

Motion in a straight line

Objective : Higher order problems for developing problem solving skills

- A freely falling body crosses three points A, B and C with velocities v , $2v$ and $3v$. Then the ratio of distances AB to AC is
 - 1 : 2
 - 1 : 3
 - 1 : 1
 - 3 : 8
- Water drops fall from a tap at a height h above the ground. The drops fall at regular intervals of time such that when the first drop touches the ground, fifth drop just leaves the tap. Ratio of relative velocity of 1st drop w.r.t 2nd drop (v_{12}) and relative velocity of 3rd drop w.r.t the 4th drop (v_{34}) is
 - 3:2
 - 4:3
 - 4:1
 - 1:1
- When a body is projected vertically up, it crosses points P and Q with velocities v_1 and v_2 . If R is the midpoint of PQ, its velocity at R is
 - $\frac{v_1 + v_2}{2}$
 - $\sqrt{\frac{v_1 + v_2}{2}}$
 - $\frac{v_1^2 + v_2^2}{v_1 + v_2}$
 - $\sqrt{\frac{v_1^2 + v_2^2}{2}}$
- The engine of a train, moving with uniform acceleration, passes an electric pole with a velocity u and the last compartment with a velocity v . The length of train that has passed the pole when the instantaneous velocity of the train is equal to its average velocity is (total length of the train is l)
 - $\frac{l(v + 3u)}{4(v + u)}$
 - $\frac{l}{2}$
 - $\frac{3l}{4}$
 - $\frac{l(v + 3u)}{4(v - u)}$
- If a body is released from certain height above the ground, in the last second of its fall it covers half of the total distance travelled by it. Then the average speed for its motion is
 - $(2 - \sqrt{2}) \text{ ms}^{-1}$
 - $(10 + 5\sqrt{2}) \text{ ms}^{-1}$
 - 2 ms^{-1}
 - 4 ms^{-1}
- The photograph of a ball is taken which is dropped down along a vertical scale from the zero division. During the exposure (i.e. when shutter of camera is open) the ball moved from 40 cm division to 90 cm division. Then time of exposure of the shutter of the camera is ($g = 9.8 \text{ ms}^{-2}$)
 - $1/7 \text{ s}$
 - $2/7 \text{ s}$
 - $3/7 \text{ s}$
 - $4/7 \text{ s}$
- A body is dropped from a tower. At an instant when it has descended X meters (from the top of the tower) another body is dropped from a point Y meters below the top of the tower. If they reach the ground at the same instant of time, height of the tower is
 - $\frac{(X + Y)^2}{4Y}$
 - $\frac{(X - Y)^2}{4X}$
 - $\frac{(X + Y)^2}{4X}$
 - $\frac{(X - Y)^2}{4Y}$
- A boy sees a ball going up through a window of height 2.45m. If the total time for which the ball is in sight is 0.5 s then height to which the ball rises, above the window, is nearly
 - 0.98 m
 - 0.49 m
 - 0.245 m
 - 0.306 m
- A body projected vertically up from the ground crosses a point P after t seconds and again after $3t/2$ seconds from the instant is projected. Maximum height reached by the body above P is
 - $gt^2/16$
 - $gt^2/32$
 - $gt^2/64$
 - $gt^2/32$

Motion in a straight line

10. A body is thrown up in a lift with a velocity u relative to the lift and the time of flight is found to be t . The acceleration with which the lift is moving up is
1. $\frac{u-gt}{t}$ 2. $\frac{2u-gt}{t}$ 3. $\frac{u+gt}{t}$ 4. $\frac{2u+gt}{t}$
11. A body has velocities of 3ms^{-1} and 4ms^{-1} at two points along its path. Its velocity at the midpoint of the line joining these two points is
1. $\sqrt{12.5}\text{ms}^{-1}$ 2. $\sqrt{7}\text{ms}^{-1}$ 3. $\sqrt{12}\text{ms}^{-1}$ 4. $\sqrt{5.2}\text{ms}^{-1}$
12. A body is projected vertically upwards. If t_1 and t_2 be the times at which it is at height h above the point of projection while ascending and descending, respectively, then the velocity of projection is
1. $\frac{1}{2}g(t_1+t_2)$ 2. $g(t_1-t_2)$ 3. $g(t_1+t_2)$ 4. $\frac{1}{2}g(t_1-t_2)$
13. A particle is projected vertically upwards and it attains a height H . It reaches point P which is at a height h ($h < H$) above the ground after t_1 seconds and t_2 seconds from the start. If $t_1 / t_2 = 1/3$ then h is equal to
1. $\frac{2H}{3}$ 2. $\frac{3H}{4}$ 3. $\frac{4H}{5}$ 4. $\frac{2H}{\sqrt{5}}$
14. A train accelerates from rest at a constant rate α for distance x_1 and time t_1 . After that it decelerates to rest at a constant rate β in distance x_2 and time t_2 . Then
1. $\frac{x_1}{x_2} = \frac{\alpha}{\beta} = \frac{t_1}{t_2}$ 2. $\frac{x_1}{x_2} = \frac{\beta}{\alpha} = \frac{t_1}{t_2}$ 3. $\frac{x_1}{x_2} = \frac{\alpha}{\beta} = \frac{t_2}{t_1}$ 4. $\frac{x_1}{x_2} = \frac{\beta}{\alpha} = \frac{t_2}{t_1}$
15. A body starts from rest and moves with uniform acceleration. If it attains velocity v in n seconds then its displacement in the last two seconds of its motion is
1. $2v\frac{(n-1)}{n}$ 2. $v\frac{(n-1)}{n}$ 3. $v\frac{(n+1)}{n}$ 4. $2v\frac{(n+1)}{n}$
16. A train starts from rest and moves with uniform acceleration α for some time and acquires a velocity v . It then moves with constant velocity for some time and then decelerates at a rate β and finally comes to rest at the next station. If L is the distance between two stations then the total time of travel is
1. $\frac{L}{v} + \frac{v}{2}\left[\frac{1}{\alpha} + \frac{1}{\beta}\right]$ 2. $\frac{L}{v} + \frac{v}{2}\left[\frac{1}{\alpha} - \frac{1}{\beta}\right]$ 3. $\frac{L}{v} - \frac{v}{2}\left[\frac{1}{\alpha} + \frac{1}{\beta}\right]$ 4. $\frac{L}{v} - \frac{v}{2}\left[\frac{1}{\alpha} - \frac{1}{\beta}\right]$
17. If S_1 , S_2 and S_3 are the distance covered by a body moving with uniform acceleration in consecutive equal intervals of time, the value of S_2 is
1. $\frac{S_1 + S_3}{2}$ 2. $\frac{S_1 - S_3}{2}$ 3. $\frac{S_1 + S_3}{4}$ 4. $\frac{S_1 - S_3}{4}$
18. A body moving in a straight line with uniform acceleration covers the distance S_1 and S_2 in successive intervals t_1 and t_2 respectively. Acceleration of the body is
1. $\frac{S_1t_2 - S_2t_1}{(t_1+t_2)t_1t_2}$ 2. $\frac{S_2t_1 - S_1t_2}{(t_1-t_2)t_1t_2}$ 3. $\frac{2(S_2t_1 + S_1t_2)}{(t_1+t_2)t_1t_2}$ 4. $\frac{2(S_2t_1 - S_1t_2)}{(t_1+t_2)t_1t_2}$

Motion in a straight line

19. Two trains A and B are travelling from station P to Q starting from P and stopping at Q. Train A has constant acceleration a for $(1/3)^{\text{rd}}$ of time, constant velocity for second $(1/3)^{\text{rd}}$ of time and constant retardation a for last $(1/3)^{\text{rd}}$ of time. Train B has same constant acceleration a for first $(1/3)^{\text{rd}}$ of distance, constant velocity for 2nd $(1/3)^{\text{rd}}$ of distance and constant retardation a for last $(1/3)^{\text{rd}}$ of distance. Find the ratio of time taken by train A and train B from P to Q.

1. $3\sqrt{3} : 5$ 2. $3 : 5$ 3. $3 : 2\sqrt{5}$ 4. $\sqrt{3} : \sqrt{2}$

20. The maximum acceleration or deceleration that a train may have is a . The minimum time in which the train may reach from one station to the other separated by a distance d is

1. $2\sqrt{\frac{d}{a}}$ 2. $\frac{1}{2}\sqrt{\frac{a}{d}}$ 3. $\sqrt{\frac{2d}{a}}$ 4. $\sqrt{\frac{d}{2a}}$

Key

1. 4
2. 4
3. 4
4. 1
5. 2
6. 1
7. 3
8. 4
9. 4
10. 2
11. 1
12. 1
13. 2
14. 2
15. 1
16. 1
17. 1
18. 4
19. 1
20. 1