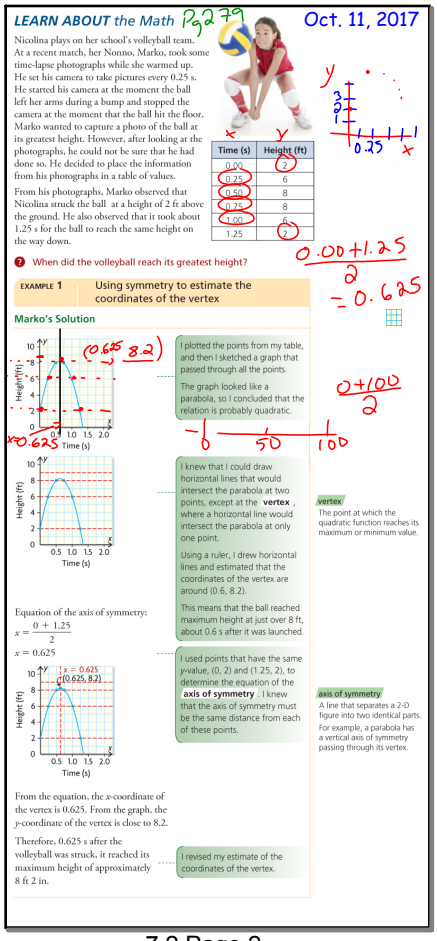

LEARN ABOUT the Math Pg 279

Oct. 11, 2017

Nicolina plays on her school's volleyball team. At a recent match, her Nonno, Marko, took some time-lapse photographs while she warmed up. He set his camera to take pictures every 0.25 s. He started his camera at the moment the ball left her arms during a bump and stopped the camera at the moment that the ball hit the floor. Marko wanted to capture a photo of the ball at its greatest height. However, after looking at the photographs, he could not be sure that he had done so. He decided to place the information from his photographs in a table of values.

From his photographs, Marko observed that Nicolina struck the ball at a height of 2 ft above the ground. He also observed that it took about 1.25 s for the ball to reach the same height on the way down.

Time (s)	Height (ft)
0.00	2
0.25	6
0.50	8
0.75	8
1.00	6
1.25	2

When did the volleyball reach its greatest height?

EXAMPLE 1 Using symmetry to estimate the coordinates of the vertex

Marko's Solution

I plotted the points from my table, and then I sketched a graph that passed through all the points.

The graph looked like a parabola, so I concluded that the relation is probably quadratic.

I knew that I could draw horizontal lines that would intersect the parabola at two points, except at the **vertex**, where a horizontal line would intersect the parabola at only one point.

Using a ruler, I drew horizontal lines and estimated that the coordinates of the vertex are around (0.6, 8.2).

This means that the ball reached maximum height at just over 8 ft, about 0.6 s after it was launched.

vertex
The point at which the quadratic function reaches its maximum or minimum value.

Equation of the axis of symmetry:

$$x = \frac{0 + 1.25}{2}$$

$$x = 0.625$$

I used points that have the same y-value, (0, 2) and (1.25, 2), to determine the equation of the **axis of symmetry**. I knew that the axis of symmetry must be the same distance from each of these points.

axis of symmetry
A line that separates a 2-D figure into two identical parts. For example, a parabola has a vertical axis of symmetry passing through its vertex.

From the equation, the x-coordinate of the vertex is 0.625. From the graph, the y-coordinate of the vertex is close to 8.2.

Therefore, 0.625 s after the volleyball was struck, it reached its maximum height of approximately 8 ft 2 in.

I revised my estimate of the coordinates of the vertex.

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Reflecting Pg 280

A. How could Marko conclude that the graph was a quadratic function?

B. If a horizontal line intersects a parabola at two points, can one of the points be the vertex? Explain.

C. Explain how Marko was able to use symmetry to determine the time at which the volleyball reached its maximum height.

Answers

A. The graph appears to be quadratic because it demonstrates a modified form of a basic $y = x^2$ graph. The graph passes the vertical-line test, and so, the model represents a function.

B. No. The vertex is a turning point for the graph, which means that no other point on the graph will have the same y-value as the vertex.

C. Marko averaged the times taken for the volleyball to reach the same height going up as coming down. He concluded that the time calculation must produce the time corresponding to the axis of symmetry on the graph, which would also be the line containing the vertex. He knew that the points could be connected because time is continuous, and so, he connected the dots provided in the table with a smooth curve. He then drew a vertical line (axis of symmetry) from his time calculation and noticed where it intersected his smooth curve. This gave him the maximum height of the volleyball and the time at which it reached that height.

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Attachments

7s2e2 final.mp4

7s2e4 final.mp4

7s2e3 final.mp4

fm7s2-p8.tns