

**Topic 20: Exercises on Mechanics 1**  
**Level 2**

1. A particle moves in a straight line with retardation which increases uniformly with the distance moved. Initially the retardation is  $5 \text{ ms}^{-2}$  and when the particle has moved a distance of  $12 \text{ m}$  the retardation is  $11 \text{ ms}^{-2}$ . Find the distance moved by the particle in coming to rest if the initial velocity is  $20 \text{ ms}^{-1}$ .

2. A particle moves in a straight line away from a fixed point  $O$  in the line, such that at time  $t$  its displacement from  $O$  is  $x$  and its velocity is  $v$ . At time  $t = 0$ ,  $x = 0$  and  $v = V$ . Subsequently the particle is slowing down at a rate proportional to the square of its speed. Find expressions for the velocity  $v$  and the displacement  $x$  in terms of the time  $t$ .

$$\frac{V}{1+Vkt}; \frac{1}{k} \ln(Vkt+1)$$

3. A particle of mass  $m$  moves in a horizontal straight line. The particle is resisted by a constant force  $mk$  and a variable force  $mv^2$ , where  $k$  is a positive constant and  $v$  is the speed. When  $t = 0$ ,  $v = u$ . Find the distance traveled and the time taken as the particle is brought to rest.

$$\frac{1}{2} \ln \left( 1 + \frac{u^2}{k} \right); \frac{1}{\sqrt{k}} \tan^{-1} \left( \frac{u}{\sqrt{k}} \right)$$

4. A particle of mass  $m$  moves in a horizontal straight line. The particle is resisted by a constant force  $2m$  and a variable force  $mv$ , where  $v$  is the speed. When  $t = 0$ ,  $v = 4$ . Find the distance travelled and the time taken for the particle to come to rest.

$4 - 2\ln 3$ m; $t = \ln 3$
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