Jan. 25, 2020

This is a 1-D problem involving average acceleration and instantaneous acceleration.

A particle's position is given by $x = 2 + 4t - 5t^2 + 9t^3$, where t is in seconds and x is in meters.

(a) What is the average acceleration of the particle between $t = 1$ s and $t = 2$ s?

(b) What is the acceleration of the particle at $t = 3$ s?

Solution:

(a) $$v = \frac{dx}{dt} = 4 - 10t + 27t^2$$

$$v(1) = 4 - 10(1) + 27(1)^2 = 21 \text{ m/s}$$

$$v(2) = 4 - 10(2) + 27(2)^2 = 92 \text{ m/s}$$

$$\Delta t = 2 - 1 = 1$$

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v(2) - v(1)}{1} = \frac{92 - 21}{1} = 71 \text{ m/s}^2 \text{ (answer)}$$

(b) $$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = -10 + 54t$$

$$a(3) = -10 + 54(3) = 152 \text{ m/s}^2 \text{ (answer)}$$