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Solution 38

Consider the velocity-time graph of a body shown in figure.

The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the perpendicular from point B to OE.

Now, Initial velocity of the body,

u = OA -----(1)

And,Final velocity of the body,

v = BC ------(2)

But from the graph BC =BD + DC

Therefore, v=BD + DC ------(3)

Again DC = OA

So,v =BD + OA

Now, from equation (1), OA =u

So, v=BD + u ------(4)

We should find out the value of BD now. We know the slope of a velocity-time graph is equal to the acceleration, a.

Thus, Acceleration, a= slope of line AB

or a = BD/AD

But AD =OC= t, so putting t in place of AD in the above relation, we get:

or BD = at

Now, putting this value of BD in equation(4), we get:

v= u+ at

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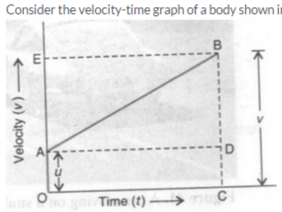

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$$a = \frac{BD}{t}$$

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Solution 39

Consider the velocity-time graph of a body shown in figure. The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC.

Suppose the body travels a distance s in time t. In the figure, the distance travelled by the body is given by the area of the space between the velocity-time graph AB and the time axis OC, which is equal to the area of the figure OABC. Thus:

Distance travelled = Area of figure OABC

= Area of rectangle OADC + area of triangle ABD

Now, we will find out the area of rectangle OADC and area of triangle ABD.

(i) Area of rectangle OADC =OA x OC

= u x t

=ut

(ii) Area of triangle ABD= (1/2) x Area of rectangle AEBD

= (1/2) x AD x BD

= (1/2) x t x at

= (1/2) at^2

Distance travelled, s = Area of rectangle OADC + area of triangle ABD

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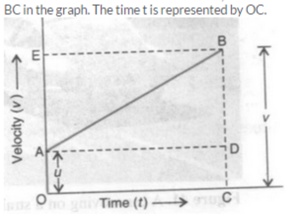

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=(1/2) x t x at

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Distance travelled, s = Area of rectangle OADC + area of triangle ABD

$$s = ut + \frac{1}{2}at^2$$

Solution 40

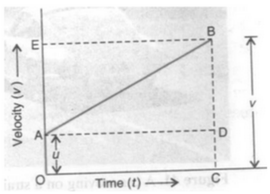
Consider the velocity-time graph of a body shown in figure. The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the perpendicular from point B to OE.

The distance travelled s by a body in time t is given by the area of the figure OABC which is a trapezium.

Distance travelled, s= Area of trapezium OABC

Now, OA + CB = u + v and OC =t Putting these values in the above relation, we get:

Eliminate t from the above equation. This can be done by obtaining the value of t from the first equation of motion.



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The distance travelled s by a body in time t is given by the area of the figure OABC which is a trapezium.

Distance travelled, s= Area of trapezium OABC

$$s = \frac{(\text{Sum of parallel sides}) \times \text{Height}}{2}$$

$$s = \frac{(OA + CB) \times OC}{2}$$

Now, OA + CB = u + v and OC =t Putting these values in the above relation, we get:

$$s = \left(\frac{u+v}{2}\right) \times t \qquad \text{----------(1)}$$

Eliminate t from the above equation. This can be done by obtaining the value of t from the first equation of motion.

Thus, v = u + at (first equation of motion)

And, at = v

*********** END **********