2$

The average velocity of the particle is $\bar{v} = \frac{A_1 - A_2}{t_4}$ (answer)