

NAME: _____

American Football, Quarterbacks, and Parabolas

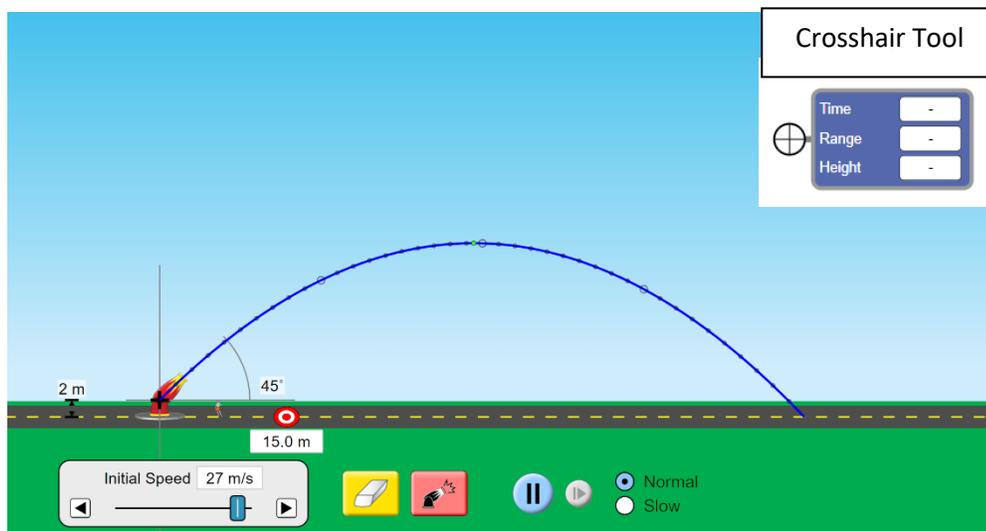
1. According to <https://www.sportscasting.com/how-fast-can-patrick-mahomes-throw-a-football/>, NFL quarterback Patrick Mahomes can throw a football 60 miles per hour or 27 meters per second. If Mahomes throws the ball at a 45 degree angle, a computer models the path of the ball as the function shown below:

$$f(x) = -.0135x^2 + x + 2$$

where x is horizontal distance measured in meters and $f(x)$ is vertical distance measured in meters.

- a. Graph the above function using DESMOS at <https://www.desmos.com/calculator/iq3lygfoci> or use a graphing calculator.
- b. What is the y-intercept?
- c. What does the y-intercept represent?
- d. What is the vertex?
- e. In meters, what is the maximum height the football reaches?
- f. As height in the United States is usually measure in feet, where 1 meter = 3.28 feet, what is the maximum height the football reached in terms of feet?
- g. What is the horizontal distance that the ball traveled in meters?
- h. As horizontal distance in American football is usually measured in yards, identify the number of yards that Mahomes threw the football.

NOTE: 1 meter = 1.09361 yards



2. Using https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html, simulate Mahomes throwing the FOOTBALL with the conditions described in number 1 as shown above.

3.
 - a. If the angle in which a football is thrown increases, what do you think will happen to the football?

 - b. Using the same simulator, simulate Mahomes throwing the ball at a 60 degree angle and sketch the path of the football on the picture at the top of this page.

Was your hypotheses in 3a correct?

4.
 - a. Estimate the maximum height in which the football reaches when Mahomes throws the football at an angle 60 degrees. Then, dragging the crosshair tool, determine the height of the football at its highest point when thrown by Mahomes at a 60 degree angle.

 - b. Estimate the horizontal distance traveled by the football when Mahomes throws the football at an angle of 60 degrees. Then, dragging the crosshair tool, determine the horizontal distance traveled by the football when thrown by Mahomes at a 60 degree angle,

5. a. Using the crosshair tool on the simulator, identify 5 points on the parabolic path of the football thrown at a 60 degree angle.
- b. Using a graphing calculator or Desmos, determine a quadratic regression function to model the path of the football thrown at a 60 degree angle.
- c. Graph the above function using DESMOS at <https://www.desmos.com/calculator/iq3lygfoci> or use a graphing calculator. What is the domain and range for this graph?
6. Mahomes has said that he believes he can throw the football 100 yards under certain conditions.
Source: <https://www.cbssports.com/nfl/news/nfl-mvp-patrick-mahomes-thinks-he-could-possibly-make-a-100-yard-throw-but-only-in-one-city/>
- a. In Denver, Colorado, sitting at an elevation of 5,280 feet above sea level, where air is thinner, it has been determined by kickers and physicists that balls travel 10% further.
Source: <https://profootballtalk.nbcsports.com/2016/11/21/altitude-in-mexico-city-will-affect-the-kicking-game-tonight/>
- If Mahomes would throw a football at a 45 degree angle in Denver, how many yards would the football travel?
- b. Using research from Denver, and knowing that Mexico City sits at an elevation of 7,380 miles feet above sea level, it can be determined that footballs in Mexico City could travel 14% further.
(NOTE: The NFL has been playing one regular season game each year in Mexico City since 2016)
- If Mahomes would throw a football at a 45 degree angle in Mexico City, how many yards would the football travel?
- c. While the elevation in Denver and Mexico City helps increase yardage for quarterbacks, Mahomes will also need wind from behind to help increase distance.
- How many more yards will the wind need to assist with in order for Mahomes to reach his 100 yard goal?