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SSC

Physics Chapter: 02 (Motion)

Concept Part

Motion: A body is said to be in motion with respect to its surroundings when it changes its position with time. And this change of position with time is called motion.

Rest: An object is said to be at rest if it does not change its position with respect to its surroundings with time.

Reference Point: The point with respect to which the displacement of an object is measured is called a reference point.

Displacement: The change in the position of an object along a definite direction with time is called displacement of that object.

Distance: Distance is the total movement of an object without any regard to direction.

Vector Quantity: Physical quantities which require both magnitude and direction to be expressed are called vector quantities.

Scalar Quantity: Physical quantities that can only be fully expressed by magnitude are called scalar quantities.

Velocity: Velocity is the rate of change of displacement with time.

Speed: Speed is the rate of change of distance with time.

Instantaneous Speed: Speed is the rate of change of distance with time, when the time is specific the speed is called instantaneous speed.

Uniform Velocity: When an object travels the same distance every second, the velocity of that object is called uniform velocity.

Acceleration: The rate of change of velocity of a moving object is called acceleration.

Retardation: The rate of decrease in velocity of a moving body is called retardation.

Acceleration due to gravity: The rate of change of velocity of a freely falling body on Earth due to the force of gravity is called acceleration due to gravity.

Formula

1. $v = u + at$
2. $s = (\frac{u+v}{2})t$
3. $s = ut + \frac{1}{2}at^2$
4. $v^2 = u^2 + 2as$

(These 1-4 formulas are only for uniform acceleration)

5. for uniform velocity, $s = vt$
6. $T = \frac{2u}{g}$
7. $H = \frac{u^2}{2g}$

s/h= displacement/height
u = initial velocity
v = final velocity
a = acceleration
g = gravity
t = time
H = Maximum height

*For free falling object (1-4) s=h and a=g

8. $v = u + gt$
9. $h = (\frac{u+v}{2})t$
10. $h = ut + \frac{1}{2}gt^2$
11. $v^2 = u^2 + 2gh$

*when the object is thrown upward then (1-4) s=h and a= $-g$,

12. $v = u - gt$
13. $h = (\frac{u+v}{2})t$
14. $h = ut - \frac{1}{2}gt^2$
15. $v^2 = u^2 - 2gh$

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Mathematical Problems

1. A deer is running with a uniform 72 km/h velocity. In the meantime a tiger started chasing the deer from 72m behind with uniform acceleration 1.5ms^{-2} for 30s. Is it possible for the tiger to catch the deer? Give your opinion with a mathematical analysis.
2. A truck moves from rest with a uniform acceleration of 2 ms^{-2} for 40 s. Determine the distance.
3. An object from rest travels a distance of 50 m in 5 seconds with uniform acceleration. Determine the acceleration.
4. A motorcycle driver starts to move with a uniform acceleration of 2 ms^{-2} when he sees a bi-cycle moving with a uniform velocity of 18 ms^{-1}, at that time the cycle is 81 m behind the motorcycle. The initial velocity of the motorcycle is zero.
i) When does the velocity of the motorcycle and by-cycle become equal after starting?
ii) In their way motor-cycle and by-cycle will meet with each other only once. Explain.
5. A boy dropped a ball from the rooftop of a building a height of 19.6 m, The ball took 2s to touch the ground from the rooftop. Determine the acceleration of a freely falling body.
6. An object was dropped from the top of a building the height of which was 180 m, At the same time another body B was thrown up straight with a velocity of 60 ms^{-1}.
i) What will be the height of B object after 5s?
ii) Where will A and B meet? Show it mathematically?
7. When a rat was 15m ahead of a cat. The cat started running to catch the rat with a uniform acceleration of 2 ms^{-2}. The rat was running with a uniform velocity of 14 ms^{-1}.
i) Find out the time when the velocity of the cat will be equal to that of the rat.
ii) Will the cat be able to catch the rat? Explain mathematically.
8. An object is thrown upward from the earth at a speed of 100 ms^{-1}, How much height will it attain at how much time? Explain.
9. A bus driver sees a pedestrian at a 46 m distance when the bus is at 54 km/h of velocity. The driver holds the break instantly to save the pedestrian and the bus stops near the distance of 1m only, then find the acceleration of the bus.
10. A bus while moving with 32 ms^{-1} uniform velocity, saw that another bus was moving from its rest position with 4ms^{-2} acceleration, the bus was 80m in front of the 1st bus.
i) Find out the traveling distance of the 2nd bus after 15 s.
ii) When will the buses meet with one another? Explain mathematically.