CBSE Test Paper 04

Chapter 3 Motion in A Straight Line

1. A ball starts from rest and accelerates at 0.500 m/ s^2 while moving down an inclined plane 9.00 m long. When it reaches the bottom, the ball rolls up another plane, where, after moving 15.0 m, it comes to rest. What is the ball's speed in m/s 8.00 m along the second plane? **1**
    a. 2.23 m/s
    b. 2.56 m/s
    c. 2.05 m/s
    d. 2.15 m/s
2. Path length is a **1**
    a. tensor
    b. Derived unit
    c. scalar
    d. vector
3. While determining velocity from position-time graph. Velocity at any time is the slope of the _______ to the point on the graph at that instant. **1**
    a. perpendicular
    b. tangent
    c. line from origin
    d. Unit vector
4. A bus start from rest with an acceleration of 1 m/sec2. A man who is 48 meter behind the bus with a uniform velocity of 10 m/sec. then the minimum time after which the man will catch the bus is **1**
    a. 14 sec
    b. 4 sec
    c. 10 sec
    d. 8 sec

5. A particle moves along the x axis. Its position is given by the equation $x = 2.00 + 3.00t - 4.00t^2$ with x in meters and t in seconds. Determine its position in m at the instant it changes direction **1**

   a. 3.21 m
   b. 1.97 m
   c. 2.22 m
   d. 2.56 m

6. Can speed of an object be negative? Justify. **1**

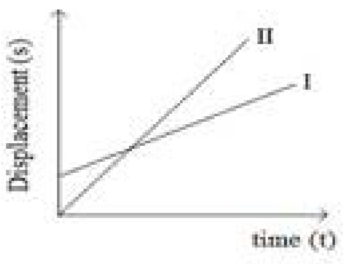
7. What are positive and negative acceleration in straight line motion? **1**

8. A railway train 400m long is going from New Delhi railway station to Kanpur. Can we consider railway train as a point object. **1**

9. The position of an object moving along the x-axis is given by $x = a + bt^2$, where a = 8.5 m, b = 2.5 m and t is measured in seconds. What is its velocity at t = 0 s and t = 2.0 s? What is the average velocity between t = 0 s and t = 4.0 s? **2**

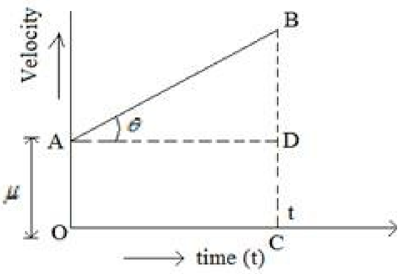
10. Sameer went on his bike from Delhi to Gurugram at a speed of 60km/hr and came back at a speed of 40km/hr. What is his average speed for entire journey? **2**

11. In Figure shows displacement - time curves I and II. What conclusions do you draw from these graphs? **2**



12. How does the velocity-time graph for uniform motion gives a geometrical way of calculating the displacement covered during a given time t? **3**

13. Establish $s = ut + \frac{1}{2}at^2$ from velocity time graph for a uniform accelerated motion? **3**



14. A woman starts from her home at 9.00 am, walks with a speed of 5 km h^{-1} on a straight road up to her office 2.5 km away, stays at the office up to 5.00 pm, and returns home by an auto with a speed of 25 km h^{-1}. Choose suitable scales and plot the x-t graph of her motion. **3**

15. On a two-lane road, car A is travelling with a speed of 36 km h^{-1}. Two cars B and C approach car A in opposite directions with a speed of 54 km h^{-1} each. At a certain instant, when the distance AB is equal to AC, both being 1 km, B decides to overtake A before C does. What minimum acceleration of car B is required to avoid an accident? **5**

Answer

1. c. 2.05 m/s

Explanation: For First Plane

Initial velocity u = 0

Acceleration a = 0.500 m/s^2

Distance covered s = 9.0 m

Final velocity v = ?

We know

$v^2 - u^2 = 2as$

$=> v^2 - 0 = 2 \times 0.500 \times 9.0$

$=> v^2 = 9$

=> v = 3 m/s

This is initial velocity for second plane

For second plane

Initial velocity u = 3 m/s

Final velocity v = 0 (as it stop)

Distance covered s = 15 m

Acceleration a = ?

$=> 0 - 9 = 2 \times a \times 15$

$=> a = \frac{-9}{30} = -0.3\ m/s^2$

Now velocity at distance = 8.0 m

$=> v^2 - 9 = 2 \times (-0.3) \times 8.0$

$=> v^2 = -4.8 + 9 = 4.2$

=> v = 2.05 m/s

2. c. scalar

Explanation: Path length has no particular direction and it depends upon the path chosen to reach the destination where displacement of the destination is absolute no matter what path is used to get there. So it is scaler.

3. b. tangent

Explanation: Velocity is defined as the rate of change of position with respect to time, which may also be referred to as the instantaneous velocity to emphasize the distinction from the average velocity.

In terms of a displacement-time (x vs. t) graph, the instantaneous velocity (or, simply, velocity) can be thought of as the slope of the tangent line to the curve at any point.

4. d. 8 sec

Explanation: Let the distance traveled by the bus when man catch the bus be S meter distance traveled by the man when he catch the bus S'=S+48 meter

Given :

Initial velocity of bus u=0

Initial velocity of man u'=10m/sec Acceleration of Bus=1 m/s^2

Accelerationof Man=0

We will use formula for displacement

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

By substituting the values in above equation we get,

Displacement of Bus $S = \frac{1}{2}t^2 \ \ldots\ldots(1)$

Displacement of Man $S + 48 = 10t \ \ldots\ldots\ldots(2)$

By substituting the value of S from eq(1) in eq(2)we get

$\frac{1}{2}t^2 + 48 = 10t$

$=> t^2 - 20t + 96 = 0$

$=> t^2 - 12t - 8t + 96 = 0$

$=> (t - 8)(t - 12) = 0$

=> t = 8, 12

Taking minimum value t = 8 sec

5. d. 2.56 m

Explanation: it will change direction When the speed is zero.

Velocity v = $\frac{dx}{dt} = 3 - 8t$

Put v = 0, we get

$=> 3 - 8t = 0$

$=> t = \frac{3}{8}$

It ll change direction at $t = \frac{3}{8}$

Position at this time.

$x(\frac{3}{8}) = 2 + 3(\frac{3}{8}) - 4(\frac{3}{8})^2$

= $2 + \frac{9}{8} - \frac{9}{16}$

= $\frac{32+18-9}{16}$

= $\frac{41}{16}$

= 2.56 m

6. No, speed of an object can never be negative because distance is also always positive.

7. If speed of an object increases with time, its acceleration is positive. (Acceleration is in the direction of motion) and if speed of an object decreases with time its acceleration is negative (Acceleration is opposite to the direction of motion).

8. Yes, because length of the train is smaller as compared to the distance between New Delhi and Kanpur.

9. We know that, $v = \frac{dx}{dt}$

   $v = \frac{d}{dt}\left(a + bt^2\right)$ = 2bt = 5t m/s (i)

   at t = 0, from equation (i) we have v = 0,

   at t = 2 from equation (i) we have v = 10 m/s

   Average velocity = $\frac{x(4)-x(2)}{4-2} = \frac{a+16b-a-4b}{2}$

   = $6 \times b = 6 \times 2.5$ = 15 m/s

10. Here distance is constant i.e to and fro 2s so

    Average velocity = total distance / total time

    Here formula.

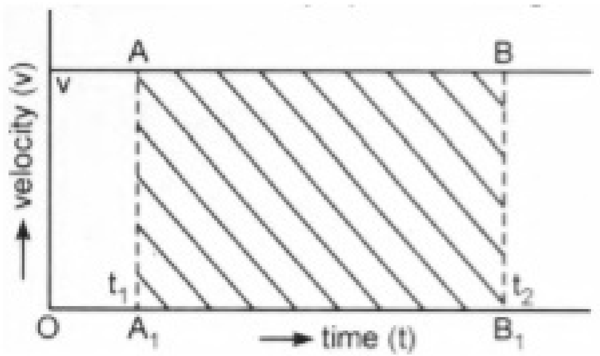
    $vav = \frac{2u_1 v_2}{v_1+v_2}$

    $= \frac{2\times60\times40}{60+40}$

    = 48 km/hr.

11. i. Both the curves are representing uniform linear motion.

ii. Uniform velocity of II is more than the velocity of I because slope of curve (II) is greater.

12. 

Consider velocity-time graph for uniform motion along a straight path as shown in the given figure. Let A and B be two points on the velocity-time graph corresponding to the instants t_1 and t_2. As the motion is uniform, hence we have

$AA_1 = BB_1 = v$. Area under v-t graph between t_1 and t_2 = area ABB_1A_1

$= AA_1 \times A_1B_1 = v(t_2 - t_1)$ .... (A)

But, v = $\frac{\text{Displacement}}{\text{Time}} = \frac{x_2 - x_1}{t_2 - t_1}$

Therefore, $V(t_2 - t_1) = x_2 - x_1$

and area $ABB_1A_1 = (x_2 - x_1)$.

Hence, area under a velocity-time graph between the instants t_1 and t_2 gives the magnitude of displacement of a particle in the time interval $(t_2 - t_1)$.

13. Displacement of the particle in time (t)

S = area under $v - t$ graph

S = area of trapezium OABC

$S = \frac{1}{2}(v + u)t$

$S = \frac{1}{2}(u + at + u)t$ (v = u + at)

$S = \frac{1}{2}(2u + at)t$

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

14. Given: Speed of woman = 5 km/h

Distance from home to office = 2.5 km

Time $= \frac{\text{Distance covered}}{\text{Speed of women}}$

$Time = \frac{2.5}{5} = 0.5h = 30\text{min}$

When she return, she covers the same distance in the evening by an auto.

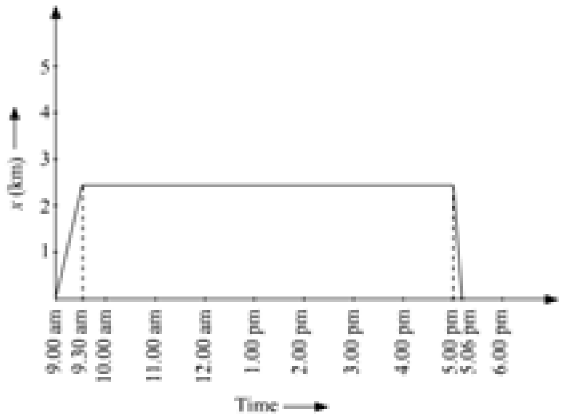
Given Speed of auto = 25 km/h

$\text{Time} = \frac{\text{Distance Covered}}{\text{Speed of auto}}$

$$Time = \frac{2.5}{25} = 0.1\text{h} = 6\text{min}$$

and Women at Rest from 9:30 am to 5:00 pm during this time speed is zero

x-t graph of the motion of women from home to office and office to home.



15. Speed of car A=36 km/h

= 36 $\times$ 5/18 =10 m/s

let Vb and Vc be speed of car B and C

Vb = Vc = 54 km/h

= 54 $\times$ 5/18 = 15 m/s

relative speed of car B with respect to car A,Vba is

Vba = Vb - Va = 15-10 = 5m/s

relative speed of car C with respect to car A,Vca is

Vca = Vc + Va = 15 + 10 = 25m/s

AB = AC = 1 km = 1000m

Let t be the time taken by car AC

s = ut

t = s/u = AC/vca = 1000/25 = 40s

Let a be the accelaration of car B for time t =40 sec

s = ut + 1/2at^2

1000 = 5 $\times$ 40 + 1/2a $\times$ 40 $\times$ 40

1000 = 200 + 800a

800 = 800a

a =1 m/s^2