Tutorial #1: (Motion along one and two dimensions)

Please try and complete the first 4 problems before attending the online lecture.

Problem #1 (Displacement, time and average velocity)

Starting from a pillar, a boy runs $200m$ east at an average speed of $5.0m/s$ and then runs $280m$ west at an average speed of $4m/s$ to a post. Calculate the following.

a. the boy's average speed from pillar to post and (Ans: 4.4 m/s)

b. his average velocity from pillar to post (Ans: -0.73m/s)

Problem #2 (Instantaneous velocity)

A car is stopped at a traffic signal. It then travels along a straight road such that the distance from the light is given by $x(t) = bt^2 - ct^3$, where $b = 3.00m/s^2$ and $c = 0.110m/s^3$. Calculate the following.

a. the average velocity of the car for the time interval $t = 0s$ to $= 10.0$ (Ans: 19.0m/s)

b. the instantaneous velocity of the car at $t = 0s$, $t = 5.0s$ and at $= 10.0$ (Ans: 0, 22.0 m/s, 27.0 m/s)

c. how long after starting from the rest is the car again at rest? (Ans: 18.2s)

Problem #3 (Motion with constant acceleration)

A deer is moving with a constant acceleration and covers a distance 66.0 m between 2 points in 6.70s. Its speed as it passes the second point is 14.4m/s.

a. What is the speed of the deer at the first point? (Ans: 5.3m/s)

b. What is its acceleration? (Ans: 1.3m/s^2)

Problem #4 (Motion with constant acceleration)

In the fastest measured tennis serve, the ball left the racquet at $73.14m/s$. A served tennis ball is typically in contact with the racquet for 29.0ms and starts from rest. Assume constant acceleration.

a. What was the ball's acceleration during the serve? (Ans: 2,522m/s^2)

b. How far did the ball travel during the serve? (Ans: 1.06m)

Problem #5 (Free falling bodies)

A small rock is thrown vertically upward with a speed of $18.00 m/s$ from the edge of a roof of $37.0 m$ tall building. The rock does not hit the building on its way back down and lands on the street below. Ignore air resistance.

a. What is the speed of the rock just before it hits the street? (Ans: -32.4m/s)

b. How much time elapses from when the rock is thrown until it hits the ground? (Ans: 5.14s)

Problem #6 (Free falling bodies)

A tennis ball on Mars where the acceleration due to gravity is $0.379 g$ and air resistance is negligible is hit directly upward and returns to the same level $7.5 s$ later.

a. How high above the original point did the ball go? (Ans: 26.1m)

b. How fast was it moving past just after it was hit? (Ans: 13.9m/s)

Problem #7 (Projectiles)

A ball is thrown horizontally from the roof of a building 9.0 m tall and lands 9.5 m from the base. What was the ball's initial speed? (Ans: 7m/s)

Problem #8 (Projectiles)

A projectile is fired with an initial speed of 46.6 m/s at an angle of 42.2^0 above the horizontal on a long flat firing range. Determine the following.

a. Maximum height reached by the projectile. (Ans: 50m)
b. The total time in the air. (Ans: 6.39s)
c. The horizontal distance covered (that is the range). (Ans: 221m)
d. The velocity of the projectile 1.5 s after firing. (Ans: 38.3 m/s; angle is 25.7 deg above horizontal)

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