The Catapult Lab

A catapult is a mechanism used to throw missiles in ancient and medieval warfare. At first, catapults were specifically designed to shoot spears or other missiles at a low trajectory. They were originally distinguished from ballistae and trebuchets, both of which were large military engines used to hurl stones and other missiles, but these distinctions later blurred. Soon after, larger catapults mounted on a single arm also hurled stones, pots of boiling oil, and incendiaries at a high trajectory. They were used to attack or defend fortifications. Catapults were widely employed in siege warfare, but with the introduction of artillery they passed from use. In the 20th century catapults using hydraulic pressure were reintroduced to launch aircraft from warships.

OBJECTIVE/ DESIGN PROBLEM:

The goal of the project is to increase your understanding of Conservation of Energy. Using the equations for Spring Potential and Kinetic Energy to determine the path of a projectile.

Allowed Materials:

- Materials supplied by group from outside of school.
- Any materials that I may provide.

WORK PRODUCTS:

- Catapult itself
- Presentation Prior to Performance Testing and Cost Estimate
- Formal Lab Report

You will be given class time to work on your project.

Formal Lab Report Requirements:

1. This report must be typed on plain paper (type on one side only).

2. The names of all members of your lab team and the date of submission is to be written in the lower right hand corner of the first page of the report.

3. An appropriate and descriptive title for the report should be placed in the center of the first page of the report.

4. Each of the following sections of the laboratory report should be prefaced with the section names.

Presentation Requirements:

• A scaled drawing of your design with dimensions and major parts labeled (can be done neatly by hand or using a computer program) OR properly labeled top, front, and side view pictures that includes dimensions.

• The rationale behind your design and problems that needed to be overcome in the design process (trouble shooting)

• Submit your cost estimate

• Everyone needs to be involved in the presentation and performance testing

LAB REPORT FORMAT-

Use these descriptors as headers for each section of your paper

I. Purpose (5 points)

This is a statement of the problem to be investigated. It provides the overall direction for laboratory investigation and must be addressed in the conclusion.

EXPECTATIONS:

• Performance of catapult discussed

• Performance of your catapult based on your expectations and knowledge of physics versus reality is discussed

• Describes the design project with goals

• Includes how theoretical calculations and physics will be used to inform design

II. Equipment (5 points)-What you used

-A list of all laboratory equipment used in the investigation.

-A detailed and labeled diagram to illustrate the configuration of the apparatus.

III. Procedure (20 points)-How you solved your design problem

-Identify and name all the crucial parts of the catapult

-Describe how you tested and revised your design

Someone who was not present during the lab should be able to understand how the experiment was performed and be able to reproduce the results by reading your procedure.

EXPECTATIONS:

• Describes your design process in a way that your procedure could be replicated

•Describes the major components of a catapult and how they work

• Describes your process to building, analyzing, and revising your design based on your understanding of catapults and Conservation of Energy

IV. Data (20 points)

-Record of trial and error data with design for each modification (angle of attack, initial velocity, and average range for a given an angle of attack)

-Data measured directly from the experiment. THIS INCLUDES ANGLE OF ATTACK, INITIAL SPRING PE, INITIAL KE, HEIGHT OF LAUNCH, FLIGHT TIME, AVERAGE RANGE FOR SPECIFIC ANGLE OF ATTACK, AND INITIAL VELOCITY OF PROJECTILE BASED ON THE DATA

-Include data in properly labeled data tables with units.

EXPECTATIONS:

• Includes preliminary design data and final design data to standard requested: Launch angle, height of launch, range, initial velocity, and flight time

• Data tables clearly titled and labeled using units in the body of the report

• Observations, insights, or comments included

• Cost analysis included

V. Data analysis (30 points)

-Analyzing angle of attack with initial velocity and average range.

-Include all graphs, analysis of graphs, post laboratory calculations and percent errors. How far were you on average from your target?

-Sample Calculations with units are used

-All graphs should have a title, labeled coordinate axis and units.

-Unusual results or trends should be noted and explained if possible.

-State the meaning of any graphs if included

EXPECTATIONS:

• Evidence of using data and observations to inform design process

• Equations and sample calculations included in your report

• Precision and accuracy of your final design is calculated and discussed

• Scaled drawing OR labeled top, side, and front pictures with dimensions are included in report

VI. Conclusion (20 points)

-Discuss any questionable data or surprising results.

-Explain the possible source of any error or questionable results.

-Reflection: What would you change given the opportunity to do this again?

EXPECTATIONS

• Performance of catapult discussed

• Performance of your catapult based on your expectations and knowledge of physics versus reality is discussed

• Students include a reflection on what they learned by participating in this design process

Rubric for Catapult Laboratory Report

Outcomes	**Below Standards**	**Meets Standards**	**Above Standards**
Statement of Objective: States why the student is doing the investigation and what the goals are. Should be clear and concise.	0	1	2
Design Plan: Complete description of the catapult and diagram with all parts labeled and clearly drawn.	0	1-2	3
Data: All data taken should be listed in this section. All data must have units and data tables should be clearly labeled. Must include: time of flight, distance in x-direction, angle of launch and initial velocity.	0	1-2	3-4
Data Analysis: Correct equations have been used, calculations are correct and appropriate units are used. See laboratory sheet for additional requirements.	0-1	2-3	4-5
Conclusion: Results are summarized and the hypothesis addressed. Significant sources of error and suggestions for improvements are addressed.	0	1-2	3-4
Accuracy: Projectile hit target on testing day.	0	1	2
Organization and presentation: Report is neatly typed or written, sections have been well marked, and mistakes are either erased or whited out.	0	1	2

Total: 22 points