Answer on Question #64149-Physics-Classical Mechanics

An object is moving with an initial velocity of 20m/s. It must slow down to a stop in .33 seconds and travel 4m. Write a solution that applies a force to the object to satisfy the expected result.

Solution

If acceleration is constant:

$$a = \frac{v_i}{t} = \frac{20}{0.33} = 60.6\frac{m}{s^2}.$$

$$d = v_i t - \frac{at^2}{2} = 20(0.33) - \frac{60.6(0.33)^2}{2} = 3.3\ m \neq 4\ m.$$

Thus,

$$d = v_i t - \int_0^{0.33} a(t)tdt$$

$$\int_0^{0.33} a(t)tdt = v_i t - d = 20(0.33) - 4 = 2.6\ m$$

Let

$$a(t) = a_0(1 - \alpha t),$$

where $a_0 = 60.6\frac{m}{s^2}$.

Therefore,

$$\int_0^{0.33} a_0(1 - \alpha t)tdt = \frac{60.6(0.33)^2}{2} - \alpha\frac{0.33^3}{3} = 2.6$$

So,

$$\alpha = 58.4\frac{m}{s^3}.$$

The deceleration is

$$a(t) = a_0(1 - \alpha t) = a(t) = 60.6(1 - 58.4t) = (60.6 - 3540t)\frac{m}{s^2}.$$

The applied force:

$$F = ma = m(60.6 - 3540t)\ N.$$