☐PHYS115 ✓PHYS121 ☐PHYS123
☐PHYS116 ☐PHYS122 ☐PHYS124

Lab Cover Letter

Author (*You*) Trevor N ____________ Signature: Trev N. ____________

I declare that this assignment is original and has not been submitted for assessment elsewhere, and acknowledge that the assessor of this assignment may, for the purpose of assessing this assignment: (1) reproduce this assignment and provide a copy to another member of faculty; and/or (2) communicate a copy of this assignment to a plagiarism checking service (which may then retain a copy of this assignment on its database for the purpose of future plagiarism checking).

Lab Partner(s) Katherine ____________

Date Performed Mar 6 ____________ Date Submitted Mar 19 ____________

Lab (*such as #1: UNC*) H4 COL ____________

TA: Phillip ____________

GRADE (*to be filled in by your TA*) See your TA for detailed feedback.
An '*x*' next to a subcategory means you need to improve this aspect of your work.

***Paper Subtotals* (points)**

( ) ***General* (6)**
_____ Sig. figs.
_____ Units
_____ Clarity of Presentation
_____ Format

( ) ***Abstract* (4)**
_____ Quantity or principle
_____ How measurement was made
_____ Numerical Results
_____ Conclusion

( ) ***Intro & Theory* (9)**
_____ Basic principle
_____ Main equations to be used
_____ Apparatus
_____ What will be plotted
_____ Fitting parameters related

( ) ***Exp. Procedures* (15)**
_____ Description
_____ Stating and justifying uncertainties
_____ Data Record
_____ Quality of Lab Work

( ) ***Analysis & Error Analysis* (20)**
_____ Discussion
_____ Equations & Calculations
_____ Presentation inc. Graphs, Tables
_____ Results Reported & Reasonable
_____ Underlined items addressed

( ) ***Discussion & Conclusions* (6)**
_____ Numerical comparison of results
_____ Logical conclusions
_____ Discussion of pos. errors
_____ Suggestions to reduce errors

( ) **Paper Total (60 points)**
(30 points for CME or EPF)

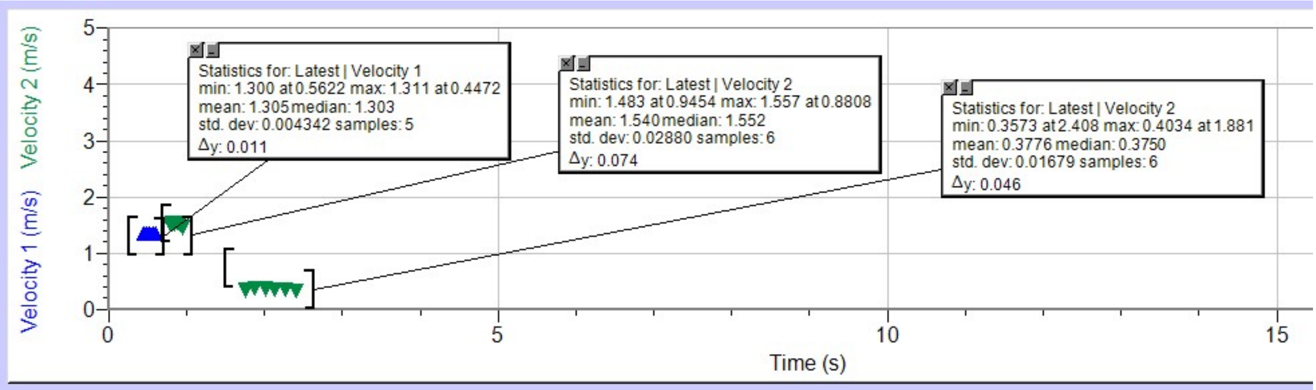
( ) **Notebook (10 points)**
_____ Format (*proper style, following directions*)
_____ Apparatus (*brief description of equipment, including sketches*)
_____ Data (*including computer file names and manually recorded data*)
_____ Experimental Technique (*describing your procedures; stating & justifying uncerts.*)
_____ Analysis (*results and errors*)

( ) **Worksheet(s)/Fill-in-the-Blank-Report (30 points)** *if applicable*

( ) **Adjustments** – late submissions, improper procedures, etc. – or bonus points for exceptional work.

( ) Total Grade

Graded by ___________ *(TA's initial)*


Statistics for: Latest | Velocity 1
min: 1.300 at 0.5622 max: 1.311 at 0.4472
mean: 1.305 median: 1.303
std. dev: 0.004342 samples: 5
Δy: 0.011
Statistics for: Latest | Velocity 2
min: 1.483 at 0.9454 max: 1.557 at 0.8808
mean: 1.540 median: 1.552
std. dev: 0.02880 samples: 6
Δy: 0.074
Statistics for: Latest | Velocity 2
min: 0.3573 at 2.408 max: 0.4034 at 1.881
mean: 0.3776 median: 0.3750
std. dev: 0.01679 samples: 6
Δy: 0.046
Velocity 1 (m/s)
Velocity 2 (m/s)
Time (s)
0
5
10
15
0
1
2
3
4
5

COL Worksheet

Your Name: Trevor N. **Signature:** Trev N.

Lab partner(s): Katherine

Course & Section: PHY8121 Sec 118 **Station #** 14 **Date:** Mar 6 2024

Section D. Procedure

1. What are the masses of your two carts, gratings, and mass bars?

m_{cart1} = 490.3 ± 0.1 g (units)

m_{cart2} = 495.3 ± 0.1 g (units)

$m_{grating1}$ = 12.7 ± 0.1 g (units)

$m_{grating2}$ = 13.1 ± 0.1 g (units)

m_{bar1} = 497.7 ± 0.1 g (units)

m_{bar2} = 494.9 ± 0.1 g (units)

2. What is the average velocity for each photogate? Remember that if the two don't agree, you will have to find their ratios and adjust the velocities of all subsequent velocity measurements.

$v_{photogate1}$ = 1.379 ± 0.006 m/s (units)

$v_{photogate2}$ = 1.330 ± 0.004 m/s (units)

Section E Analysis

3. Record your data in the tables below. Do not forget to include the directions for the vector quantities.

Collision 1

	Cart 1 before collision	Cart 1 after collision	Cart 2 before collision	Cart 2 after collision
Mass (kg)	1.0007 ± 0.0002	1.0007 ± 0.0002	1.0033 ± 0.0002	1.0033 ± 0.0002
Velocity (m/s)	0.707 ± 0.004	0 ± 0	0 ± 0	0.572 ± 0.008
Momentum (kg m/s)	0.707	0	0	0.574
Kinetic energy (J)	0.250	0	0	0.164

ε_p = -0.188

ε_k = -0.344

Collision 2

	Cart 1 before collision	Cart 1 after collision	Cart 2 before collision	Cart 2 after collision
Mass (kg)	1.0007 ± 0.0002	1.0007 ± 0.0002	0.5084 ± 0.0001	0.5084 ± 0.0001
Velocity (m/s)	1.305 ± 0.002	0.38 ± 0.07	0 ± 0	1.54 ± 0.01
Momentum (kg m/s)	1.306	0.38	0	0.783
Kinetic energy (J)	0.852	0.073	0	0.603

ε_p = -0.11

ε_k = -0.21

Collision 3*

	Cart 1 before collision	Cart 1 after collision	Cart 2 before collision	Cart 2 after collision
Mass (kg)	0.5030 ± 0.0001	0.5030 ± 0.0001	1.0033 ± 0.0002	1.0033 ± 0.0002
Velocity (m/s)	1.18 ± 0.02	-0.278 ± 0.007	0 ± 0	0.720 ± 0.004
Momentum (kg m/s)	0.59 ± 0.01	-0.139 ± 0.004	0 ± 0	0.722 ± 0.004
Kinetic energy (J)	0.35 ± 0.01	0.019 ± 0.001	0 ± 0	0.260 ± 0.003

ε_p = -0.01 ± 0.01

ε_k = -0.20 ± 0.01

Collision 4

	Cart 1 before collision	Cart 1 after collision	Cart 2 before collision	Cart 2 after collision
Mass (kg)	1.0007 ± 0.0002	1.0007 ± 0.0002	1.0033 ± 0.0002	1.0033 ± 0.0002
Velocity (m/s)	1.50 ± 0.01	0.67 ± 0.02	0 ± 0	0.67 ± 0.02
Momentum (kg m/s)	1.50	0.67	0	0.67
Kinetic energy (J)	1.13	0.23	0	0.23

ε_p = -0.11

ε_k = -0.60

Collision 5

	Cart 1 before collision	Cart 1 after collision	Cart 2 before collision	Cart 2 after collision
Mass (kg)	1.0007 ± 0.0002	1.0007 ± 0.0002	0.5084 ± 0.0001	0.5084 ± 0.0001
Velocity (m/s)	0 ± 0	-0.409 ± 0.004	0 ± 0	0.829 ± 0.005
Momentum (kg m/s)	0	-0.409	0	0.421
Kinetic energy (J)	0	0.084	0	0.175

Δp = 0.012 Kg.m/s

ΔK = 0.512 J

Collision 6

	Cart 1 before collision	Cart 1 after collision	Cart 2 before collision	Cart 2 after collision
Mass (kg)	0.5030 ± 0.0001	0.5080 ± 0.0001	0.5084 ± 0.0001	0.5084 ± 0.0001
Velocity (m/s)	0 ± 0	-0.926 ± 0.003	0 ± 0	0.891 ± 0.005
Momentum (kg m/s)	0	-0.466	0	0.453
Kinetic energy (J)	0	0.216	0	0.202

Δp = 0.013 Kg.m/s.

ΔK = 0.835 J.

4*. Write out the error analysis for collision 3 to find the uncertainties in momentum and kinetic energy, and the uncertainties in ε_p and ε_k.

$$\vec{\varepsilon}_p = \frac{\vec{P}_1' + \vec{P}_2' - \vec{P}_1}{\vec{P}_1} \qquad \delta_{\vec{\varepsilon}_p} = \sqrt{\delta^2_{\varepsilon_p P_1'} + \delta^2_{\varepsilon_p P_2'} + \delta^2_{\varepsilon_p P_1}} = \sqrt{\frac{\delta^2_{P_1'}}{\vec{P}_1^2} + \frac{\delta^2_{P_2'}}{\vec{P}_1^2} + \frac{\delta^2_{P_1}(\vec{P}_1' + \vec{P}_2')^2}{\vec{P}_1^4}}$$

$$\varepsilon_k = \frac{K_1' + K_2' - K_1}{K_1} \qquad \delta_{\varepsilon_k} = \sqrt{\frac{\delta^2_{K_1'}}{K_1^2} + \frac{\delta^2_{K_2'}}{K_1^2} + \frac{\delta^2_{K_1}(K_1' + K_2')^2}{K_1^4}}$$

5. For the elastic collisions, did your data fit the conservation of energy and momentum model? Explain.

Yes, all of our ε_p were very low, meaning it did not change much during the collision, which means it follows the model

And not as much of conservation of energy, as our collisions were not perfectly elastic, more energy was lost, as seen by our higher (but still low) ε_k value.

6. For the inelastic collisions, did your data fit the conservation of momentum model? Explain. What was the relative energy loss? Where did the energy go?

Yes, just like our elastic collisions, our ε_p were low.

Our ε_k was -0.20 ± 0.01, which is expected as the energy was absorbed by the velcro holding the carts together.

7. For the "explosion," did your data fit the conservation of momentum model? Explain. What was the energy gained?

Yes, just like the others, our Δ_p was low.

We gain energy from the stored spring energy, that is why our Δ_k was positive.

GRADE:_______ (out of 30 points)

GRADED BY _______ (TA's initials)