Q **3.**

A particle of mass m is initially at rest at the origin. It is subjected to a force and starts moving along the x-axis. Its kinetic energy K changes with time as $dK/dt = \gamma t$, where γ is a positive constant of appropriate dimensions. Which of the following statements is (are) true?

A. The force applied on the particle is constant

B. The speed of the particle is proportional to time

C. The distance of the particle from the origin increases linearly with time

D. The force is conservative

Solution:

$\frac{dk}{dt} = \gamma t$ and $k = \frac{1}{2}mv^2$

Differentiating $k = \frac{1}{2}mv^2$ w.r.t. time

$\therefore \frac{dk}{dt} = mv\frac{dv}{dt} = \gamma t$

$\therefore m\int_0^v vdv = \gamma\int_0^t tdt$

$\frac{mv^2}{2} = \frac{\gamma t^2}{2}$

$v = \sqrt{\frac{\gamma}{m}}t$

$\Rightarrow v \propto t$; So option (B) is correct

since $F = ma$

And $a = \frac{dv}{dt} = \sqrt{\frac{\gamma}{m}}$

$\therefore F = m\sqrt{\frac{\gamma}{m}} = \sqrt{\gamma m}$ = constant

Here resultant force which is applied force in this case is constant.

So option (A) is correct

Since force applied is constant and displacement between any two points on x-axis will also be constant, thus work done will be independent of path , hence force is conservative in nature, So option D is correct

Option (A), (B) and (D) are correct answers