A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2rt^2$ where k is a constant. What is the power delivered to the particle by the force acting on it?

Solution

We have, $a_c = k^2rt^2 = \frac{v^2}{r}$ where v is instantaneous speed at time t.

$v^2 = k^2r^2t^2$

$\Rightarrow v = krt$

v = 0 at t = 0 which means particle starts at rest and accelerates under the action of some force.

$$\Delta K = \frac{1}{2}mv^2 - 0 = \frac{1}{2}m(krt)^2 = \frac{1}{2}mk^2r^2t^2$$

$$W = \Delta K = \frac{1}{2}mk^2r^2t^2$$

$$P = \frac{dW}{dt} = mk^2r^2t$$