Q10. A ball is thrown upwards with a velocity v from a height h above the ground. What is the time taken for the ball to reach the ground?

Q11. From the top of a tower two stones are thrown with the same initial speed. One directed downward takes a time t_1 to hit the ground. The other, directed upward, takes time t_2 to hit the ground. Find the height of the tower?

Q12. A ball dropped from the top of a building takes 0.5 s to clear a window of height 5 m. What is the height of building above the window?

Q13. A ball is dropped into a lake from a height of 5 m above the water surface. It is known that the ball sinks in the water with constant velocity. It touches the bottom 5 s after being dropped. How deep is the lake? If the lake was dry then with what velocity the ball should be thrown so that it hits the bottom in 5 s?

Q14. Two ships are 10 km apart on a vertical line. The ship on the north moves west-wards at 40 km/hr. The other is moving north-wards at 40 km/hr. What is the closest distance between them & at what time it happens?

Q15. A man can swim in still water at the speed of 3 km/hr. He wants to cross a 500 m wide river flowing at 2 km/hr. He keeps himself always at an angle of 120° with the stream direction. What is the time he takes to cross the river and what is his drift?

Q16. A man running on a horizontal road at 8 km/hr observes rain to be falling vertically. If he runs at speed to 12 km/hr he finds the rain to be falling at angle of 30° with the vertical. What is the true velocity of the rain drops?

Q17. A river flows from West to East at a speed of 5 m/min. A man on the south bank of the river capable of swimming at 10 m/min in still water wants to swim across in the shortest possible time. What should be his direction of swimming?

Q18. Two cars A & B travel in the same direction with velocities v_a & v_b ($v_a > v_b$). At the moment when the car A is at distance s behind the car B its driver starts braking with a deceleration a. What is the condition to avoid a collision?

Q19. A swimmer crosses a flowing stream of width w to and fro in time t_1. The time taken to cover the same distance up and down the stream is t_2. If t_3 is the time the swimmer would take to swim a distance $2w$ in still water then find the relation between all the three t's.

Shrinivas Academy

IXth - Physics Foundation Batch.

Physics Tutorial Sheet No. 1.2 (Kinematics of a Particle)

By Sanjeet Singh Adarsh (9822793601 sadarsh@iitbombay.org)

Q1. A particle starts from rest with a constant acceleration and at time t its speed is found to be 100 m/s and one second later it becomes 150 m/s. What is the distance covered in the $(t+1)^{th}$ second?

Q2. A train starting from rest with a constant acceleration α reaches a speed v, then remains at this speed for some time and then starts braking to a stop, with a constant deceleration of β. What is the total time taken if it has covered a distance of l during the entire motion?

Q3. A particle moving on a straight line with uniform acceleration covers distances a & b in successive time intervals of t_1 & t_2 respectively. What is its acceleration?

Q4. A particle travels half of a certain distance with a velocity v_o. The remaining distance is covered with velocity v_1 for half of the time & with v_2 for the other half of the time. Find the average velocity of the particle for its entire journey?

Q5. A body starts with an initial velocity of 10 m/s and travels along a straight line with a constant acceleration. When its speed reaches 50 m/s the acceleration direction is just reversed. Find the velocity of the particle when it crosses the start point back again.

Q6. A driver having a fixed reaction time can stop his car over a distance of 30 m if its speed was 72 km/hr. If the speed was 36 km/hr then the stopping distance would be 10 m. What is the stopping distance if the car moves at 54 km/hr?

Q7. Two particles move with constant velocities $\boldsymbol{v_1}$ & $\boldsymbol{v_2}$. At the initial moment their position vectors are $\boldsymbol{r_1}$ & $\boldsymbol{r_2}$. How these four vectors must be related so that the particles collide with each other?

Q8. A body starts moving with a constant acceleration on a straight line path and moves for a time t_o. Then the acceleration is suddenly reversed in direction. Find the time when the body crosses the start point again.

Q9. Two cars start off to race with velocities u_1 & u_2 and accelerations of a_1 & a_2. If the race ends in a *dead heat* find the length of the race track.

Q10. A man 48 m behind a bus starts moving with a constant velocity of 10 m/s to catch the bus which starts accelerating at the same instant with 1 m/s^2. What is the minimum time in which the man can catch the bus?

Q11. A body starts moving on a straight line path with alternate acceleration & retardation of magnitudes a & r respectively during equal intervals of time t. Find the distance travelled by the body by the end of $2n$ such intervals.

Q12. In a car race the car A takes time t lesser than car B to cross the finish point & has a velocity v more than the velocity with which B crosses the finish point. Assuming that they start from rest and have constant accelerations of a_1 & a_2 express v in terms of the other 3 quantities.

Q13. Two points start moving towards each other with initial velocities of v_1 & v_2 and they have accelerations of a_1 & a_2 respectively which are directed against their initial velocity directions. For what maximum initial separation they can still meet each other during the journey?

Q14. A particle moves with constant acceleration. If v_1, v_2 and v_3 are the average velocities in the three successive intervals t_1, t_2 and t_3 of time, then find the correct relation between these six quantities.

Q15. A particle moves on a straight line with some constant acceleration. Its displacement from the origin at three time instants (which are in Arithmetic Progression of common difference d) are s_1, s_2 and s_3. If these displacements are in Geometric Progression, then find the acceleration of the particle.

Q16. Two bodies start moving from a point on a straight line. One moves with a constant velocity of u and the other with a constant acceleration of a. What is the maximum separation between them, before the instant the following body catches up with the leading one?

Q17. The driver of a train moving at the speed v_1 sees another train in front of him on the same track moving ahead at the speed of v_2 ($v_2 < v_1$). He immediately apply brakes to his train and gets a constant deceleration of magnitude a. Find the minimum initial separation required between them to avoid collision?

Q18. A train is moving with constant acceleration. The two ends of the train pass through a point on the track with velocities v_1 & v_2. With what velocity the mid point of the train passes through the same point?

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Physics Tutorial Sheet No. 1.3 (1-D Motion under Gravity & Relative Velocity)

By Sanjeet Singh Adarsh (9822793601 sadarsh@iitbombay.org)

Take $g = 10\ m/s^2$ wherever necessary.

Q1. A stone is dropped from a balloon going up with a constant velocity of 5 m/s. If the balloon was at a height of 50 m when the stone was dropped find its height when the stone hits the ground.

Q2. A particle is projected upwards from point A on the ground. At time t_1 it crosses a point B and continues to move upwards. It takes further time t_2 to reach the ground finally. Find the height of the point B & the maximum height reached by the particle.

Q3. A balloon is ascending with an acceleration of 0.5 m/s^2. A stone is dropped from the balloon and after 2s another stone is dropped. Find the separation between the stones 2s after dropping the second stone?

Q4. Water drops are falling from a 16 m high roof at regular intervals. The first drop touches the ground when the fifth drop is just starting from the roof. Find the separation between the drops when the first one hits the ground.

Q5. Two bodies start falling freely from the same height, the second body being released t seconds after the first. How long after the first started falling, the distance between them will be equal to l?

Q6. A stone is dropped from a height h. With what velocity another stone should be thrown upwards, at the same instant, so that the two meet at a height $2h/3$?

Q7. A balloon at rest on the ground, starts rising upward with constant acceleration a. After t_o seconds a stone is dropped which hits the ground after t seconds. Find the value of t?

Q8. A stone falls freely from rest and the distance covered by it in the last second of its motion equals the distance covered by it in the first three second of its motion. What is the total time of motion of this stone?

Q9. A boy sitting on the top corner of a tall building drops a ball downwards. 2 seconds later he drops the second ball. Then 3 seconds later he drops the third ball. Then 4 sec later he drops the fourth ball and so on…. What is the distance between the first and third ball, when he drops the fifth one?