

Question #58753, Physics / Mechanics | Relativity

A football quarterback runs 15.0 m straight down the playing field in 2.50 s. He is then hit and pushed 3.00 m straight backward in 1.75 s. He breaks the tackle and runs straight forward another 21.0 m in 5.20 s. Calculate his average velocity (a) for each of the three intervals and (b) for the entire motion c) What is his total displacement? What is his total distance?

Solution.

The total displacement is the distance between the initial and the final point of the object motion, while the total distance refers to the length of the path made by the object.

- a. The average velocity for an interval is equal to the displacement of the interval divided by the time:

$$v_a = \frac{d}{\Delta t};$$

Interval I:

$$v_a = \frac{15.0}{2.50} = 6 \text{ m/s};$$

Interval II:

$$v_a = \frac{-3.00}{1.75} = -1.71 \text{ m/s};$$

Interval III:

$$v_a = \frac{21.0}{5.20} = 4.04 \text{ m/s}$$

- b. The average velocity is equal to the total displacement divided by total time:

$$V_a = \frac{D}{\Delta T} = \frac{\sum d_i}{\sum \Delta t_i};$$

$$V_a = \frac{15.0 - 3.00 + 21.0}{2.50 + 1.75 + 5.20} = 3.49 \text{ m/s}$$

- c. The total displacement:

$$D = \sum d_i;$$

$$D = 15.0 - 3.00 + 21.0 = 33.0 \text{ m}$$

The total distance:

$$D = \sum |d_i|;$$

$$D = 15.0 + 3.00 + 21.0 = 39.0 \text{ m}$$