

2D Motion Problems

1. In a movie stunt, a motorcyclist is trying to jump from one building to another without the use of a ramp. The first building is 5 meters taller than the second building. Assuming that she can get her motorcycle up to 20 m s^{-1} immediately before the jump, determine the longest horizontal separation between buildings for which she can be successful.

2. A WWII bomber is flying at a height of 25000 m with a velocity of 100 m s^{-1} . It is going to drop a bomb on a factory.

- Calculate at what horizontal distance from the factory the bomber must release the bomb.
- Calculate the bomb's final velocity when it hits the factory.

3. Andre, the human cannonball is launched with a velocity that has an x-component of 10 m s^{-1} . He lands softly 40 meters from the launch point in the safety net that is at the same height as the end of the cannon.

- Determine his initial vertical velocity.
- Sketch Andre's path. For each second, show the x and y components of velocity and acceleration. (This is a 2-d motion diagram.)

4. Juna kicks a soccer ball towards the goal from 15 meters away. The initial velocity of the ball is 25 m s^{-1} at 15 degrees above the ground.

- Calculate how long the goalkeeper has to react and move to the ball.
- Calculate how high above the ground the ball will be when it passes the goalkeeper.

5. Kyle throws a baseball 25 meters horizontally to Zayd. He releases the ball with a speed of 30 m s^{-1} at an angle of 7 degrees above the horizontal.

- Calculate the initial horizontal and vertical velocities of the ball.
- Calculate how long is the ball in the air.
- Determine where the ball is compared to the release height when it is caught.
- Calculate the final velocity vector of the ball.

6. During a water polo match, Isaac shoots from 5 meters in front of the goal. He releases the ball 0.5 meters above the water with the intention that it will skip off the water right at the goal line. Determine the speed he must throw the ball if he releases it horizontally.

7. A stunt bike leaves a ramp at 30 m s^{-1} . The ramp is 3.0 meters above the ground and angled at 40 degrees above the horizontal. Determine how far the motorcycle will travel horizontally before it lands on the ground.

8. Chris hits a 7 iron to a green (platform) that is 10.0 meters above and 130 meters horizontally away from the launch position. The initial direction of the ball is 40 degrees above the horizontal.

a. Calculate the initial velocity of the ball.

b. Determine the "flat" distance for the shot. (Calculate how far horizontally the ball would have traveled if it had returned to the launch height).