IB Physics

Measuring the Initial Velocity of an Air Rocket

You can measure the initial velocity of an air rocket by firing it straight up into the air and timing how long it takes to reach the earth again. **If you need help with this there is a website for this lab with videos**

Materials:

1. Get a launch platform, a bicycle pump, a nose cone, a rocket body, and four different sizes of thrust washers. (Super, High, Medium, and Low) Locate yourself at least 30 feet from the nearest group, or hard surface.

Design

2. Your goal is to measure the initial velocity of the air rocket as it leaves the launch pad from the time it is in the air. This is tricky because the launch is always unpredictable – so the timer's reaction time introduces a **systematic** error. Clever students estimate this error and add it to the average of time. You need to decide how many trials of each washer to do, how to time, and how to correct for the timer's reaction time. There is also random trial to trial error. (Not every launch is the same.) **Write a brief sentence on how you dealt with this systematic error**

Data Collection and Processing

3. •**Create a nice data table for your raw data.** Include in your table **labels**, **units** and **uncertainty**. You will have to calculate the uncertainty for each washer from the trials. The uncertainty for multiple trials of a washer is $\pm\frac{range}{2}$ where the range is Max-Min. This trial to trial error is actual **random** error intrinsic to the timing method and the apparatus itself.

Your data table should: •be a **table** (draw lines around it) •have the **units** labeled •have the **uncertainty** of each thrust washer's data in it. Watch the online videos if this makes no sense to you.

4. •Calculate one initial launch velocity from the **average** of your trials for each washer. It would be appropriate to add the timer's reaction time to the average to arrive at the total time the rocket is in the air. (Remember – at ½ **the total time** in the air the final velocity is 0, so you know v, a and t) •Show each of these calculations.

5. •Also **calculate the uncertainty of this velocity** from the uncertainty of time.

(use the relation $\frac{\Delta u}{u}=\frac{\Delta t}{t}$ - that the fractional uncertainty of the time is the same as that of the velocity) •Show each of these calculations.

6. •Create an appropriate **graph** to present your calculated **velocities**. (**Computer generated**, or by hand **on graph paper**…) **Be sure that the graph starts with 0 (zero) on the y-axis**. Your graph should reflect the uncertainty of the velocity you calculated.

Conclusion and Evaluation

7. •Evaluate the procedure as per IB criteria:
   - Cite what your velocities were (all 4) and write a sentence or two about any patterns that emerged
   - List 2-3 main sources of error present in the procedure and equipment used
   - Suggest improvements to mitigate the identified sources of error