Projectile Motion

1. An archerfish hunts by dislodging an unsuspecting insect from its resting place with a stream of water expelled from the fish's mouth. Suppose the archerfish squirts water with an initial speed of 2.30 m/s at a beetle on a leaf 3.00 cm above the water's surface.
   (a) If the fish aims in such a way that the stream of water is moving horizontally when it hits the beetle, what is the launch angle?
   (b) How much time does the beetle have to react?
   (c) What is the horizontal distance between the fish and the beetle when the water is launched?

2. The great, grey-green Zambezi River flows over Victoria Falls in south central Africa. The falls are approximately 108 m high. If the river is flowing horizontally at 3.60 m/s just before going over the falls, what is the speed of the water when it hits the bottom? Assume the water is in free-fall as it drops.

3. A mountain climber jumps a 3.0-m wide crevasse by leaping horizontally with a speed of 8.0 m/s.
   (a) If the climber's direction of motion on landing is 45^0 below the horizontal, what is the height difference between the two sides of the crevasse?
   (b) Where does the climber land?

4. A golfer gives a ball a maximum initial speed of 30.0 m/s.
   (a) What is the longest possible hole in one for this golfer?
   (b) What is the minimum speed of the ball during this hole-in-one shot?
   (c) What is the highest tree the ball could clear on its way to the hole in one?

5. A hot air balloon rises from the ground at the rate of 2.0 m/s. A champagne bottle is opened to celebrate takeoff, expelling the cork with a speed of 5.0 m/s. When opened, the bottle is pointed horizontally and is 6.0 m above the ground.
   (a) What is the initial velocity of the cork, as seen by an observer on the ground?
   (b) Determine the maximum height above the ground attained by the cork.
   (c) How long does the cork remain in the air?

6. A swimmer runs horizontally off a diving board with a speed of 2.50 m/s, and hits the water a horizontal distance of 1.96 m from the end of the board.
   (a) How high above the water was the diving board?
   (b) If the swimmer runs off the board with a reduced speed, does it take more, less, or the same time to reach the water?

7. On August 25, 1894, Chicago catcher William Schriver caught a baseball thrown from the top of the Washington Monument (555 feet, 898 steps, 169.16 m).
   (a) If the ball was thrown horizontally from the top of the 555-foot (169.16 m) monument with a speed of 5.00 m/s, where did it land?
   (b) What was the ball's speed and direction of motion when caught?

8. On a hot summer day, a young girl swings on a rope above the local swimming hole. When she lets go of her rope, her initial velocity is 2.25 m/s at an angle of 35.0^0 above the horizontal. If she is in flight for 1.60 s, how high above the water was she when she let go of the rope?

9. A soccer ball is kicked with an initial speed of 10.2 m/s in a direction 25.0^0 above the horizontal. Find the magnitude and direction of its velocity at (a) .250 s and (b) .500 s after being kicked. (c) Is the ball at its greatest height before or after .500 s? Explain.