$$v = \frac{dx}{dt} = 12 - 3t^2 \qquad ....[1]$$

$$a = \frac{dv}{dt} = -6t \qquad ....[2]$$

For v = 0, By Eq[1], we get t = 2sec. Putting the value of t in Eq[2], we get

a = - 6 X 2 = 12 m/s^2

Example 5. The velocity of any particle is related with its displacement As; $x = \sqrt{v+1}$, Calculate acceleration at x = 5 m.

Solution. $x = \sqrt{v+1} \qquad x^2 = v+1 \qquad v = (x^2 - 1)$

Therefore $\quad a = \frac{dv}{dt} = \frac{d}{dt}(x^2 - 1) = 2x\frac{dx}{dt} = 2x \; v = 2x(x^2 - 1)$

at x = 5 m $\quad a = 2 \times 5(25 - 1) = 240\,m/s^2$

Example 6. An object moving with a speed of 6.25 m/s, is decelerated at a rate given by: $\frac{dv}{dt} = -2.5\sqrt{v}$ where υ is the instantaneous speed. The time taken by the object, to come to rest, would be :

(1) 1 s **(2) 2 s (3) 4 s (4) 8 s **(A.I.E.E.E. 2011)**

Solution. $Given \; \frac{dv}{dt} = -2.5\sqrt{v} \;\Rightarrow\; \frac{dv}{\sqrt{v}} = -2.5\,dt$

Integrating both the sides of the above equation

$$\int_{6.25}^{v} \frac{dv}{\sqrt{v}} = -\int_{0}^{t} 2.5\,dt \; [Given\ at\ t = 0, v = 6.25m/s]$$

$$\int_{6.25}^{v} v^{-1/2}.dv = -2.5\int_{0}^{t} dt \Rightarrow \left[\frac{v^{1/2}}{1/2}\right]_{6.25}^{v} = -2.5[t]_0^t$$

$$2\left(\sqrt{v} - \sqrt{6.25}\right) = -2.5\,t$$

$$\Rightarrow \left(\sqrt{v} - 2.5\right) = -1.25\,t ......[1]$$

Putting v =0, in Eq[1] we get t = 2s.

Example 7. The velocity of a particle moving in the x direction varies as $V = \alpha\sqrt{x}$ where α is a constant. Assuming that at the moment t = 0 the particle was located at