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Word problems involving conic sections with answers

Solving Problems Involving Graphs of Circles — Solving Word Problems Involving Equations of Circles Explore More at As we discussed at the beginning of this section, hyperbolas have real-world applications in many fields, such as astronomy, physics, engineering, and architecture. The design efficiency of hyperbolic cooling towers is particularly interesting. Cooling towers are used to transfer waste heat to the atmosphere and are often touted for their ability to generate power efficiently. Because of their hyperbolic form, these structures are able to withstand extreme winds while requiring less material than any other forms of their size and strength. For example, a 500-foot tower can be made of a reinforced concrete shell only 6 or 8 inches wide! Figure 10. Cooling towers at the Drax power station in North Yorkshire, United Kingdom (credit: Les Haines, Flickr) The first hyperbolic towers were designed in 1914 and were 35 meters high. Today, the tallest cooling towers are in France, standing a remarkable 170 meters tall. In Example 6 we will use the design layout of a cooling tower to find a hyperbolic equation that models its sides. The design layout of a cooling tower is shown in Figure 11. The tower stands 179.6 meters tall. The diameter of the top is 72 meters. At their closest, the sides of the tower are 60 meters apart. Figure 11. Project design for a natural draft cooling tower Find the equation of the hyperbola that models the sides of the cooling tower. Assume that the center of the hyperbola—indicated by the intersection of dashed perpendicular lines in the figure—is the origin of the coordinate plane. Round final values to four decimal places. We are assuming the center of the tower is at the origin, so we can use the standard form of a horizontal hyperbola centered at the origin: [latex]\frac{{x}^{2}}{{a}^{2}}-\frac{{y}^{2}}{{b}^{2}}=1[/latex], where the branches of the hyperbola form the sides of the cooling tower. We must find the values of [latex]{a}^{2}[/latex] and [latex]{b}^{2}[/latex] to complete the model. First, we find [latex]{a}^{2}[/latex]. Recall that the length of the transverse axis of a hyperbola is [latex]2a[/latex]. This length is represented by the distance where the sides are closest, which is given as [latex]\text{ }65.3\text{ }[/latex] meters. So, [latex]2a=60[/latex]. Therefore, [latex]a=30[/latex] and [latex]{a}^{2}=900[/latex]. To solve for [latex]{b}^{2}[/latex], we need to substitute for [latex]x[/latex] and [latex]y[/latex] in our equation using a known point. To do this, we can use the dimensions of the tower to find some point [latex]\left(x,y\right)[/latex] that lies on the hyperbola. We will use the top right corner of the tower to represent that point. Since the y-axis bisects the tower, our x-value can be represented by the radius of the top, or 36 meters. The y-value is represented by the distance from the origin to the top, which is given as 79.6 meters. Therefore, [latex]\begin{array}{ll}\frac{{x}^{2}}{{a}^{2}}-\frac{{y}^{2}}{{b}^{2}}=1\hfill & \begin{array}{cccc}& & & \end{array}\text{Standard form of horizontal hyperbola}.\hfill \\ \text{ }{b}^{2}=\frac{{y}^{2}}{\frac{{x}^{2}}{{a}^{2}}-1}\hfill & \begin{array}{cccc}& & & \end{array}\text{Isolate }{b}^{2}\hfill \\ \text{ }=\frac{{\left(79.6\right)}^{2}}{\frac{{\left(36\right)}^{2}}{900}-1}\hfill & \begin{array}{cccc}& & & \end{array}\text{Substitute for }{a}^{2},x,\text{ and }y\hfill \\ \text{ }\approx 14400.3636\hfill & \begin{array}{cccc}& & & \end{array}\text{Round to four decimal places}\hfill \end{array}[/latex] The sides of the tower can be modeled by the hyperbolic equation [latex]\frac{{x}^{2}}{900}-\frac{{y}^{2}}{14400.3636 }=1,\text{or}\frac{{x}^{2}}{{30}^{2}}-\frac{{y}^{2}}{{120.0015}^{2} }=1[/latex] A design for a cooling tower project is shown in Figure 12. Find the equation of the hyperbola that models the sides of the cooling tower. Assume that the center of the hyperbola—indicated by the intersection of dashed perpendicular lines in the figure—is the origin of the coordinate plane. Round final values to four decimal places. Figure 12 Solution Problem 1 :An engineer designs a satellite dish with a parabolic cross section. The dish is 5 m wide at the opening, and the focus is placed 1 2 . m from the vertex (a) Position a coordinate system with the origin at the vertex and the x -axis on the parabola's axis of symmetry and find an equation of the parabola.(b) Find the depth of the satellite dish at the vertex.Solution : From the given information, the parabola is symmetric about x axis and open rightward.y2 = 4axhere a = 1.2y2 = 4(1.2)xy2 = 4.8 xThe parabola is passing through the point (x, 2.5)(2.5)2 = 4.8 xx = 6.25/4.8x = 1.3 mHence the depth of the satellite dish is 1.3 m.Problem 2 :Parabolic cable of a 60 m portion of the roadbed of a suspension bridge are positioned as shown below. Vertical Cables are to be spaced every 6 m along this portion of the roadbed. Calculate the lengths of first two of these vertical cables from the vertex. Solution : (x - h)2 = 4a(y - k)(x - 0)2 = 4a(y - 3)x2 = 4a(y - 3)The parabola is passing through the point (30, 16)302 = 4a(16 - 3)900 = 4a(13)a = 900/42a = 225/13x2 = 4(225/13)(y - 3)length of 1st cable :62 = 4(225/13)(h1 - 3)36(13)/4(225) = (h1 - 3)0.52 + 3 = h1h1 = 3.52 mlength of 2nd cable :122 = 4(225/13)(h2 - 3)144(13)/4(225) = (h2 - 3)2.08 + 3 = h2h2 = 5.08 mProblem 3 :Cross section of a Nuclear cooling tower is in the shape of a hyperbola with equation (x2/302) - (y2/442) = 1 . The tower is 150 m tall and the distance from the top of the tower to the centre of the hyperbola is half the distance from the base of the tower to the centre of the hyperbola. Find the diameter of the top and base of the tower. Solution :Since the distance from the top of the tower to the centre of the hyperbola is half the distance from the base of the tower to the centre of the hyperbola, let us consider 3y = 150 y = 50 (x2/302) - (y2/442) = 1By applying the point A in the general equation, we get(x12/302) - (502/442) = 1(x12/302) = 1 + (502/442) (x12/302) = (1936 + 2500)/1936(x12/302) = 4436/1936x12 = (4436) (900)/1936x1 = 45.41By applying the point B in the equation, we get(x22/302) - (1002/442) = 1(x22/302) = 1 + (1002/442) (x22/302) = (1936 + 10000)/1936(x22/302) = 11936/1936x22 = (11936) (900)/1936x2 = 74.45 m Apart from the stuff given above, if you need any other stuff in math, please use our google custom search here. If you have any feedback about our math content, please mail us : v4formath@gmail.comWe always appreciate your feedback. You can also visit the following web pages on different stuff in math. 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