# Math Journal: Football and Parabolas

During a football game, a team has four plays, or downs to advance the football at least ten yards. After a first down is gained, the team has another four downs to gain ten or more yards.

If a team does not move the football ten yards or more after three downs, then the team has the option of punting the football. By punting the football, the offensive team gives possession of the ball to the other team. Punting is the logical choice when the offensive team (1) is a long way from making a first down, (2) is out of field goal range, and (3) is not in a critical situation.

The punter receives the football about 10 to 12 yards behind the current position on the field. He drops the ball from his hands to kick it, so the ball is in air above the ground when the kick is made.  The punter's job is to kick the football as far down the field as possible without the ball going into the endzone.

A punter kicked a punt that was in the air for a distance of 41.7 yards. The path of the football can be modeled by $y = -0.035(x - 20)^2 + 15$ where $x$ is the distance (in yards) and $y$ is the height (in feet) the football is kicked.

1. Find the coordinates of the vertex.  What is the maximum height of the football? Label your answer with units.

2. Find the coordinates of the y-intercept.  Explain, in the context of the problem, why the y-intercept is not (0,0). (Hint: Read the 3rd paragraph again.)

3. What is the approximate height of the football when it has traveled 8 yards?  Based on this result, what are the coordinates of another point on the graph?

4. What is the coordinate of the x-intercept (where the graph crosses the x-axis?  (Hint: Read the last paragraph again.)

**5.** Neatly graph the quadratic function. Label the coordinates of the vertex, the y-intercept, the x-intercept, and at least three more points.
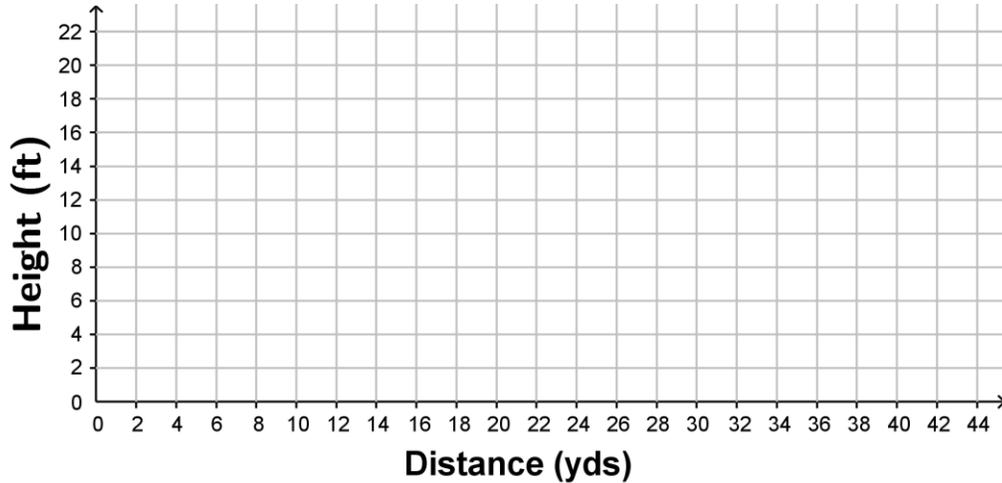


On fourth down, a team is just out of field goal range. The punter is called in. To avoid kicking the ball into the endzone, he needs to kick the ball high and short to get it as close to the opposing endzone as possible without going in. If he gets it to the 99 yard line, the opposing team has to run it the full length of the football field to score. His punt can be modeled by $y = -0.088(x - 15)^2 + 21$ where $x$ is the distance (in yards) and y is the height (in yards) the football is kicked.

**6.** Neatly graph the quadratic function. Label the coordinates of the vertex, the y-intercept, and at least three more points.
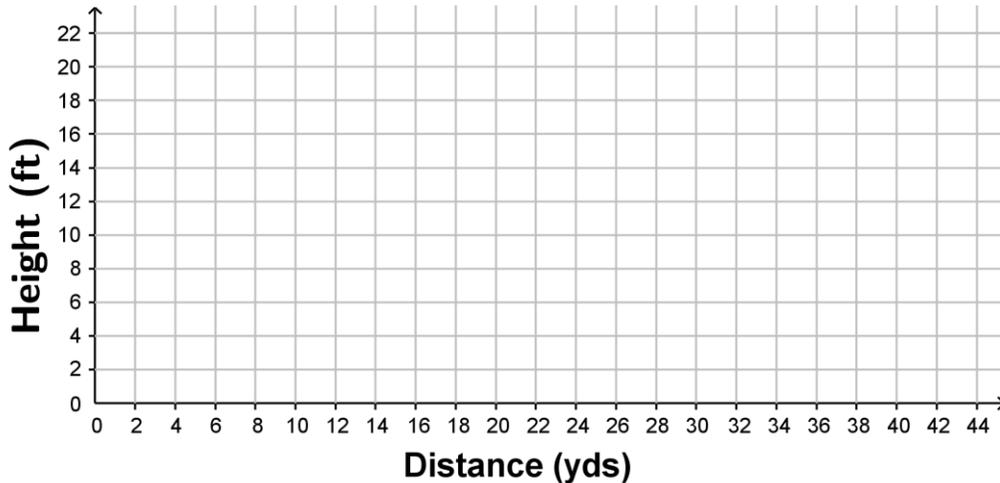


**7.** Approximate the coordinate of the x-intercept. If the ball was punted from the 40-yard line, did the ball reach the endzone when it landed? If not, where did it land? Explain.