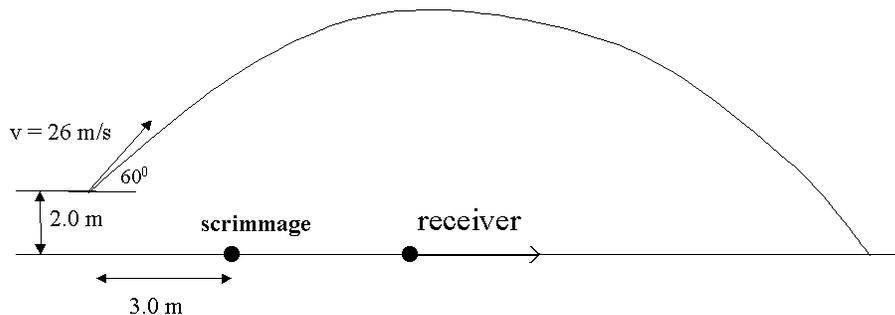


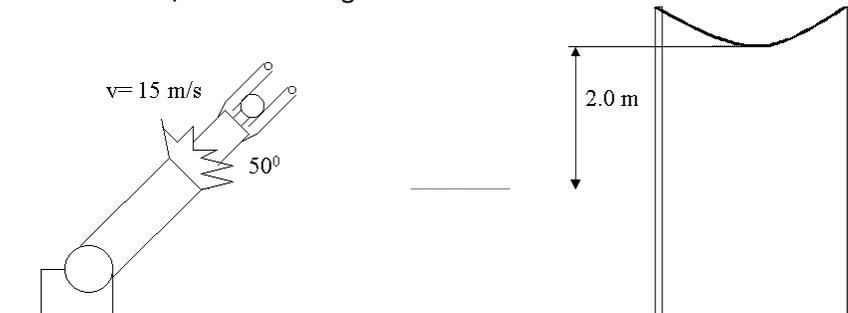
Projectile Motion Problems

Problem

- A shell is fired from a cliff that is 36 m above a horizontal plane. The muzzle speed of the shell is 80.0 m/s and it is fired at an elevation of 25° above the horizontal.
 - Determine the horizontal range of the shell.
 - Determine the velocity of the shell as it strikes the ground.
- A football quarterback attempts a pass to one of the receivers. As the ball is snapped, the receiver leaves the line of scrimmage and runs directly down field. The quarterback releases the ball 2.0 s later and from a position 3.0 m behind the line of scrimmage. He throws the ball with a speed of 26 m/s at an elevation of 60° above the horizontal. The receiver makes a diving reception, catching the ball just as it reaches the ground. See the diagram below.



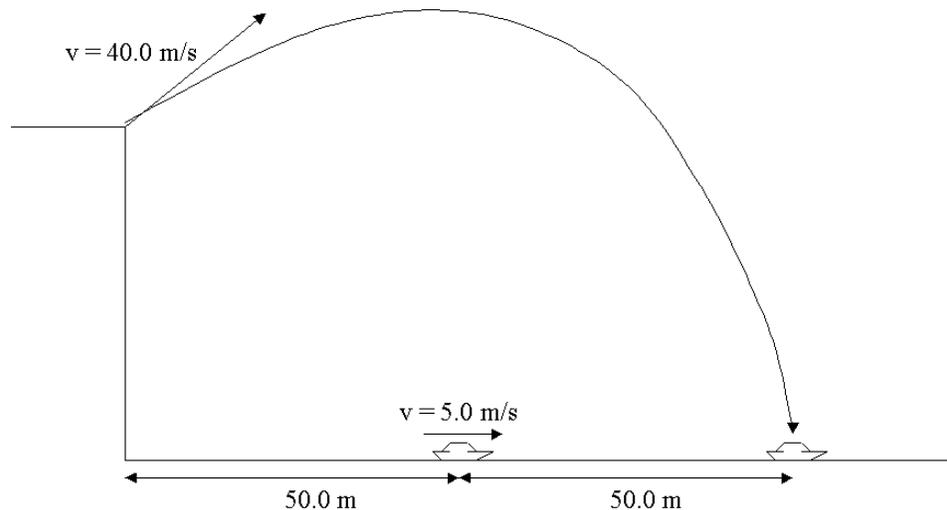
- What is the time of flight of the football?
 - What is the average speed of the receiver?
- A circus clown is fired from a canon into a net that is situated 2.0 m above the cannon and some distance from it. The cannon is elevated at 50.0° to the horizontal and the clown's speed at launch is 15 m/s. See the diagram below.



- Find the horizontal distance from the cannon where the net needs to be placed in order for the clown to land in it.
- Calculate the clown's velocity as he lands in the net.

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4. A boat is 50.0 m from the base of a cliff, fleeing at 5.0 m/s. A gun, mounted on the edge of the cliff fires a shell at 40.0 m/s and hits the boat when it has fled another 50.0 m. See the diagram below.



- (a) At what angle above the horizontal must the gun be aimed so that the shell will hit the target?
(b) How high is the cliff?
(c) With what velocity does the shell hit the boat?
5. A baseball is hit by a bat and given a velocity of 40.0 m/s at an angle of 30.0° above the horizontal. The height of the ball above the ground upon impact with the bat is 1.0 m.
- (a) What maximum height above the ground does the ball reach?
(b) A fielder is 110.0 m from home plate when the ball is hit and the ball's trajectory is directly at him. If he begins running at the moment the ball is hit and catches the ball when it is still 3.0 m above the ground, how long does he run before catching the ball?
(c) How fast (average speed) does he have to run in order to catch the ball?

Essay

6. A baseball player is running with the ball and throws to first base in an attempt to get the runner out. Describe the considerations the player must take into account in order to be successful. Your approach should include both projectile motion and relative motion principles.