Answer on Question 78600, Physics, Mechanics, Relativity

Question:

The displacement (in meters) of a particle moving along x-axis is given by $x = 18t + 5t^2$. Calculate:

a) instantaneous velocity at $t = 2\ s$

b) average velocity between $t = 2\ s$ and $t = 3\ s$

c) instantaneous acceleration.

Solution:

a) We can find the instantaneous velocity from the formula:

$$v = \frac{d}{dt}x(t) = \frac{d}{dt}(18t + 5t^2) = 18 + 10t.$$

The instantaneous velocity at $t = 2\ s$ is:

$$v(t = 2\ s) = 18 + 10 \cdot 2 = 38\ \frac{m}{s}.$$

b) Let's first find the total displacement of a particle between $t = 2\ s$ and $t = 3\ s$:

$$x_{total} = 18t\Big|_2^3 + 5t^2\Big|_2^3 = 18 \cdot (3 - 2) + 5 \cdot (9 - 4) = 43\ m.$$

Average velocity is defined as total displacement divided by total time taken:

$$v_{avg} = \frac{x_{total}}{t_{total}} = \frac{43\ m}{3\ s - 2\ s} = 43\ \frac{m}{s}.$$

c) We can find the instantaneous acceleration from the formula:

$$a = \frac{d}{dt}v(t) = \frac{d}{dt}(18 + 10t) = 10\ \frac{m}{s^2}.$$

Answer:

a) $v(t = 2\ s) = 38\ \frac{m}{s}$. b) $v_{avg} = 43\ \frac{m}{s}$. c) $a = 10\ \frac{m}{s^2}$.