

Answer on question #64018, Physics

Question A particle starting with a velocity of 8m/s moves so that it's acceleration is always proportional to the distance travelled. If the velocity is 10m/s when it travels 6m, find the velocity when it travels 15m.

Solution There is too little data given to solve this problem. I am going to show it here.

First of all, let's find the equation of motion for this particle. We know that acceleration is proportional to the distance. Hence,

$$a(t) = ks(t) = k \int v(t) dt$$

Now, let us write down the definition of acceleration

$$a = \frac{dv}{dt}$$

Hence

$$\frac{dv}{dt} = k \int v(t) dt$$

By differentiating we have

$$\frac{d^2v}{dt^2} = kv(t)$$

The solution is

$$v(t) = C_1 e^{\sqrt{k}t} + C_2$$

Now we have only two conditions, first one

$$C_1 e^{\sqrt{k} \cdot 0} + C_2 = 8$$

that is equal to

$$C_1 + C_2 = 8$$

and second

$$\frac{C_1}{\sqrt{k}} e^{\sqrt{k}t_1} + C_2 t_1 = 6, \quad C_1 e^{\sqrt{k}t_1} + C_2 = 10$$

Having 4 unknown variables (k, t, C_1, C_2) and only 3 equations it is impossible to find the equation of motion for the particle and hence, find its velocity at 15 m.