Kinematics Team Problems

Fun With Fiziks

July 5, 2022

Practice Problems

1. Luke is driving at $9\ m/s$ and suddenly realizes that there is a red light ahead. He is $5\ m$ from the light. He brakes and comes to a stop just in time. What is his acceleration?

2. Jonathan sees Lilian $10\ m$ ahead of him and decides to run up to her. Initially, Lilian is walking at $2\ m/s$ and Jonathan is walking at $1\ m/s$. Jonathan starts running with an acceleration of $3\ m/s^2$. Because he is so loud, Lilian instantly notices and runs with an acceleration of $2\ m/s^2$. How long does it take for Jonathan to reach Lilian?

3. For their physics project, Jonathan and Andrew decide to investigate the kinematics behind shooting a basketball. Assume there is no air resistance. Also, assume that the basketball goes in if it touches the top of the hoop.

   (a) Jonathan throws the basketball to Andrew, who is standing $10\ m$ away. He throws the ball at $2m/s$, at an angle of $30°$ to the horizontal. Does the ball reach Andrew?

   (b) Andrew stands $4\ m$ away from the hoop to shoot a free throw. The hoop is $3\ m$ tall. If Andrew is $1.5\ m$ tall and shoots the ball at an angle of $60°$ to the horizontal, what speed is required to make it?

   (c) Giannis once threw a basketball at Harden's face. Jonathan, being a big fan, wants to recreate this with Andrew, who stands $5\ m$ away. Jonathan accidentally chucks the basketball at Andrew with a speed of $10\ m/s$ at an angle of $10°$ to the horizontal. If Andrew's reaction time is $0.15\ s$, does he dodge the ball in time?

4. A ball is bouncing vertically between a floor and ceiling, which are both horizontal and separated by $4\ m$. The ball starts from the ground and bounces up towards the ceiling at $12\ m/s$. How long does a complete up-down cycle take?

5. Chris wants to take the train to get from city A to city B. The distance between the cities is s. The train's maximal acceleration is a_1 and its

maximal deceleration is a_2 (in absolute value). What is the shortest time in which the train can travel between A and B?

6. Justin played many carnival games at the fair. One game involves throwing a ball and bouncing it off of a wall into a basket. After many valiant attempts, he has concluded that it is physically impossible. To be fair, this may or may not be a true statement. Given the setup of the game shown below, determine if Justin is correct or if he just has to get better. If he is correct, find v_0 and θ so that the ball goes in.