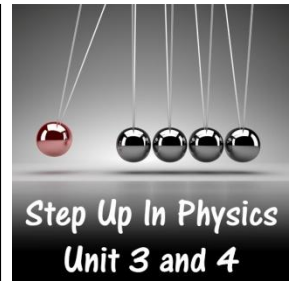


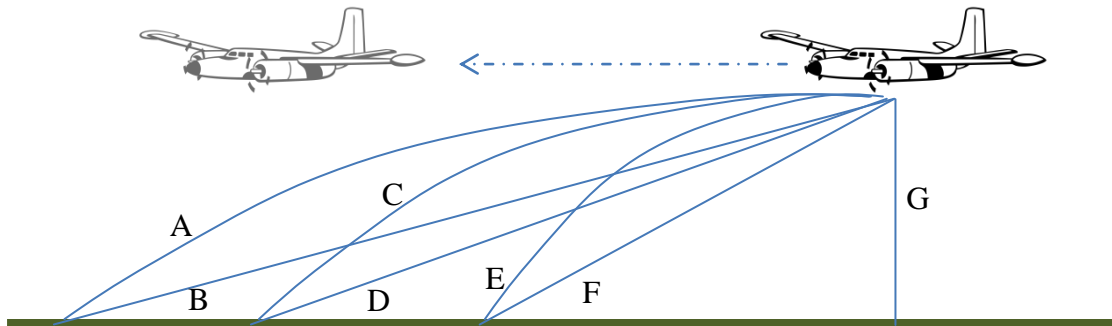
# Projectile Motion

## Problems Worksheet

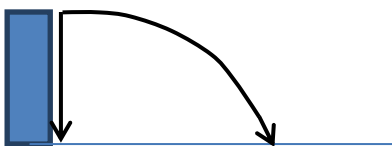


For all questions, ignore the effects of air resistance unless otherwise stated.

1. One of the landing gears falls off a plane that is flying horizontally with a constant velocity. Which of the following paths correctly represents the motion the landing gear will follow?

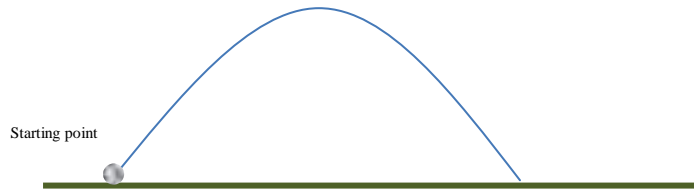


2. “At the peak of its path towards the hoop, a basketball has zero velocity,” Paula phrased in the middle of her Physics speech. Explain why you either agree or disagree with this statement.
3. Simone is throwing stones horizontally off the top of a small cliff into a river below. During one such throw, she accidentally taps a stone so it falls straight off the cliff. Approximating that both stones were at the same initial height above the water, explain which stone would hit the water first.



4. To combat a bush fire, a water bombing aircraft is flying horizontally at  $180 \text{ ms}^{-1}$  and 700 m above the ground. Calculate how far ahead of the fire the pilot should release the water.
5. A golf player hits a golf ball with an initial velocity of  $45.0 \text{ ms}^{-1}$  angled at  $32.0^\circ$  above the horizontal.
- Calculate the time the ball takes to reach its maximum height.
  - Calculate the maximum height achieved by the ball.
  - Calculate the horizontal displacement of the ball when it lands.
6. Two pirate ships are battling over a prized cargo ship. Pirate ship one fires cannonballs with a velocity of  $110 \text{ ms}^{-1}$  at an angle of  $18^\circ$  above the horizontal which successfully hit the second pirate ship. Calculate the distance between the two pirate ships.

7. Professional golfers are experts at adjusting their shots based on the wind conditions of the day. In truth, all players are affected by air resistance even on a very still day. The diagram below shows the path a golf ball takes in a vacuum.
- a. Over the top of this diagram draw in the path the golf ball would take when air resistance is a factor.



- b. Explain how you determined your answer to part (a).

8. During a castle siege in medieval times, the archers on the castle's walls had an advantage because they fired their arrows from an elevated position. A recurve bow is capable of firing arrows with a speed of  $60 \text{ ms}^{-1}$ . If the castle's archers shot their arrows from a  $12.0 \text{ m}$  elevation above the ground and an angle of  $22.0^\circ$  above the horizontal:
- a. Calculate the maximum height the arrows reach above the ground.

- b. Calculate the horizontal displacement achieved by the arrows.

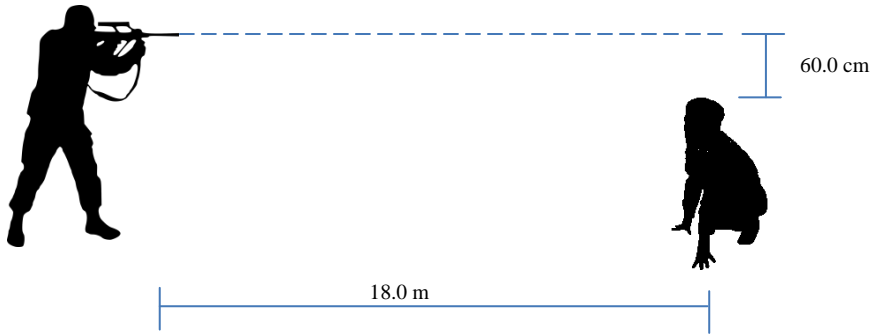
9. A basketball player successfully shoots the ball through the hoop. The ball was shot from 1.90 m above the ground and the hoop is 2.80 m above the ground. The basketball was shot at an angle of  $65.0^\circ$  and the ball was in the air for 0.850 s.
- Calculate the initial speed of the ball as the player took the shot.

- Calculate the displacement of the hoop as measured from the initial position of the ball.

10. To win the game, a golfer needs to chip the ball into the 18<sup>th</sup> hole which is located along the same horizontal plane as the ball at a distance of 9.50 m. After a beautiful swing, the ball sails through the air and lands straight in the hole. If the ball was hit with a velocity of  $14.2 \text{ ms}^{-1}$ , calculate the angle the ball was initially launched at. You may use the trigonometric identity;  
 $2\cos\theta\sin\theta = \sin 2\theta$

11. A paintball gun uses compressed air to fire paintballs at high velocities. This however is not enough to make the acceleration due to gravity negligible which causes the paintball to drop as it flies through the air. The best players realise this and adjust their aim to compensate.

Noah wants to hit Peter who is crouched down 18.0 m, in horizontal direction, away from Noah. The muzzle of Noah's gun is 60.0 cm above the tip of Peter's head. Noah aims his paintball gun above the horizontal so that the initial vertical velocity of the paintball is  $2.00 \text{ ms}^{-1}$ . The paintball just grazes the tip of Peter's head. Calculate the initial velocity of the paintball.



12. The optimum angle to launch a projectile to achieve the maximum horizontal displacement along a flat surface is  $45^\circ$ . Show this is true using relevant equations of motion and the trigonometric identity;  $2\cos\theta\sin\theta = \sin 2\theta$