**Name:**

**Lab Partner:**

**Course: AP Physics**

**Period:**

**Date:**

**AP Lab #9- Conservation of Momentum**

**Purpose/Problem:** To investigate whether the linear momentum of a system and kinetic energy of the system is conserved after a collision.

**Hypotheses:**   
If two carts of unequal mass collide and stick together, one initially at rest,   
(a) the final momentum of the system *(immediately* after they begin to move together) will be greater than/ less than/ equal to (you choose J) the initial momentum (just before colliding) of the system.

(b) the final kinetic energy of the system *(immediately* after they begin to move together) will be greater than/ less than/ equal to (you choose J) the initial kinetic energy (just before colliding) of the system.

**Materials:** Two dynamics carts with velcro, Vernier LabQuest3, motion detector, spring scale (also list any other items used such as meter sticks or masking tape).

**Experimental Design & Procedure:** You and your lab partner(s) need to agree on the specifics of your procedure. With only one motion detector, both the velocity of the initially moving cart and the velocity of both carts after the collision can be determined since they stick together after colliding. You may use anything provided at your table as well as masking tape and meter sticks and other items you normally bring to class (as needed). Your experimental design/ procedure needs to include enough detail to be repeatable by someone reading your lab who does NOT have the opportunity to consult with you. Your lab partner(s) is/are your best resource(s) for developing a procedure for this lab.

**Observation & Data:** You MUST perform multiple trials (three trials is not enough to be considered "multiple"—five or more is good) so that you can graph your results. You are probably going to have mass and velocity data and as usual you must include a table to organize your data.

**Analysis:** Math, equations, graphs, & fun. I'm guessing you will use your mass and velocity data to determine the momentum and kinetic energy of the carts under certain conditions. I imagine you will then use these values to calculate something related to the momentum and energy of each cart and/or the *system* before and after colliding. What is the momentum of the *system* just before the carts collide? Just after? How will you get this from a graph? If initial momentum and final momentum of the system are represented on each axis, what should the slope be if they are equal? A similar analysis can be done using kinetic energy to address your other hypothesis.

**Conclusion:** You MUST relate your conclusion back to your two hypotheses.   
(a)Is momentum conserved (the same before and after collision) in this experiment?   
(b) Is kinetic energy conserved (the same before and after collision) in this experiment?   
What evidence supports your conclusion? Use a percent difference calculation here to confirm this (please note that it is impossible to compare to the number zero in a percent different calculation but that should not stop you if you are clever – think of your slopes).

What physics did you learn from having done this experiment? What are your real sources of error (do NOT say "human error")? Would the results have been fundamentally different if the two carts had been identical?

Have a great day J!

***Lab Report* Rubric**

**AP Physics 1 Lab: Conservation of Momentum**

**15 pts**

Penalty Box (check means that there are problems in that area)

|  |  |
| --- | --- |
| □ lab notes not attached to lab report  □ doesn’t use third-person voice  □ lab framework is not followed (calculations not in analysis section, data tables not together in proper section, etc) | □ more than a few obvious spelling/grammatical errors  □ math is not easy to follow (original algebra not shown, plug-in not shown, unclear progression) |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Missing** | **Inadequate** | **Needs** **Improvement** | **Adequate** | **Points** |
| **Title, Heading, Purpose, Hypothesis, Materials** (1 pt) | | | | |  |
| **Graphs**  (2 pt) | Concern with 3 or all:  \* correct labels & units \* axes are scaled correctly \* best-fit line \* detailed title | Concern with two:  \* correct labels & units \* axes are scaled correctly \* best-fit line \* detailed title | Concern with one:  \* correct labels & units \* axes are scaled correctly \* best-fit line (points drawn from table rather than line)  \* detailed title | \* correct labels & units  \* axes are scaled correctly  \* best-fit line(s)  \* detailed title(s) |  |
| **Diagrams & Data Tables**  (2 pt) | \* diagram is missing  \* data tables are missing or extremely vague (i.e. numerical values only) | \* diagram is unclear or unrelated  or has major omissions  \* data tables have major omissions  (i.e. table missing for a graphed set of data) | \* diagram is vague or has minor omissions  \* data tables have minor omissions  (i.e. units incorrect or missing) | \* diagram present & clear  \*diagram labeled and captioned as necessary  \* data tables clear and complete  \* tables include labels and proper units |  |
| **Procedure & Conclusion**  (3 pt) | \* procedure or conclusion extremely vague or missing altogether  \*unintelligible  \*missing: no attempt made to explain | \*major problems with procedure and conclusion  \*unclear with important details missing  \*lengthy/unrelated digressions  \*vague or ambiguous statements | \* minor problems with procedure and conclusion: unclear  \*vague details or omissions  \* effort required to comprehend the progression  \*unrelated digressions  \*All logical steps present, but in non-sequential order | \* procedure clear & complete, matching what was actually done  \* conclusion is drawn that is related to the purpose/problem  \* makes sense on 1st read-through  \* organized, sequential, argues from evidence |  |
| **Error Analysis**  (2 pt) | \*error analysis missing  \*emotional response  \*”miscalculation” or ”mistake”  \*”faulty equipment”  \*”human error” | \*estimated values not related to calculated results  \*no attempt/failed attempt to quantify  \*ambiguous, unclear language  \*missing necessary diagrams  \*incorrect statements | \*sources of error identified, but focus on non-major sources  \*estimated values unfounded or unreasonable--related loosely/not related to calculations  \*ambiguous, unclear language  \*incorrect statements | \*major sources identified & explored  \* quantified (amounts estimated)  \*shows effect on calculation  \*diagrams included |  |
| **Analysis Questions**  (5 pt) | These are graded question by question.  -please include questions along with the answers in the lab report- | | | |  |
| **Total :** | | | | |  |