PHYL101

Applied Exam-1

Duration: 40 minutes

Total: 6 points

Name & Surname:

Student ID:

Lab section:

Table #:

Date:

Signature of the student

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As the instructor of this Lab Section I confirm that the student has participated in and completed the applied exam on time.

Stamp of the PHYS Labs and signature of the instructor

This page serves as proof of the fact that the student participated in and completed the applied exam, only if it is submitted in time and accepted by the Lab instructor. The student and the instructor shall sign it along with the stamp of the Physics Laboratories.

Complete this examination YOURSELF! Be careful about units, significant figures. You shall show all your formulae & calculations explicitly and express your final answers clearly.

1. Read all instructions carefully before starting the exam.

2. Follow the procedure step by step as outlined in the exam document.

3. Record your measurements in the provided data table.

4. Ensure that all calculations are shown clearly in the appropriate section.

5. Use only a scientific calculator. Smartphones and other electronic devices are not

allowed.

6. Write all numerical values with correct significant figures and units.

7. Use parentheses in the tables to indicate the units.

The Ballistic Pendulum: Conservation of Momentum

Objective

To study the principle of conservation of momentum and, by applying this principle, measure the initial velocity of a ball.

Theory

When a steel ball is shot towards the pendulum attachment, it undergoes a completely inelastic collision. The conservation of momentum during the collision is expressed as:

$$(m_{\text{ball}} + m_{\text{pend}})v_{\text{final}} = m_{\text{ball}}v_{\text{initial}}$$

After the collision, the system swings upwards, converting kinetic energy into potential energy:

$$\frac{1}{2}(m_{\text{ball}} + m_{\text{pend}})v_{\text{final}}^2 = (m_{\text{ball}} + m_{\text{pend}})gH$$

Using the maximum height H reached by the pendulum, the initial velocity v_{initial} can be determined as:

$$v_{\text{initial}} = \sqrt{2gH} \times \frac{m_{\text{ball}} + m_{\text{pend}}}{m_{\text{ball}}}$$

Apparatus

- Ballistic pendulum with pendulum attachment
- Steel ball
- Meter stick
- Balance

Procedure

1. The following quantities are given on the board: the mass of the steel ball (m_{ball}), the mass of the pendulum (m_{pend}), and the length of the pendulum (L).
2. Fire the steel ball into the pendulum attachment three times for each compression level of the spring gun. Set the angle pointer to zero before firing.
3. Record the maximum height H for each trial using the angle pointer and calculate $H = L(1 - \cos\theta)$.
4. Compute the average height H for each compression level.
5. Calculate the initial velocity v_{initial} for each compression level.
6. Take the gravitational acceleration as $g = 981$ cm/s^2 in the CGS system and $g = 9.81$ m/s^2 in the MKS system.

Data Table

Compression Level	**Trial**	θ **(degrees)**	H ( )
Short	1		
	2		
	3		
Medium	1		
	2		
	3		
Long	1		
	2		
	3		

Calculations

- Calculate the height $H = L(1 - \cos\theta)$ and record it in the table.
- Use the conservation of momentum and energy equations to determine v_{initial}. Show all your calculations and record them in the table.

Compression Level	H_{avg} ( )	$v_{\textbf{initial}}$ ( )
Short		
Medium		
Long		