20-P-KM-AF-002

Rectilinear Erratic Motion: Intermediate

Q:

The particle starts at the origin and moves with velocity $v = (t-A)^2 - C$ m/s for $0 < t < B$ and it changed to $v^2 = (t-B)$ for $B < t < D$. Determine the position and distance travelled. What is the average speed.

A: note*: C has to be $(B-A)^2$ in order for the two graphs to match up correctly and make the question make sense. (this is coded in)

for $0 < t < B$, use $v = ds/dt$

$$\int_0^s ds = \int_0^B v\,dt \Rightarrow s = \int_0^B [(t-A)^2 - C]\,dt$$

$$s_1 = -\frac{B(3C - B^2 + 3AB - 3A^2)}{3} = \text{position}$$

$|s_1| = \text{distance}$

for $B < t < D$

$$\int_0^s ds = \int_B^D v\,dt \Rightarrow s = \int_B^D [t-B]\,dt$$

$$s = \frac{t^2}{2} - Bt \Big|_B^D = \frac{D^2}{2} - BD - \frac{B^2}{2} + B^2$$

$$= \frac{D^2}{2} - BD + \frac{B^2}{2}$$

$$= (D-B)^2/2$$

$$\text{average speed} = \frac{|s_1| + |s_2|}{D}$$

$$\text{distance} = |s_1| + |s_2|$$

$$\text{position} = s_1 + s_2$$