

Parabolic Projectile Paths

Name _____

We will measure the time that a ball is in the air and estimate the maximum height the ball achieved using algebra and a robotic light sensor.

Definitions:

- A **parabola** is the graph of a second-order polynomial, like $f(x)=x^2$. The equation of a parabola in general is $f(x)=ax^2+bx+c$, where a , b , and c are constants.
- **Projectile motion** is a term that described the movement of a “thrown” object as it flies through the air, like a baseball.

Equipment:

- Cardboard tube with light sensor attached
- NXT brick attached to computer with Mindstorms data logger
- Ball launcher
- Ball

Procedure:

The students acquiring the data begin the data logging program by clicking the “play” button. When the computer is acquiring data, the students launching the ball hit the launcher at the 2 second mark. Once the data is acquired, it looks like a graph on the screen that is mostly flat with two spikes. The students doing data analysis zoom in on the selected launch data to read the times of the first and second peak and read these numbers to the class. Repeat at least three times.

Trial	Height of light sensor (cm)	Time of 1 st peak (s)	Time of 2 nd peak (s)	Average of 1 st and 2 nd peak times (s)
1				
2				
3				

Analysis:

Choose a particular trial to investigate. Write the experimental data from that trial as two coordinates on the graph describing the height of the ball over time.

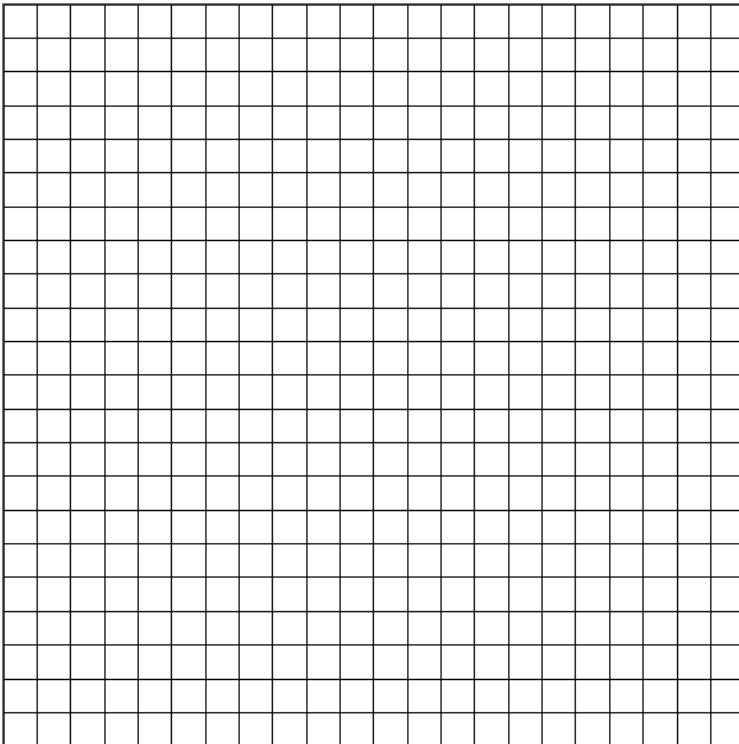
Write the origin as a coordinate.

Using the general formula for a parabola $f(x)=ax^2+bx+c$ and these three points, estimate the height attained by the ball. You can do this by getting three

equations from plugging in the three points into $f(x)$ and simultaneously solving the three equations for a , b , and c .

When does the ball reach its peak height? What is that height?

Plot the parabola on the grid below. Don't forget to label your axes.



Questions:

1. If the ball travels faster than in your trial, but passes the light sensor at the same times, is the maximum height more, less, or the same as what you estimated for your trial? Why?
2. If the ball travels at the same initial speed as in your trial, but the maximum height is more, will the ball return to the light sensor before, after, or at the same time as in your trial? Why?