Question #85562, Physics / Other

The force of resistance on an object moving through a fluid is proportional to the square of its velocity. The initial velocity of an object of mass 1 kg moving through the fluid is 40 ms−1. After 5 s the velocity reduces to 20 ms−1. Calculate its velocity after 10 s

Solution

$$F = ma = m\frac{dv}{dt} = -kv^2$$

$$\frac{dv}{dt} = -\frac{k}{m}v^2$$

$$\int \frac{dv}{v^2} = -\frac{k}{m}\int dt$$

$$-\frac{1}{v} = -\frac{k}{m}t + C$$

1) $t = 0\ s$.

$$-\frac{1}{40} = -\frac{k}{m}(0) + C$$

$$C = -\frac{1}{40}\frac{s}{m}.$$

2) $t = 5\ s$.

$$-\frac{1}{20} = -\frac{k}{1}(5) - \frac{1}{40}$$

$$k = 0.005\frac{kg}{m}.$$

3) $t = 10\ s$.

$$-\frac{1}{v} = -0.005(10) - \frac{1}{40}$$

$$v \approx 13.3\frac{m}{s}.$$

Answer provided by https://www.AssignmentExpert.com