Physics Formulas

Average Velocity Formula

We know velocity very well but do not have information about average velocity. Moreover, average velocity helps us to determine the relationship between distance and time. Furthermore, in this topic, we will talk about average velocity formula, its derivation, and solved example.

Solve Questions

A particle is subjected to two mutually perpendicular simple harmonic motion such that its

$$\chi$$

and y coordinates are given by :

$$\chi = 2 \ sin \ \omega t$$

$$y = 2 \ sin \ \left(\omega t + \frac{\pi}{4}\right)$$

the path of the particle will be

1 Verified answer

A horizontal platform is executing simple harmonic motion in the vertical direction of frequency

$$\nu$$

. A block of mass m is placed on the platform. What is the maximum amplitude of the

platform so that the block is not detached form it?

1 Verified answer

What is not true for a body executing simple harmonic motion?

1 Verified answer

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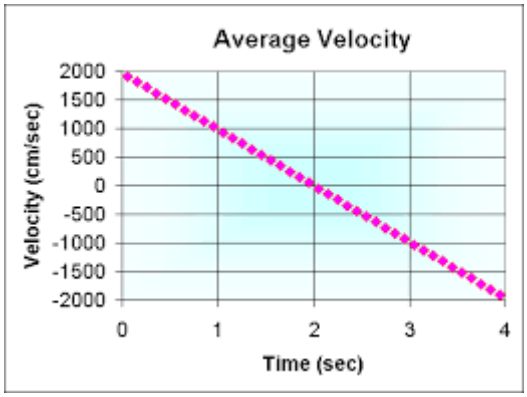
Velocity

For understanding average velocity we first need to know velocity. Velocity refers to the rate of change of displacement with respect to time. Also, we calculate it using the velocity formula.

Average Velocity



It refers to the variation amidst the starting and ending position, which we divide by starting and ending time. Also, velocity has direction and magnitude. Furthermore, its unit for the measure is meters per second (m/s).

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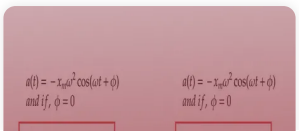
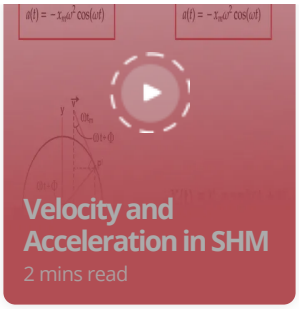




Average Velocity Formula

The formula of average velocity is as follows:

$$\text{average velocity} = \frac{(endposition)-(startposition)}{(endtime)-(starttime)}$$

$$v_{avg} = \frac{x_2-x_1}{t_2-t_1}$$

Derivation of the Formula

v_{avg} = refers to the average velocity in meter per second
x_1 = refers to the starting position of the object in meter/s
x_2 = refers to the ending position of the object in meter/s
t_1 = refers to the initial time of motion in second/s
t_2 = refers to the final time of the motion in second/s

Solved Example on Average Velocity Formula

Example 1

While driving a man sees a road signboard that says Chennai- 220 km away. Moreover, an hour later he sees another signboard that says Chennai- 100 km away. Now, calculate the velocity of the vehicle which the man is driving?

Solution:

For solving any velocity problem choosing the direction is important for solving it. Also, in this question, the position is expressed as a distance away from the location. So, for the location of Chennai we choose x = 0, also we

assume the distance values to be positive, so the vehicle is moving in a direction x (-x).

negative. Then, the starting position $x_1 = 220$ km, and the end position will be $x_2 = 100$ km. Besides, the travel time is given as difference, in this way we choose the starting time to be $t_1 = 0$ hours, and the ending time be $t_2 = 1.0$ hours. But the question has asked the velocity values to be in meter per second. For correcting this we will convert kilometer in meters and hours in seconds.

$$1 \text{ hour} = (1 \text{ hour}) \left(\frac{60min}{1hour}\right) \left(\frac{60s}{1min}\right)$$
$$1 \text{ hour} = (1 \text{ hour}) \left(\frac{60min}{1hour}\right) \left(\frac{60s}{1min}\right)$$
$$1 \text{ hour} = 60 \times 60 \text{ s} = 3600 \text{ s}$$

Now let's calculate the distance in meter

$$1 \text{ km} = (1 \text{ km}) \left(\frac{1000m}{1km}\right)$$
$$1 \text{ km} = (1 \text{ km}) \left(\frac{1000m}{1km}\right)$$
$$1 \text{ km} = 1000 \text{ m}$$

Now using this we can convert 220 km and 100 km to meter

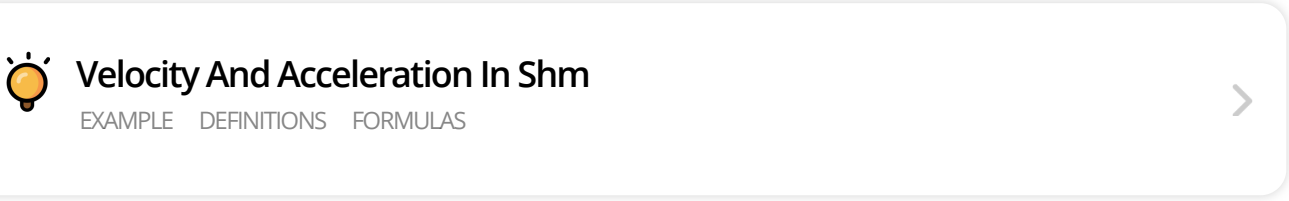
$$x_1 = (220 \text{ km}) \left(\frac{1000m}{1km}\right)$$
therefore, $x_1 = 2{,}20{,}000$ m
$$x_2 = (100 \text{ km}) \left(\frac{1000m}{1km}\right)$$
therefore,$x_1 = 1{,}00{,}000$ m
$$t_1 = (0 \text{ hours}) \left(\frac{3600s}{1hour}\right)$$
therefore,$t_1 = 0$ s
$$t_2 = (1 \text{ hours}) \left(\frac{3600s}{1hour}\right)$$
therefore, $t_1 = 3600$ s

Now put all the values in the average velocity formula

$$v_{avg} = \frac{x_2 - x_1}{t_2 - t_1}$$
$$v_{avg} = \frac{(100000m) - (220000m)}{(3600s) - (0s)}$$
$$v_{avg} = \frac{(-120000m)}{(3600s)}$$
$$v_{avg} \cong -33.33 \text{ m/s}$$

So, the average velocity of the car is -33.33 m/s according to the direction described above. Moreover, it can also be stated that the average velocity is 33.33 m/s towards Chennai.

Revise with Concepts



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Next
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