the point x = 0. Find the acceleration.

Solution. $a = \frac{dv}{dt} = \alpha \frac{d}{dt}\sqrt{x} = \alpha . \frac{1}{2} x^{-1/2} . \frac{dx}{dt}$ $\left[\because \frac{dx}{dt} = V = \alpha\sqrt{x} \right]$

$$\mathbf{a} = \alpha . \frac{1}{2\sqrt{x}} . \alpha\sqrt{x} \quad \Rightarrow \quad a = \frac{\alpha^2}{2}$$

Example 8. A particle located at x = 0 at time t = 0 , starts moving along the positive x-direction with a velocity *v* that varies as $v = a\sqrt{x}$ .The displacement of the particle varies with time as

(a) t^2 (b) t (c) $t^{1/2}$ (d) t^3 **(A.I.E.E.E 2006)

Solution. Given that $v = \alpha\sqrt{x}$ or $\frac{dx}{dt} = \alpha\sqrt{x}$

$\therefore$ $\frac{dx}{\sqrt{x}} = \alpha\, dt$ or $\int_0^x \frac{dx}{\sqrt{x}} = \int_0^t \alpha\, dt$

$$\left[2\sqrt{x}\right]_0^x = \left[\alpha . t\right]_0^t \quad \Rightarrow \quad 2\sqrt{x} = \alpha . t$$

Hence $Or \quad x = \frac{\alpha^2 . t^2}{4} \quad \Rightarrow \quad x \propto t^2$

Example 9. The position x of the particle w.r.t. time t along x-axis is given by $x = 9t^2 - t^3$, where x is in metre and t is in sec. What will be the position of this particle when it achives maximum speed along +x direction? **[AIPMT 2007]**

Solution. For speed to be maximum, the acceleration must be zero, i.e. $\frac{dv}{dt} = 0$

$$\because \quad x = 9t^2 - t^3 \Rightarrow \quad v = \frac{dx}{dt} = 18t - 3t^2 \Rightarrow \quad a = \frac{dv}{dt} = 18 - 6t$$

For a = 0, t = 3sec. Putting this value of t in the equation of x, we get

$$x = 9(3^2) - 3^3 = 81 - 27 = 54m$$