CBSE Test Paper 03

Chapter 3 Motion in A Straight Line

1. If the position- time graph is a straight line **1**

   a. The velocity is increasing
   b. The velocity is decreasing
   c. The velocity is zero
   d. The velocity is constant

2. Two parallel rail tracks run north-south. Train A moves north with a speed of 54 km/ hr, and train B moves south with a speed of 90 km/ hr. What is the velocity of ground with respect to B in m/s? Choose the positive direction of x-axis to be from south to north. **1**

   a. 22
   b. 30
   c. 25.0
   d. 28

3. A car moving at 60 km/h comes to a stop in 4.0 s. What was its deceleration? **1**

   a. $20\ m/s^2$
   b. $-30\ m/s^2$
   c. $-15\ m/s^2$
   d. $-25\ m/s^2$

4. A ball starts from rest and accelerates at 0.500 $\mathrm{m/s^2}$ 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. How many seconds does it take to roll down the first plane? **1**

   a. 8.00
   b. 4.00
   c. 6.0

d. 2.00

5. A truck has a velocity of 3 m /s at time t=0. It accelerates at 3 m / s^2 on seeing police .What is its velocity in m/s at a time of 2 sec **1**

   a. 7
   b. 9
   c. 12
   d. 8

6. The v-t graphs of two objects make angle 30° and 60° with the time axis. Find the ratio of their accelerations. **1**

7. Two balls of different masses are thrown vertically upward with same initial speed. Which one will rise to a greater height? **1**

8. Suppose two trains A and B are moving with uniform velocities along parallel tracks in the same direction and the velocities of A and B be 60 km /h in East and 65 km/h in East. Find the relative velocity of B w.r.t. A. **1**

9. The displacement of a body is proportional to t^3, where t is time elapsed. What is the nature of acceleration-time graph of the body? **2**

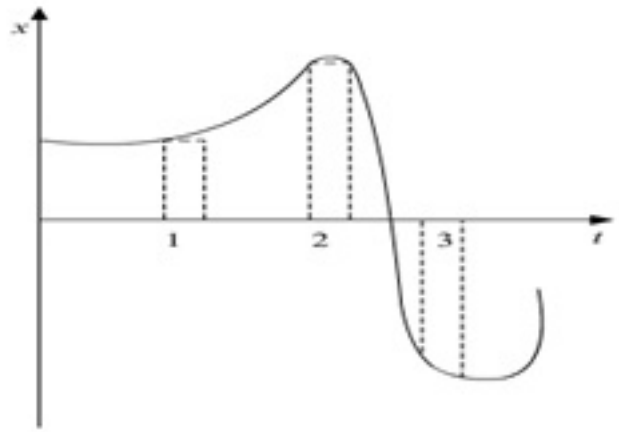
10. The odometer of Raja's car reads 1700 km at the start of a trip and 2500 km at the end of the trip. The trip took 16 h. What is the average speed of Raja's car in ms^{-1}? **2**

11. The position of an object is given by $x = 2t^2 + 3t$. Find out that its motion is uniform or non - uniform. **2**

12. Two town A and B are connected by a regular bus service with a bus leaving in either direction every T min. A man cycling with a speed of 20 kmh^{-1} in the direction A to B notices that a bus goes past him every 18 min in the direction of his motion, and every 6 min in the opposite direction. What is the period T of the bus service and with what speed do the buses ply of the road? **3**

13. Is earth inertial or non - inertial frame of reference? **3**

14. Below figure gives the x-t plot of a particle in one-dimensional motion. Three different equal intervals of time are shown. In which interval is the average speed greatest, and in which is it the least? Give the sign of average velocity for each interval. **3**



15. A ball is thrown upward with an initial velocity of 100 m/s. After how much time will it return? Draw velocity-time graph for the ball and find from the graph. **5**

    i. Maximum height attained by the ball.

    ii. Height of the ball after 15 s. Take g = 10 ms^{-1}.

CBSE Test Paper 03

Chapter 3 Motion in A Straight Line

Answer

1. d. The velocity is constant

   Explanation: The principle is that the slope of the line on a position-time graph reveals useful information about the velocity of the object.

   If the velocity is constant, then the slope is constant (i.e., a straight line).

2. c. 25.0

   Explanation: Choose the positive direction of x-axis to be from south to north.

   Then, $v_A = +54 kmh^{-1} = +15 ms^{-1}$

   $v_B = -90 kmh^{-1} = -25 ms^{-1}$

   Relative velocity of B with respect to A $= v_B - v_A = 15 - (-25) = 40 ms^{-1}$,

   i.e. the train B appears to A to move with a speed of 40 ms^{-1} from north to south.

   Relative velocity of ground with respect to B $= 0 - v_B = 0 - (-25) = 25 ms^{-1}$

3. c. $-15\ m/s^2$

   Explanation: initial velocity u = 60 m/s

   As it stop final velocity v = 0

   Time taken t = 4 s

   We know,

   $a = \frac{v-u}{t}$

   $= \frac{0-60}{4} = -15\ m/s^2$

   Negative sign shows it is declaration.

4. c. 6.0

   Explanation: For First Plane

   Initial velocity u = 0

   Acceleration a = 0.500 m/s^2

   Distance covered s = 9.0 m

   Time taken t = ?

We know

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

$\Rightarrow 9 = 0 \times t + \frac{1}{2} \times (0.5)t^2$

$\Rightarrow t^2 = \frac{9 \times 2}{0.5} = 36$

$\Rightarrow$ t = 6 s

5. b. 9

Explanation: Initial velocity u = 3 m/s

Acceleration a = 3 m/s^2

Initial time $t_1 = 0\ s$

Final time $t_2 = 2\ s$

Time taken t = 2-0= 2 s

Final velocity v = ?

We know,

$v = u + at$

$\Rightarrow v = 3 + 2 \times 3$

$\Rightarrow v = 3 + 6 = 9\ m/s^2$

6. $\frac{a_1}{a_2} = \frac{\tan 30^o}{\tan 60^o}$

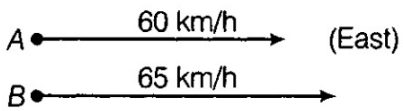
$= \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$

$\Rightarrow 1 : 3$

7. Both the balls will rise to a greater height.

8. We know that relative velocity of B w.r.t. A is given by

$V_{AB} = V_A - V_B = 65 - 60 = 5$ km/h due East



9. as s $\propto$ t^3 $\Rightarrow$ s = kt^3

velocity V= $\frac{ds}{dt}$ = 3kt^2

acceleration a = $\frac{dv}{dt}$ = 6kt

ie. a$\propto$t

$\Rightarrow$ motion is uniform, accelerated motion, a - t graph is straight-line.

10. Here, distance traveled by the car = (2500 - 1700) km = 800 km

    Time taken = 16 h

    Average speed = $\frac{\text{Total distance covered}}{\text{Total time}}$

    u = $\frac{800}{16}$ = 50 km/h

    u = $\frac{50\times5}{1\times18}$ = 13.9 m/s

11. Here it is given that , position of an object is given by:

    $x = 2t^2 + 3t$

    By Differentiating x w.r.t t, we obtain

    Velocity, $v = \frac{dx}{dt} = \frac{d}{dt}\left(2t^2 + 3t\right)$

    As velocity is time-dependent, it means that motion is non - uniform.

12. Let *V* be the speed of the bus running between towns A and B.

    Speed of the cyclist, *v* = 20 km/h

    Relative speed of the bus moving in the direction of the cyclist

    = *V* – *v* = (*V* – 20) km/h

    The bus went past the cyclist every 18 min i.e., 18 / 60 h (when he moves in the direction of the bus).

    Distance covered by the bus = (*V* – 20) × 18 / 60 km .... (i)

    Since one bus leaves after every *T* minutes, the distance travelled by the bus will be equal to

    V × *T* / 60 ....(ii)

    Both equations (i) and (ii) are equal.

    (V – 20) × 18 / 60 = *VT* / 60 .....(iii)

    Relative speed of the bus moving in the opposite direction of the cyclist

    = (*V* + 20) km/h

    Time taken by the bus to go past the cyclist = 6 min = 6 / 60 h

    ∴ (*V* + 20) × 6 / 60 = *VT* / 60 ....(iv)

    From equations (iii) and (iv), we get

    (*V* + 20) × 6 / 60 = (V – 20) × 18 / 60

    V + 20 = 3*V* – 60

    2*V* = 80

    V = 40 km/h

    Substituting the value of *V* in equation (iv), we get

(40 + 20) × 6 / 60 = 40T / 60

T = 360 / 40 = 9 min

13. If we do not take large scale motion such as wind and ocean currents into consideration, we can say that the earth is approximately an inertial frame. But, as earth revolves around the sun and also spins about its own axis, so it is an accelerated frame of reference. Hence, the earth is a non-inertial frame of reference.

14. Interval 3 (Greatest), Interval 2 (Least)
    Positive (Intervals 1 & 2), Negative (Interval 3)
    The average speed of a particle shown in the x-t graph is obtained from the slope of the graph in a particular interval of time.
    It is clear from the graph that the slope is maximum and minimum respectively in intervals 3 and 2 respectively. Because we can see from the graph that for the same gap of time, in the interval 3, change in position is largest, whereas the change in position in the interval 2 is least. Therefore, the average speed of the particle is the greatest in interval 3 and is the least in interval 2. The sign of average velocity is positive in both intervals 1 and 2 as the slope is positive in these intervals(both the changes of time and position are positive). However, it is negative in interval 3 because the slope is negative in this interval(the change of position is negative but the change in time is positive).

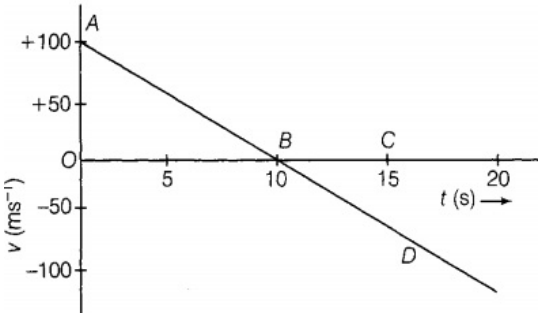
15. The initial velocity of ball is given as: u = 100 ms^{-1} and the acceleration due to gravity (g) = -10m/s^2 (negative sign is because of it being acting in downward direction)
    At highest point, v = 0
    As we know that, v = u + at
    $\Rightarrow 0 = 100 - 10 \times t$
    Time taken to reach highest point is given by:
    $t = \frac{100}{10} = 10\text{s}$
    The ball will return to the ground at t = 20 s.
    Velocities of the ball at different instants of time will be as follows.
    At t = 0, v = 100 - 10$\times$0 = 100 m/s
    At t = 5, v = 100 - 10$\times$5 = 50 m/s

At t = 10, v = 100 - 10$\times$10 = 0 m/s

At t = 15, v = 100 - 10$\times$15 = -50 m/s

At t = 20, v = 100 - 10$\times$20 = -100 m/s

The velocity time - graph will be as shown in the figure.



i. Maximum height attained by the ball

   = Area of triangle AOB

   = $\frac{1}{2} \times 10s \times 100$ ms^{-1} = 500 m

ii. Height attained after 15 seconds

   = Area of triangle AOB + Area of triangle BCD

   $= 500 + \frac{1}{2}(15 - 10) \times (-50)$(Velocity after 10 seconds is taken as negative because the ball is now coming downwards)

   = 500 - 125 = 375 m