Momentum Challenge Lab

Physics 40 & 41

A change in momentum of an object (a water balloon) is caused by an applied force over an amount of time. If we wish to minimize the force, we must maximize the total amount of time it acts over. In this lab you will measure the momentum of a water balloon, and attempt to minimize the force applied to it when being caught. Otherwise…. You may get a little wet.

For this lab you will need groups of *four*. Each partner should be assigned a job:

1. Thrower/measurer
2. Catcher
3. Timer #1 (balloon in air)
4. Timer #2 (balloon being caught)

Procedure:

1. Get the mass of your water balloon. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**kg**
2. Have the catcher stand still. The thrower/measurer should measure a distance away from them, and stand there. (at least three meters) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**m**
3. One timer should time the period where the balloon is in the air (no hands touching it). The second timer should time the period where the balloon is being caught.   
   T1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**s** T2­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**s**
4. Calculate the velocity of the balloon using d/t1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**m/s**
5. Calculate the momentum of the balloon using p=m\*v \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**kg\*m/S**
6. Find the change in momentum of the balloon, knowing that the balloon’s final velocity was zero. Δp=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kg\*m/s
7. Find the force exerted on the balloon to change its momentum using the equation F=Δp/Δt2. F=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_N
8. Use this same procedure at at least five increasing distances, or until the balloon breaks. Fill out all information on the data table on the back of this sheet.
9. Complete the group write up on the back of this page. Hand in one of these pages and one write up per group.

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| --- | --- | --- | --- | --- | --- |
| Distance | Time 1  (in air) | Time 2  (being caught) | Velocity | Δp | F |
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Calculations:

Questions for group write up.

1. Did your water balloon break during the lab? Why or why not?
2. Why was the balloon less likely to break when the catcher moved their hands backwards, “giving” with the balloon when they caught it?
3. Can you think of an application of this concept in the real world?

Your write up should be one page, double spaced.