

Session 30

Kinematics problems

1. A particle falls from rest and in the last second of its motion, it travels 70 m. Find the height from which it fell and the time of its fall. Take $g = 9.81 \text{ m/s}^2$.
2. The speed of an electric train is reduced from 60 km/hr to 40 km/hr while travelling a distance of 20 km. Find how much further it will travel before coming to rest.
3. A car starts from rest and accelerates uniformly to a speed of 72 km.p.h. over a distance of 500 m. Find acceleration of the car and time taken to attain this speed.
4. On turning a corner, a motorist rushing at 20 m/s, finds a child on the road 50 m ahead. He instantly stops the engine and applies brakes, so as to stop the car within 10 m of the child. Calculate (i) retardation, and (ii) time required to stop the car.
5. A motor car takes 10 seconds to cover 30 meters and 12 seconds to cover 42 meters. Find the uniform acceleration of the car and its velocity at the end of 15 seconds.
6. A bullet moving at the rate of 300 m/s is fired into a thick target and penetrates up to 500 mm. If it is fired into a 250 mm thick target, find the velocity of emergence. Take the resistance to be uniform in both the cases.
7. A stone is dropped from the top of a tower 50 m high. At the same time, another stone is thrown upwards from the foot of the tower with a velocity of 25 m/s. When and where the two stones cross each other?
8. A burglar's car had a start with an acceleration of 2 m/s^2 . A police vigilant party came after 5 seconds and continued to chase the burglar's car with a uniform velocity of 20 m/s. Find the time taken, in which the police van will overtake the burglar's car.
9. A stone is thrown vertically upwards with a velocity of 29.4 m/s from the top of a tower 34.3 m high. Find the total time taken by the stone to reach the foot of the tower.
10. A car moves along a straight line whose equation of motion is given by $s = 12t + 3t^2 - 2t^3$, where (s) is in metres and (t) is in seconds. Calculate (i) velocity and acceleration at start, and (ii) acceleration, when the velocity is zero.
11. A body starting from rest, moves along a straight line with an acceleration whose equation is given by: $a = 4 - t^2/9$
where a is in m/s^2 and t in seconds. Find (a) velocity after 6 seconds, and (b) distance traversed in 6 seconds.
12. A car moving with a velocity of 10 m/s shows down in such a manner that the relation between velocity and time is given by: $v = 10 - t^2 - t^3/2$
Find the distance travelled in two seconds, average velocity and average retardation of the car in these two seconds.
13. A body of mass 10 kg is moving over a smooth surface, whose equation of motion is given by the relation: $s = 5t + 2t^2$, where (s) is in metres and (t) in seconds. Find the magnitude of force responsible for the motion.

14. A balloon ascends with a uniform velocity of 3 m/s from the ground. At the end of 20 seconds, a particle is released from it. Find the time the particle takes to reach the ground.
 15. An automobile accelerates uniformly from rest on a straight level road. A second automobile starting from the same point 3 seconds later with zero initial velocity accelerates at 4 m/s^2 and overtakes the first automobile 400 m from the starting point. What is the acceleration of the first automobile?
 16. A ball is dropped from a height of 1 m on a smooth floor. The height of first bounce is 0.810 m. Determine (a) coefficient of restitution and (b) expected height after second bounce.
 17. The acceleration of a particle is given by $a = 30 - 4.5x^2$. The particle starts with no initial velocity at the position $x = 0$. Determine (a) the velocity when $x = 1.5$ m, (b) the position when velocity is again zero, and (c) position where velocity is maximum.
 18. A stone is dropped from the top of a tower. When it has fallen a distance of 10 m, another stone is dropped from a point 38 m below the top of the tower. If both the stones reach the ground at the same time, calculate (a) the height of the tower, and (b) the velocity of the stones when they reach the ground.
 19. A body is allowed to fall from the top of a tower. It falls through half the height in 2 seconds. What will be the total time to reach the ground?
 20. A car moves along a straight line whose equation of motion is given by $s = 12t + 3t^2 - 2t^3$, where s is in metres and t is in seconds. Calculate
 - (i) velocity and acceleration at start, and
 - (ii) acceleration, when the velocity is zero.
 21. A stone dropped into a well is heard to strike the water after 4 seconds. Find the depth of well, if the velocity of sound is 350 m/sec.
- A stone is thrown vertically upwards with a velocity of 29.4 m/s from the top of a tower 34.3 m high. Find the total time taken by the stone to reach the foot of the tower.