# Enrichment 5-1

Cannonballs in Flight

When cannonballs are shot out of a cannon, their flight through the air depends on both the angle at which the cannon is set and the amount of gunpowder that is loaded into the cannon, which affects the initial velocity of the cannonball.

The equation $y = 0.5x - 0.01x^2$ represents the parabolic flight of a certain cannonball shot at an angle of 26° with the horizon and at an initial velocity of 25 meters per second. In this equation, y is the height of the cannonball, in meters, and x is the horizontal distance traveled, in meters. The graph of the equation is shown to the right.

Distance traveled

1. Given that the points $(10, 4)$ and $(40, 4)$ lie on the parabola, at what x-coordinate must the vertex lie?

2. Use the equation and your answer to question 1 to find the maximum height of the cannonball.

3. Use the point $(0, 0)$ and the location of the vertex to find the total horizontal distance that the cannonball will travel.
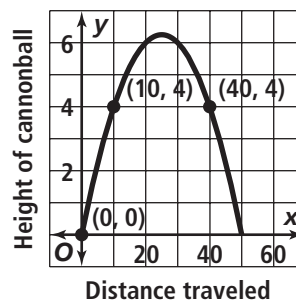
When the angle of the cannon is decreased, the cannonball will travel in a different flight. The parabolic flight of the cannonball is shown to the right, with the vertex labeled.

Distance traveled

4. What is the total horizontal distance that this cannonball will travel?
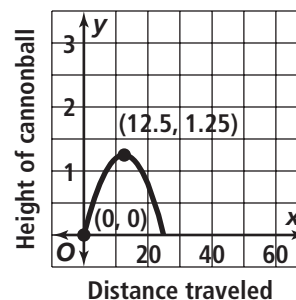
Using the same angle, the initial velocity of the cannonball is increased to produce the graph of the flight shown to the right. The point shown represents the total horizontal distance the cannonball will travel.

Distance traveled

5. How far will the cannonball travel horizontally before it reaches its maximum height?
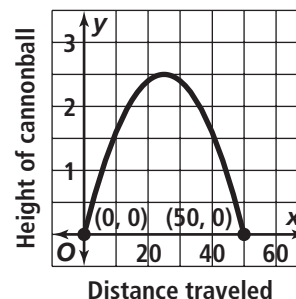
Note: Sources: Gustafson, R. David. *Concepts of intermediate algebra: an early functions approach.* Pacific Grove, Calif.: Brooks/Cole Pub. Co., 1996.