**Question 7**

A particle of mass *m* kg falls vertically downwards, from rest in a medium which offers air resistance equal to $kv^2$ newtons, where $v$ ms$^{-1}$ is its velocity at a time *t* seconds. After a time *T* seconds, its velocity is $V$ ms$^{-1}$ and it has travelled a distance of *D* metres.
Which of the following is **false**?

**A.** $m\dfrac{dv}{dt} = mg - kv^2$

**B.** $D = \displaystyle\int_0^V \frac{mv}{mg - kv^2}\,dv$

**C.** $V = \dfrac{D}{T}$

**D.** $T = \displaystyle\int_0^V \frac{m}{mg - kv^2}\,dv$

**E.** Its limiting or terminal velocity is equal to $\sqrt{\dfrac{mg}{k}}$ ms$^{-1}$.

**ANSWER C**

$\ddot{x} = \dfrac{dv}{dt}, \quad m\dfrac{dv}{dt} = mg - kv^2$ **A.** is true.

$\dfrac{dv}{dt} = \dfrac{mg - kv^2}{m}$ , $\dfrac{dt}{dv} = \dfrac{m}{mg - kv^2}$ , $T = \displaystyle\int_0^V \frac{m}{mg - kv^2}\,dv$, **D.** is true.

use $\ddot{x} = v\dfrac{dv}{dx}, \quad mv\dfrac{dv}{dx} = mg - kv^2$ , $\dfrac{dv}{dx} = \dfrac{mg - kv^2}{mv}$ , $\dfrac{dx}{dv} = \dfrac{mv}{mg - kv^2}$

$D = \displaystyle\int_0^V \frac{mv}{mg - kv^2}\,dv$ **B.** is true.

The limiting or terminal velocity occurs when $\ddot{x} = 0 \quad v_{\lim} = \sqrt{\dfrac{mg}{k}}$ ms$^{-1}$, **E.** is true.

$V = \dfrac{D}{T}$ is false, constant acceleration formulae do not apply.

 