Position and Velocity of an Automobile w.r.t Time.

An automobile of mass m accelerates, starting from rest, while the engine supplies constant power P, its position and velocity changes w.r.t time.

(1) **Velocity:** As Fv = P = constant

i.e. $m\frac{dv}{dt}v = P \qquad \left[\text{As } F = \frac{mdv}{dt}\right]$

or $\int v\,dv = \int \frac{P}{m}dt$

By integrating both sides we get $\frac{v^2}{2} = \frac{P}{m}t + C_1$

As initially the body is at rest i.e. v = 0 at t = 0, so $C_1 = 0$

$\therefore \qquad v = \left(\frac{2Pt}{m}\right)^{1/2}$

(2) **Position:** From the above expression $v = \left(\frac{2Pt}{m}\right)^{1/2}$

or $\frac{ds}{dt} = \left(\frac{2Pt}{m}\right)^{1/2} \qquad \left[\text{As } v = \frac{ds}{dt}\right]$

i.e. $\int ds = \int \left(\frac{2Pt}{m}\right)^{1/2} dt$

By integrating both sides we get $s = \left(\frac{2P}{m}\right)^{1/2} . \frac{2}{3}t^{3/2} + C_2$

Now as at t = 0, s = 0, so $C_2 = 0$

$\therefore \qquad s = \left(\frac{8P}{9m}\right)^{1/2} t^{3/2}$