Physics-145 Summer 2019

Quiz No. 1 Key Solution

Q1) A particle moves in a straight line according to the equation $x = 5t^2 + 3t$ where x is in meters and t in seconds.

(a) Calculate the average velocity of the particle in the time interval between $t = 0$ s and $t = 3$ s.

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x(3) - x(0)}{3 - 0} = \frac{54 - 0}{3} = 18 \text{ m/s}$$

(b) Calculate the acceleration of the particle at $t = 2$ s.

$$v = \frac{dx}{dt} = 10t + 3$$

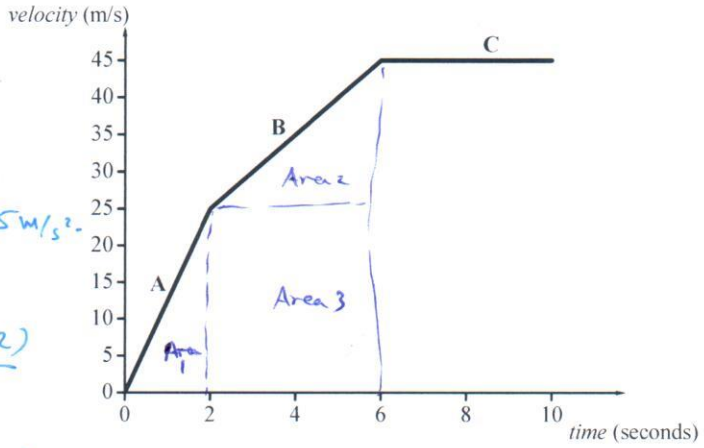
$$a = 10 \text{ m/s}^2 \longleftarrow \text{constant}$$

(c) Calculate the total distance moved in the first 10 seconds.

$$\Delta x = x(10) - x(0) = 530 - 0 = 530 \text{ m}.$$

Q2) The graph below shows the first 10 seconds velocity-time graph of a Tesla car journey. How far did the car move before reaching the speed of 45 m/s?

Solution (1):



Trip A:

$$a_A = \frac{\Delta V}{\Delta t} = \frac{V(2) - V(0)}{2} = \frac{25 - 0}{2} = 12.5 \text{ m/s}^2.$$

Trip B:

$$a_B = \frac{\Delta V}{\Delta t} = \frac{V(6) - V(2)}{6 - 2} = \frac{45 - 25}{4} = 5 \text{ m/s}^2.$$

Now: For Δx in trip A: $(\Delta x)_A = v_{0_A}(\Delta t) + \frac{1}{2} a_A (\Delta t)^2 = 0 + \frac{1}{2}(12.5)(2)^2 = 25 \text{m}.$

For Δx in trip B: $(\Delta x)_B = v_{0_B}(\Delta t) + \frac{1}{2} a_B (\Delta t)^2 = (25)(2)^2 + \frac{1}{2}(5)(4)^2 = 140 \text{ m}$

$\Rightarrow$ total distance $= (\Delta x)_A + (\Delta x)_B = 25 + 140 = 165 \text{ m}.$

Solution (2): Δx = area under the curve = Area1 + Area2 + Area3

$= \frac{1}{2} \times 2 \times 25 + \frac{1}{2} \times 4 \times 20 + 4 \times 25 = 165 \text{ m}$