Student Resource 5.2

Modeling Your Catapult Trajectory

Directions

Your team will be provided with a catapult and two different types of projectiles (ammunition and supplies) to play the catapult game. Before you play, however, you must calculate model equations for the projectile trajectories to help you place the catapult accurately during the game.

**Materials:**

* 2 Tape Measures
* Catapult
* Ammunition projectiles
* Supply projectiles
* **Student Resource 5.3: Catapult Data and Modeling Equations**

**Instructions:**

1) Place the catapult on the ground and fire ammunition to get a sense of how high and far the projectile travels.

2) Extend a tape measure on the ground long enough to measure where the ammunition will fall when you fire the catapult again. The catapult should be placed at 0 inches.

3) Extend the other tape measure up from the ground high enough to measure the highest point of the trajectory. Place the tape measure approximately where you think the vertex of the parabola will be and note how far that spot is from the catapult using the tape measure on the ground.

4) Fire the catapult as many times as necessary to record 3 accurate points along the ammunition’s trajectory. It is easiest to make 2 of the points where the ammunition is launched and where it hits the ground. The remaining point is measured where the ammunition reaches the vertical tape measure.



Tape Measure

Tape Measure

**Point 1:** (0, *y*1)

**Point 3:** (*x*3, 0)

**Point 2:** (*x*2, *y*2)

*x*2

*y*2

*y*1

*x*3

5) Record the 3 points in the table provided on **Student Resource 5.3**. Then follow the calculator procedure to create a quadratic equation that models the ammunition trajectory. Copy the equation and its graph on the same worksheet.

6) Repeat the process to create an equation that models the trajectory of the supply projectile.

**MCj04159200000[1]Calculator Procedure: Creating A Quadratic Equation from 3 Points\***

\*These instructions are written for use with Texas Instruments (TI) graphing calculators. Other graphing calculators may use different procedures or buttons.

1) Clear any previous data in your calculator.

2) Press **STAT** and then select **1:EDIT** in the menu and press **ENTER**.

3) In the L1 column, enter the 3 *x*-coordinates of the data points you recorded for your trajectory. In the L2 column, enter the 3 corresponding *y*-coordinates.

4) Enter the **STAT PLOT** menu by pressing **2nd** and then **Y=**.

5) Select Plot 1 in the menu and press **ENTER**.

6) Make sure the Plot 1 is ON and that the first plot type (scatter) is chosen. The X list should say L1 and the Y list should say L2. At the bottom of the screen, choose whatever mark you like.

7) Press **GRAPH**. You should see all 3 of the data points on the graph. If not, press **WINDOW** and adjust the ranges for the *x* and *y* axes.

8) Press **STAT** again and then go to the **CALC** menu and choose **5:QuadReg**. Press **ENTER**. You will be returned to the input screen. Type **L1[comma]L2** and press **ENTER** again.

9) Record the *a*, *b*, and *c* values that are displayed, rounding to the nearest hundredth place. Then write the quadratic equation for your trajectory in the form 

10) Press **Y=** and enter the equation you wrote down. Press **GRAPH**. The curve that is drawn should hit all 3 of the data points.