Quadratic Functions for Projectile Motion Day 1

 = Stop and talk

1. Make a projectile path that hits the target. (Don't forget units!)

Multiple correct answers. These are only samples.

Initial Height	0 m	Initial Speed	14 m/s
Launch Angle	25°	Object	pumpkin

2. Make a projectile path that has a negative launch angle and still hits the target.

Initial Height	10 m	Initial Speed	12 m/s
Launch Angle	-10°	Object	football

3. Make a projectile path that reaches a height of at least 14 m high and still hits the target.

Initial Height	4 m	Initial Speed	20 m/s
Launch Angle	80°	Object	piano

4. Now that you have played around with the simulation, summarize how the initial conditions affect the height and distance.

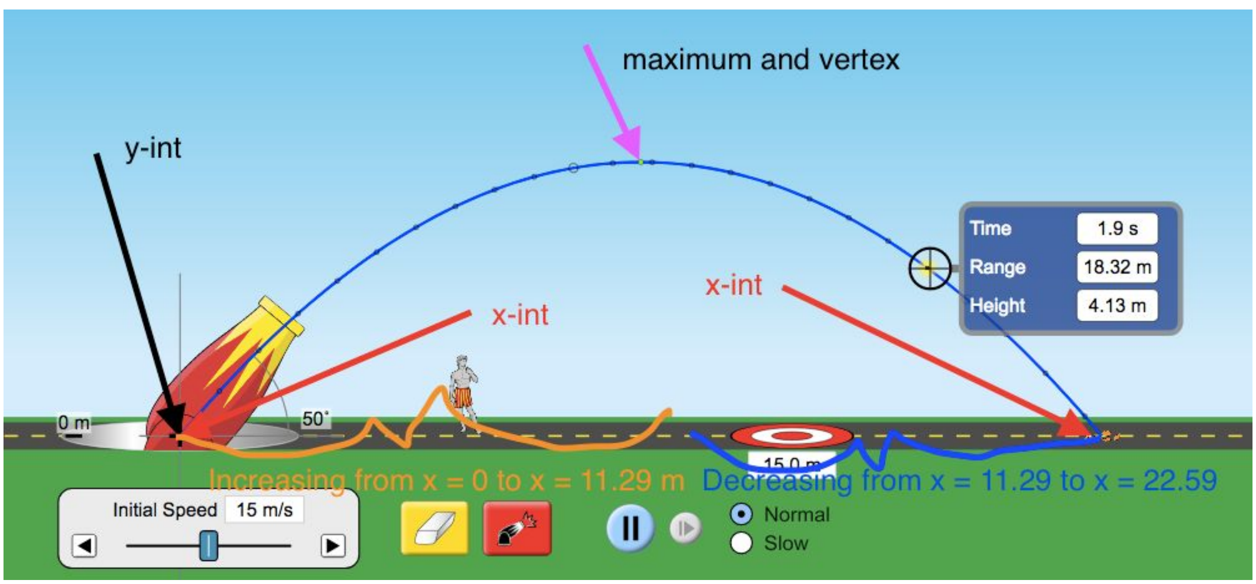
Initial Condition	Effect on Distance	Effect on Height
Increase the initial height	■ increase □ decrease	■ increase □ decrease
Increase the initial speed	■ increase □ decrease	■ increase □ decrease
Increase the launch angle	Maxes at 45°, decreases before and after.	■ increase □ decrease
Change the object	No change	No change

5. Which of the initial conditions has no effect on the distance and height? Why do you think that might be?

Changing the object has no effect because the differences in masses between them are irrelevant compared to the mass of the earth. Gravity is constant at -9.8m/s^2 regardless of the object. Changing the object DOES have an effect ONLY WHEN you consider air resistance. (You can turn on this checkbox to model in the simulation)

6. Answer the following questions about the function.

Ideally, you would allow students to replace this screenshot with a screenshot of one of their own parabolas and answer the questions for their own! The key provides answers for the screenshot shown.



a. Is this function linear or nonlinear? How do you know?

It's nonlinear because it is a curve and not a line. Students may also know that it's a parabola which is generated by a quadratic equation (order 2) and therefore cannot be linear (order 1).

b. Identify the x-intercept(s) on the graph. Estimate the coordinates. Describe what information the x-intercept(s) give you about the scenario.

Identification: See screenshot.

Coordinates: (0 m, 0 m) and (22.59 m , 0 m) For the second ordered pair, accept anything between 20 m and 24 m for the x-coordinate.

Meaning: The first x-intercept tells you that the object is 0 m away from the starting point before it has been hit. The second x-intercept tells you that it landed 22.59 m away from the starting point.

*NOTE: Hopefully some of your students will use an initial height other than zero. Make sure to have a conversation about domain restrictions. In those cases, students should only have one x-intercept because the other wouldn't actually exist for the physical problem. (The nature of the problem restricts it to the first quadrant.)

c. Identify the y-intercept(s) on the graph. Estimate the coordinates. Describe what information the y-intercept(s) give you about the scenario.

Identification: See screenshot.

Coordinates: (0 m , 0 m)

Meaning: The y-intercept says that the object had an initial height of 0 m. It started on the ground.

d. Does this function have a minimum, maximum, or both? How do you know? Identify it/them on the graph.

This function has a maximum only. It is a parabola that has negative end behavior and reaches its highest point at the vertex.

Identification: See screenshot.

e. Identify where the function is positive or negative on the graph. How do you know?

Identification: The function shown is always positive because of its practical domain. The ball can never be below the ground. Its entire trajectory is above or equal to 0 m in height.

f. Identify where the function is increasing or decreasing on the graph. How do you know?

Identification: See screenshot.

It's increasing from x = 0 m to x = 11.29 m because that's where the function is rising from left to right. (The height is increasing over that interval) Accept anything from 10 m to 13 m for the second number.

It's decreasing from 11.29 m to 22.59 m because that's where the function is falling from left to right. (The height is decreasing over that interval) Accept anything from 10 m to 13 m for the first number and anything from 20 m to 24 m for the second number.)

g. Identify the vertex on the graph and write its coordinates. Describe what information the vertex gives you about the scenario.

Identification: See screenshot.

Coordinates: (11.29 m , 6.73 m)

Meaning: After the object has traveled 11.29 m from its starting point, it has reached its maximum height of 6.73 m) Accept anything between 10 m and 13 m for the x-coordinate and between 5 m and 8 m for the y-coordinate.