

For each problem, draw a picture on a coordinate plane, clearly showing all important points. Then, write an equation and use it to answer each question. SHOW ALL WORK.

1. The main cables of a suspension bridge are 20 meters above the road at the towers and 4 meters above the road at the center. The road is 80 meters long. Vertical cables are spaced every 10 meters. The main cables hang in the shape of a parabola. Find the equation of the parabola. Then, determine how high the main cable is 20 meters from the center.
2. The outer door of an airplane hangar is in the shape of a parabola. The door is 120 feet across and 90 feet high. Find an equation describing the door's shape. If you are 6 feet tall, how far must you stand from the edge of the door to keep from hitting your head?
3. A car headlight mirror has a parabolic cross section with a diameter of 6 inches and a depth of 5 inches. How far from the vertex should the bulb be positioned if it is to be placed at the focus?
4. A doorway in a castle is shaped like a parabola. Find an equation describing the door given that it is 4 feet across and 8 feet high in the center. Determine the width of the doorway at a point 5 feet off the ground.
5. An arch in the shape of the upper half of an ellipse is used to support a bridge that is to span a river 20 meters wide. The center of the arch is 6 meters above the center of the river. Write an equation for the ellipse if the x-axis coincides with the water level and the y-axis passes through the center of the arch. How far from the edges of the arch must a boat stay to keep a person 1 meter above the water level from hitting his head on the bridge?

6. An elliptically shaped garden is surrounded by a wooden walkway. The garden is 15 meters long and 8 meters wide. The walkway is 2 meters wide. Find the equation describing the ellipse that includes both the garden and the walkway.

7. The Statuary Hall in the United States Capitol is elliptical. It measures 46 feet wide and 96 feet long. If a person is standing at one focus, her whisper can be heard by a person standing at the other focus. How far apart are the two people?

8. An arch of a bridge of a highway is semi-elliptical in shape and 42 feet across. The highest point of the arch is 14 feet above the highway. What is the maximum height, to the nearest inch, of a truck 8 feet wide that can fit under the arch? (Assume the highway is one lane)

9. A hyperbolic mirror used in some telescopes has the property that a light ray directed at its focus will be reflected to the other focus. The focus of a hyperbolic mirror has coordinates $(24, 0)$. Find the vertex of the mirror if the top edge of the mirror has a coordinate of $(24, 24)$.

10. You and a friend live 4 miles apart (on the same east-west street) and are talking on the phone. You hear a clap of thunder and 18 seconds later your friend hears the same thunder. Find the hyperbolic equation that gives the possible locations of the lightning bolt that caused the thunder you both heard. Assume sound travels at a speed of 1100 feet per second and the coordinate system is measured in feet.