Hit the Teacher

In this lab, you will have to apply your knowledge of two-dimensional kinematics to predict where a water balloon will land. You will also need to apply Newton’s 2nd Law and Hooke’s Law to determine your launch velocity of your balloon. If you are successful, you might be lucky enough to hit your teacher.

Water Balloon Launcher

Water Balloon

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You should immediately see that determining where the water balloon will land in this particular problem is multifaceted. You will first need to determine the average force and acceleration of the water balloon by using an understanding of Hooke’s Law and Newton’s 2nd Law of motion. Once you know the distance over which the acceleration occurs, you will then have your launch velocity. From this point forward, the water balloon will behave as a projectile where you will need to use your kinematics equations to solve.

objectives

* Use an understanding of Hooke’s Law to determine the average force that acts on the water balloon while it is being launched.
* Use Newton’s 2nd Law of motion to determine the net force acting on the balloon so that the launch velocity can be determined.
* Apply 2-dimensional kinematics to determine the impact point of your water balloon.

Materials

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| --- | --- |
| Bam Water Balloon Launcher | Spring scale |
| Water balloons | Table for ramp. |
| Tape measure | Chair for teacher |
| Football field | Rain gear for teacher |
| 2 meter sticks (for angle determination) |  |

Preliminary questions

1. a. Draw a free-body diagram for the balloon as it being propelled up the ramp.

b. Draw a free-body diagram for the balloon as it travels trough the air.

1. What force(s) act parallel to the incline?

Procedure/Predictions:

1. What is your given value for tension?
2. Using your value in No. 1 above, what is the average force acting on the balloon and pouch? *You may assume that there will be a 10-15% loss due to friction.* However, you are welcome to get an estimate of it if you would like.
3. Measure the distance over which an unbalanced force acts on the water balloon and pouch of the launcher.

1. Determine the angle of the launch ramp (table):
2. Determine the acceleration of the water balloon and pouch (Yes, this requires a calculation).
3. Determine the launch velocity of the water balloon (Another calculation required).
4. Determine the impact point (horizontal distance) where you would like your teacher to sit (It is at this point where you will apply your knowledge of 2D kinematics to make your prediction).

1. Test prediction.
2. Measure the horizontal and vertical distance by which you missed your target (that is if you failed).

Horizontal Error: Vertical Error:

Data Summary & Analysis:

1. Your goal in this experiment was to successfully predict where a water balloon would land.
   1. What was your displacement from your predicted impact point?
   2. If we did not account for friction, how would the horizontal distance have changed?

Error Analysis:

What were the sources of error in this laboratory investigation?

Conclusion:

Discuss your success and whether or not you accomplished your goal (that would be hitting the teacher).