Answer on Question #44163 – Engineering – Mechanics, Kinematics, Dynamics

A particle starts with initial speed 'u' and retardation 'a' to come to rest in time T. Calculate the time taken to cover first half of the total path travelled.

Solution:

$u-$ initial speed of the particle;
$a-$ retardation of the particle;
$T-$ time of traveling;
$t-$ time taken to cover first half of the total path;
Equation of motion for the particle ($D-$ travelled distance):

$$D = uT - \frac{aT^2}{2} \qquad (1)$$

Equation of motion for the particle for the first half of the path:

$$\frac{D}{2} = ut - \frac{at^2}{2} \qquad (2)$$

$(1) \text{in} (2)$:

$$\frac{uT - \frac{aT^2}{2}}{2} = ut - \frac{at^2}{2}$$

$$uT - \frac{aT^2}{2} = 2ut - at^2$$

$$at^2 - 2ut + T\left(u - \frac{aT}{2}\right) = 0$$

We have a quadratic equation and we need only positive root:

$$t = \frac{2u + \sqrt{4u^2 - 4aT\left(u - \frac{aT}{2}\right)}}{2a} = \frac{u + \sqrt{u^2 - aT\left(u - \frac{aT}{2}\right)}}{a}$$

Answer: time taken to cover first half of the total path: $t = \frac{u+\sqrt{u^2-aT\left(u-\frac{aT}{2}\right)}}{a}$