Advanced DataSnap™ Projectile Student Engineering Workbook

Name: ______________________________

CreXo™
www.crexo.com

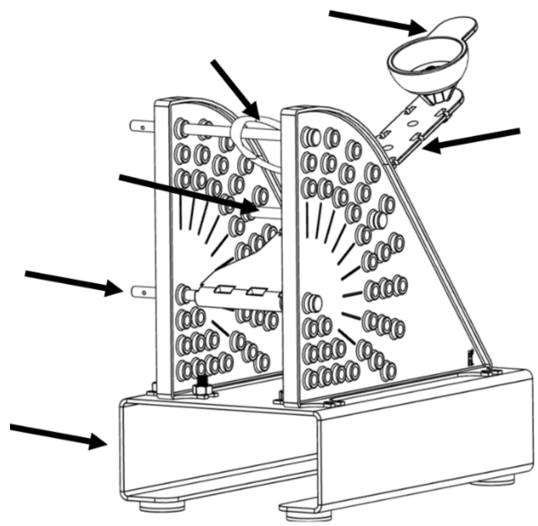
Realityworks®
Live it. Learn it.™
www.realityworks.com

Lesson 1:
Making Your Catapult Data-Smart

Instructions: As you follow the Lesson 1 slide presentation, complete the following questions.

Introduce and Define

1. Label these parts on the catapult image:
   a. Base
   b. Arm
   c. Elastic Bands
   d. Pivot Point
   e. Launch Cup
   f. Stopped Pin



2. Energy Transfer: Fill in the blanks.

   A. **Energy is stored.** When you pull back the arm and stretch the elastic, you store elastic ______________________ energy.
   B. **Energy is released.** When the arm is released, the arm accelerates forward quickly, and the elastic potential energy turns into ________________ energy.
   C. **Projectile is launched.** The arm stops and releases the projectile, which flies through the air with ________________ energy.

3. Where did the energy come from originally? What is the source of energy that powers a catapult?

4. What happens after launch? Record important concepts for these key points:
   a. Parabolic Flight Path:

   b. Horizontal Component:

   c. Vertical Component:

Lesson 2:

Pull-Back Angle – Force and Work

Instructions: As you follow the Lesson 2 slide presentation, complete the following questions.

Introduce and Define

Key Vocabulary: As you work through the slides, record these terms' definitions and a sketch/note that will help you remember important concepts.

Term	Definition	Important Concepts
Force		
Work		

1. Calculate Like an Engineer: A student applies 5 N of force to pull the Catapult arm back 0.3 meters.

    a. How much work is done on the Catapult?

    b. If another student uses the same force but pulls back farther, what happens to the work done?

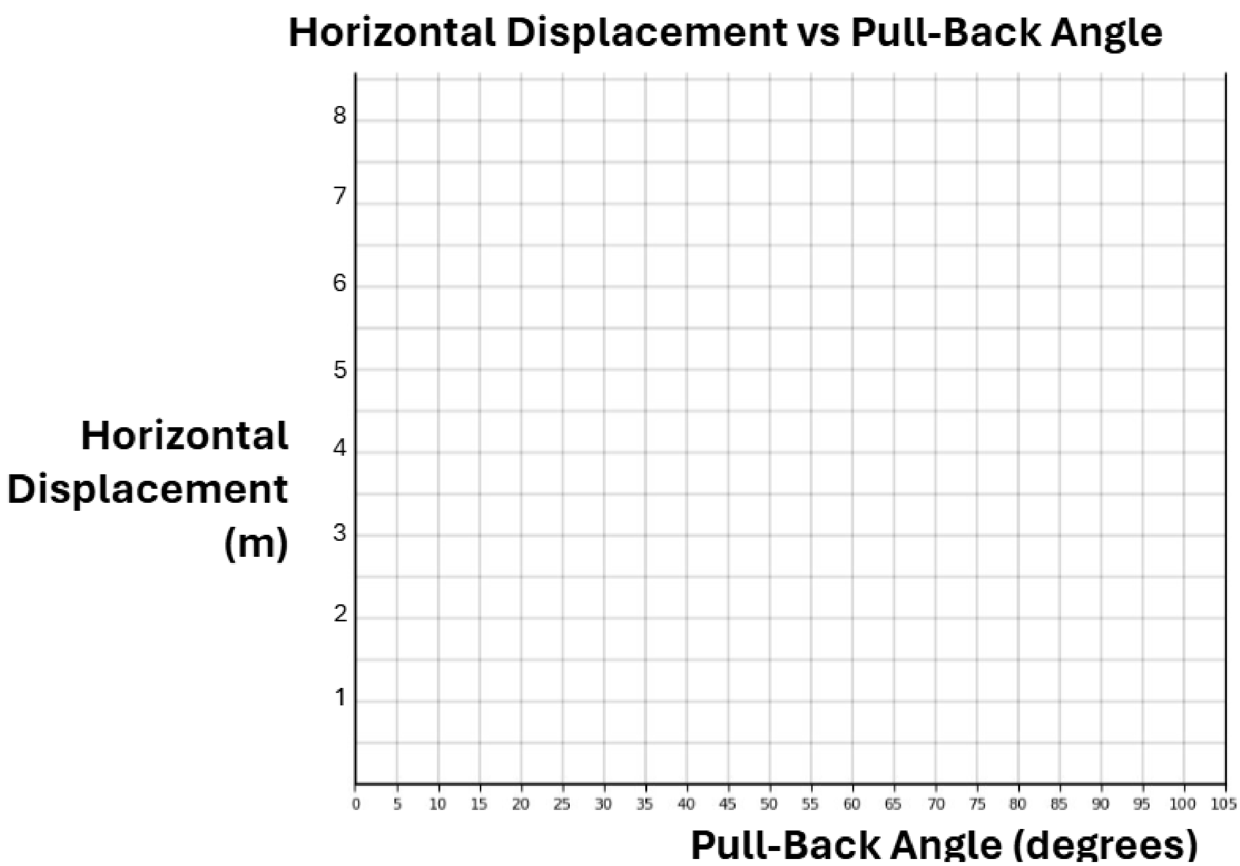
    c. How are force and work different? How are they related?

    d. Why does understanding work help you predict the projectile's motion?

8. Is there a relationship between launch velocity, flight time, and horizontal Displacement? Explain.

Data Analysis: Create a Predictive Model

9. Follow these instructions to create a Horizontal Displacement Versus Pull-Back Angle graph:
    a. Identify the largest horizontal Displacement value and choose an interval for the vertical axis that will allow you to graph all the data points gathered for this data set. (ex: 20 m per square)
    b. Label your graph's vertical y-axis with this interval.
    c. For each pull-back angle, graph the data for the 3 trials and the average you calculated. Label each as shown in the slide presentation example.
    d. Done correctly, you should have 12 points graphed total (4 at each angle 30, 45, 60).
    e. Starting from the origin, draw in a line of best fit connecting the averages as best as possible.



10. In your own words, describe the relationship your line of best fit shows between Pull-Back Angle and Horizontal Displacement.

Lesson 4:
Launch Arm Length and Velocity

Instructions: As you follow the Lesson 4 slide presentation, complete the following questions.

Introduce and Define

1. In your own words, what is angular velocity?

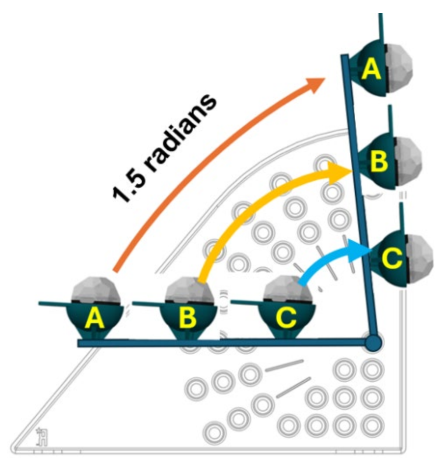
2. Label each variable in the equation for angular velocity:

$$\omega = \frac{\Delta\theta}{\Delta t}$$

3. What do you think happens to angular velocity when you put more elastic bands on the Catapult?

4. **Practice Calculating:** A student is testing a Catapult with a **short arm**. During a launch, the arm rotates through an angle of **2.0 radians** in **0.20 seconds**. What is the angular velocity of the Catapult arm?

5. **Imagine setting up your Catapult with the cup at locations A, B, and C on the arm.** No matter which location is used to launch the projectile, each cup has the same angular rotation and takes the same amount of time to rotate that angle.



   A. Which cup travels the farthest distance when the arm is released?

   B. Which cup travels the shortest distance?

   C. If they all take the same time to travel these distances, which cup must be moving the fastest?

   D. Which cup do you think is best for launching the projectile?