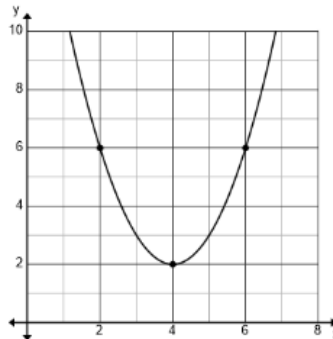


1 Pre-Calculus

Problems

1. The graph of $x^2 + y^2 - 4x + 12y + 30 = 0$ is a circle with a diameter of:
2. Let $\tan A = \frac{7}{24}$, where A is in QIII. Find $\cos A$.
3. An equivalent expression for $(\sin x + \cos x)^2 + (\sin x - \cos x)^2$ is:
4. The graph of $x^2 + y^2 + 10x - 12y - 20 = 0$ is a circle with a radius of:
5. A cliff near a lake is 125 feet high. The angle of depression of a canoe from the top of the cliff is 30° . How far is the canoe from the base of the cliff? (nearest foot).
6. Simplify: $\sin \theta \tan \theta + \cos \theta$
7. Use the angle of rotation, θ (nearest degree), where $0^\circ < \theta < 90^\circ$, to transform the conic $xy = 1$ into an equation that is in standard position and does not contain an xy term. The transformed equation is:
8. The focus of the parabola below has coordinates (a, b) . $a + b = \dots\dots\dots$

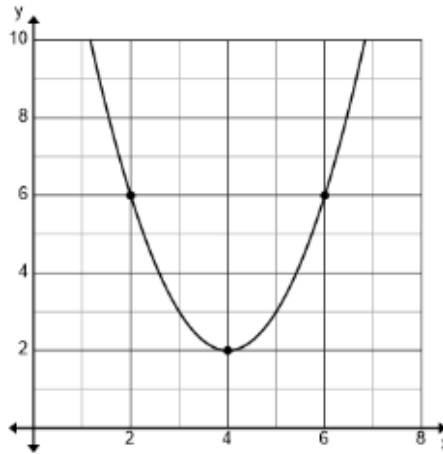


9. Find the eccentricity of the ellipse. $9x^2 + 16y^2 - 36x + 96y + 36 = 0$. (nearest hundredth)
10. Simplify: $4 \csc(2x) \cos(x)$
11. Polonium 221 has a half-life of 130 seconds. How long will it take a sample with a mass of 1.80 g to decay to a mass of 1.20 g? (nearest tenth)
12. Assume the number of hours of daylight varies sinusoidally at the Clydehurst Christian Ranch in Montana. The longest day of the year has 15 hr 30 min of daylight and the shortest day has 8 hr 30 min of daylight. How many days during the year have at least 13 hours of daylight?
13. The Holiday Inn is across the street from the Hilton. The hotels are 120 feet apart. Joe looks out the window of his room at the Holiday Inn and notices that the angle of depression to the base of the Hilton is 36° and the angle of elevation to the top of the Hilton is 44° . How tall is the Hilton? (nearest foot)
14. The graph of $r = 3 - 3 \sin \theta$ is a $\dots\dots\dots$
15. The graph of the parametric equations $x = 2 + 3 \cos \theta$ and $y = 1 + 2 \sin \theta$ is an ellipse with vertices (a, b) and (c, b) . $a + c = \dots\dots\dots$
16. If $\frac{12i+8i^4+12i^3}{\sqrt{-100+10i+6i^4}}$ simplifies to $\frac{a}{b} + \frac{c}{b}i$, then $a + b + c = \dots\dots\dots$

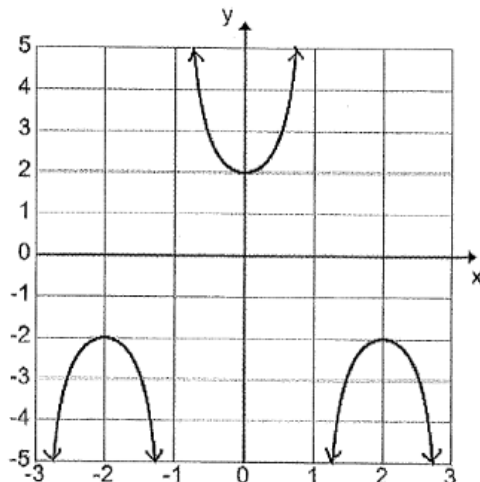
17. If $f(x) = \sec(2x)$ and $h(x) = \csc(3x)$. $f\left(\frac{5\pi}{8}\right) + h\left(\frac{11\pi}{18}\right) = \dots$. (nearest tenth)
18. Each of the wheels on Russell's jumbo wheel swamp buggy has a 4 ft diameter. When he is traveling 42 mph, what is the angular velocity of the wheels in revolutions per minute? (nearest whole number)
19. The vertex of the parabola $y = -4x^2 + 6x - 8$ is the point (a, b) . $a + b = \dots$. (nearest hundredth)
20. Multiply $(6 \operatorname{cis}(60^\circ))(-4 \operatorname{cis}(-150^\circ))$ and express the result in rectangular form.
21. Sarah released 36 bunnies into the woods near her house. Six months later the population had increased to 100 bunnies. Assume the bunny population is increasing exponentially and calculate the expected bunny population 21 months after the original release of 36 bunnies.
22. Devin drops a ball from a height of 24 feet. On each bounce, the ball rebounds three-fourths of the distance it fell. How far does the ball rebound on the tenth bounce? (nearest inch)
23. Consider $f(x) = x^3 + bx^2 + cx + d = 0$. Two of the zeroes are 5 and $2i$. $|b + c + d| = \dots$.
24. The vertices of the hyperbola $16y^2 - 9x^2 - 96y - 72x - 144 = 0$ are (a, b) and (a, c) . $b + c = \dots$.
25. Consider a parabola with vertex $\left(\frac{3}{2}, \frac{1}{4}\right)$. If the point $(-2, 4)$ lies on the graph of the parabola, which of the following points also lies on the graph of the parabola? The graph is concave up.
(A) $(2, -2)$ **(B)** $(3, 0)$ **(C)** $(4, 2)$ **(D)** $(5, 4)$ **(E)** $(6, 6)$
26. Find the angle between the line $3x - y = 6$ and the line $4x + 5y = 9$. (nearest tenth)
27. The graph of the polar equation $r = 3 - 3 \cos(\theta)$ is a \dots .
28. The graph of the parametric equations $x = 13 \cos(\theta)$ and $y = 5 \sin(\theta)$ is an ellipse with a foci (a, b) and (c, b) . $|a - c| = \dots$.
29. Consider the sphere $x^2 + y^2 + z^2 + 4x - 6y + 2z - 11 = 0$. Find the volume of the sphere. (nearest tenth)
30. The unit vector orthogonal to both $u = 2i - 3j + 4k$ and $v = -2i + 5j - 7k$ is the vector $\frac{a}{\sqrt{53}}i + \frac{b}{\sqrt{53}}j + \frac{c}{\sqrt{53}}k$. $a + b + c = \dots$.
31. Which of the following is not one of the fourth roots of $16(\cos 120^\circ + i \sin 120^\circ)$?
(A) $-\sqrt{3} - i$ **(B)** $\sqrt{3} + i$ **(C)** $1 - \sqrt{3}i$ **(D)** $-\sqrt{3} + i$ **(E)** $-1 + \sqrt{3}i$
32. Suppose Calvin has 112 mg of bismuth-214 at 12:15 PM. His sample undergoes radioactive decay and is reduced to 74.562 μg at 3:45 PM the same day. Find the half-life of bismuth-214. (nearest tenth)
- For problems 33 and 34, consider the parabola with equation $9y = 2x^2 - 8x - 46$.
33. The vertex of the graph of the parabola is the point $P(a, b)$. $a + b = \dots$.
34. The equation of the directrix of the graph of the parabola is $y = \dots$.
35. Consider the ellipse with equation $16x^2 + 9y^2 + 64x - 54y + 1 = 0$. The vertices of the graph of the ellipse are (a, b) and (a, c) . $a + b + c = \dots$.
36. Consider the hyperbola with equation $9x^2 - 4y^2 - 108x - 16y + 272 = 0$. The eccentricity of the hyperbola is \dots . (nearest tenth)
37. A stick in the ground is 4 ft 8 in tall and it casts a shadow that is 6 ft 2 in long. At the same time, the Newcastle State Bank casts a shadow that is 90 ft long. How tall is the bank? (nearest foot)
38. A guy wire runs from the ground to the top of a 42-foot pole. The angle formed between the wire and the pole is 44° . How far from the base of the pole is the wire attached to the ground? (nearest tenth)
39. Given $\vec{v} = \langle 1, 2, 3 \rangle$ and $\vec{w} = \langle 4, 5, 6 \rangle$. The unit vector in the direction $2\vec{v} + 3\vec{w}$ is the vector $\left\langle \frac{a}{d}, \frac{b}{d}, \frac{c}{d} \right\rangle$ where $d = \dots$. (nearest hundredth)
40. Consider the circle $x^2 + y^2 + 14x - 6y + 9 = 0$. The area of the circle is \dots . (nearest tenth)

41. If a 56-ft-tall tree produces a shadow that is 12 ft long, how long will the shadow be for a person that is 5 ft tall? (nearest hundredth)
42. The graph of the circle $x^2 + y^2 = 49$ and the graph of the line $y = 0.6x + 5$ intersect at points A and B . $AB = \dots\dots\dots$ (nearest tenth)
43. The graph of $y = 3 \tan(.25x)$ has a vertical asymptote at $x = \dots\dots\dots$.
44. The relation $\{(0, 0), (2, 2), (2, -2), (6, 8), (6, -8)\}$ is:
45. A hawk is perched at the edge of a roof of the Denver City State Bank. The hawk spots a mouse on the ground below. The angle of depression from the hawk to the mouse is 22° . The mouse is located 154 feet from the base of the bank. How tall is the Denver City State Bank? (nearest foot)
46. On March 1st of 2015, Piyush's father placed \$75,000 into an account for Piyush that earns interest at a rate of 6.75% compounded quarterly. Piyush plans to withdraw all of the money in the account on March 1st of 2025 and use it toward the purchase of a new BMW X7 From Grapevine BMW. If the total cost including tax, title and license is \$146,875.19 how much money will Piyush have to come up with? (nearest dollar)
47. Consider the circle $x^2 + y^2 + ax + by + c = 0$. The center of the circle is at the point $(2, 5)$ and the diameter is 14. $a + b + c = \dots\dots\dots$.
48. A population of Fire Ants is increasing exponentially in Hale County. Phoenix introduced a population of 150 ants at $t = 0$. At $t = 60$ days, the population reached 1800 ants. The population should reach 212,000 ants at $t = \dots\dots\dots$ days. (nearest whole number)
49. Austin leaves the Lubbock airport at 2:00 PM and flies on a bearing of 60° at a speed of 180 mph. At 2:30 PM, Zhikai leaves the Lubbock airport and flies on a bearing of 195° at a speed of 160 mph. How far apart are they at 4:00 PM? (nearest mile)
50. Consider an ellipse centered at $(4, 3)$ with a vertex at $(-2, 3)$. The point $(4, 7)$ lies on the ellipse. The area of the ellipse is $\dots\dots\dots$ (nearest tenth)
51. Consider the curve represented by the parametric equations $x = 6 \cos(\theta)$ and $y = 4 \sin(\theta)$. The distance between the foci is $\dots\dots\dots$ (nearest tenth)
52. Given: $\vec{v} = \langle 1, 2, 3 \rangle$ and $\vec{w} = \langle 4, 6, 8 \rangle$. The unit vector in the direction of $2\vec{v} + 3\vec{w}$ is the vector $\langle \frac{a}{d}, \frac{b}{d}, \frac{c}{d} \rangle$ where $d = \dots\dots\dots$ (nearest hundredth)
53. Consider the hyperbola with equation $4y^2 - 9x^2 + 16y + 108x - 344 = 0$. The eccentricity of the hyperbola is $\dots\dots\dots$ (nearest tenth)
54. Geometry class ends when the bell rings at 8:50. Bo Ring looks at the circular clock and sees that the time is 8:30. How much bigger is the angle formed by the hands at 8:30 then the angle formed when the bell rings?
55. The $\dots\dots\dots$ of a hyperbola is equal to the ratio of the distance between the center and a focus to the distance between the center and the corresponding vertex.
56. The highest average monthly temperature for Miller's View is 78.5° F and occurs in July. The lowest average monthly temperature occurs in January and is 43.5° F. The average monthly temperature of Miller's View varies sinusoidally with the month. What would be the predicted average temperature for May? (nearest tenth)
57. If the $\cos A = .96$ and A is in QIV, then $\cot A$ is:
58. Which of the following is NOT a solution for $\cos \theta + 1 = \cos^2 \theta$?
- (A) $\frac{8\pi}{3}$ (B) $\frac{4\pi}{3}$ (C) $-\frac{2\pi}{3}$ (D) $-\pi$ (E) -4π
59. $(1 - i)^7$ equals:

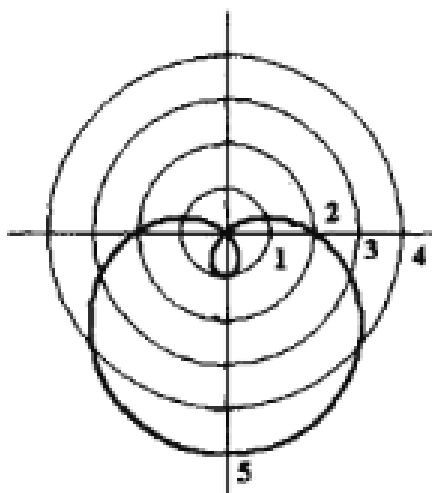
60. A ramp rises $\frac{1}{4}$ inch for every foot of run. Find the angle the end of the ramp makes with the ground if the ramp is 12 feet long. (nearest tenth of a degree)
61. If $3 \sin \theta + 4 \cos \theta = 5$ then $\tan \theta$ is:
62. The directrix of the parabola $y = -(x^2 + 2x + 5)$ is $y = \dots\dots\dots$
63. How many points of intersections do the graphs of $r = 3 \cos \theta$ and $\theta = -\frac{\pi}{2}$ have?
64. Diamond Jim deposited some money in a savings account 30 months ago at a rate of 2.5% compounded monthly. His current balance is \$553.50. How much was his original deposit?
65. The equation $y = \dots\dots\dots$ will produce this graph.



66. Determine the type of conic section this equation $x^2 + 2xy + y^2 - 6x - 6y + 9 = 0$ will produce.
67. Determine the period of the function $y = 3 - 2 \cos\left(\frac{x}{4} + \pi\right)$
68. How many points of intersections are there for the curves $r = 2 \sin \theta$ and $r = 2 \sin \theta$?
69. The directrix for the parabola $-8y = x^2$ is $y = \dots\dots\dots$
70. Let $\frac{6x^2}{5} - \frac{3xy}{2} + \frac{19y^2}{5} - 4 = 0$. What is the angle of rotation from its parent function? (nearest degree)
71. Vector $v = (8, 6, -2)$ and vector $u = (-4, x, 1)$. Find x if the dot product of vectors u and v is 2.
72. A porch is 3 feet high. A ramp is built to reach from the porch to the ground with an angle of elevation of 15° . How far from the base of the porch does the ramp touch the ground? (nearest inch)
73. Two circles, $(x - 2)^2 + (y - 5)^2 = 25$ and $(x - 6)^2 + (y - 13)^2 = 65$, intersect at two points. Find the equation of the line passing through the two points of intersection.
74. Find the unit vector in the same direction as $(8, 15)$.
75. Find the value of $\sin(\arcsin \frac{1}{2} - \arccos \frac{1}{2})$.
76. A scout troop leaves their vehicles and travels on a hike of 2 km on a bearing of 45° to Camp Fife for a swim. Then they travel 3 km on a bearing of 135° to the scout lodge for lunch. What is the least distance they will have to hike to return to their vehicles? (nearest tenth)
77. The equation $y = \dots\dots\dots$ will produce this graph.

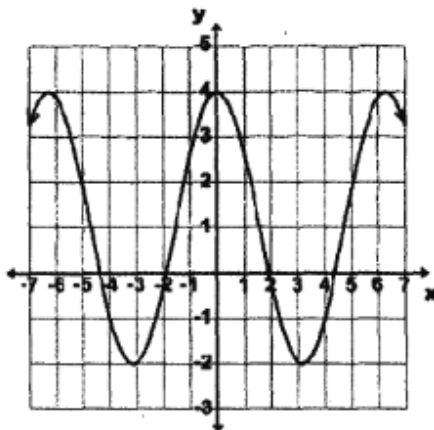


78. A line perpendicular to the axis of symmetry of a parabola is called the
79. A laser beam from the top of a 30-ft building hits an object on the ground 100 ft from the base of the building. The angle of depression of the laser to the object is: (nearest second)
80. Find the largest value of θ is $6 \cos^2 \theta + \cos \theta = 2$ and $\pi \leq \theta \leq 2\pi$.
81. Simplify $\sin \theta \cot \theta \sec \theta - \cos^2 \theta$.
82. The directrix of the parabola $8y = x^2 - 4x + 12$ is:
83. Which of the following polar equations will produce this graph on the polar grid?

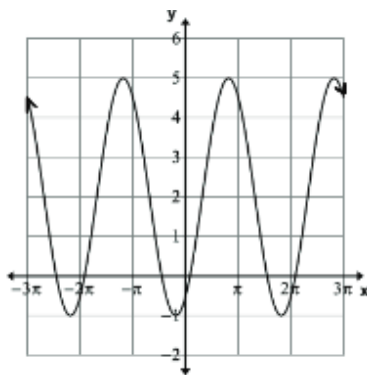


84. Pop Eye takes his family sailing. They leave dock A and sail 1.5 miles on a course of 30° to buoy B. They turn and travel 1.75 miles on a bearing of 110° to buoy C. How far is it from buoy C to dock A? (nearest tenth)
85. Use the angle of rotation, θ (nearest degree), where $0^\circ < \theta < 90^\circ$, to transform the conic $x^2 + xy + y^2 = 3$ into an equation that does not contain an xy term. The equation is:
86. The circles $x^2 + y^2 + 3x - 6y + 5 = 0$ and $2x^2 + 2y^2 + 5x - 6y + 3 = 0$ intersect in two points. The slope of the line through the two points of intersection is:

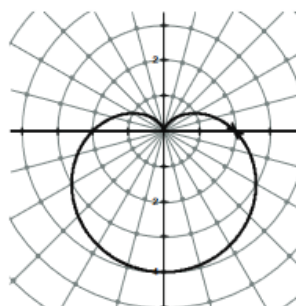
87. It is precisely 2:45 pm on a circular clock. What is the measure of the smaller angle formed by the minute hand and the hour hand of the clock?
88. $y^2 - x^2 = 0$ is an equation of a degenerate conic. Which of the following is the best graphical representation of this equation?
89. Vector $v = (2, 9)$ is perpendicular to vector $w = (4, k)$. Find k .
90. The graph shown is the graph of which of the following equations.



91. Point P has polar coordinates of $(4, \frac{2\pi}{3})$ and rectangular coordinates of (x, y) . Where does point P lie on the Cartesian coordinate plane?
92. Willie Dublett deposits \$500 in a bank account with an interest rate of 2.5% compounded monthly. How many months will it take for his balance to reach \$750?
93. Determine the range of $f(x) = 2 + 3 \cos(4x - 5)$.
94. A ramp is 18 ft. long and the angle of elevation of the ramp from the ground to the platform is $15^\circ 10' 5''$. Find the height of the platform. (nearest approximation)
95. The point $P(2, 1)$ is rotated clockwise around the origin to point $(-1, -2)$. The angle of rotation, to the nearest degree, is:
96. The center of the circle, $x^2 + y^2 - 4x - 6y + 9 = 0$, is _____units from the origin. (nearest tenth)
97. A Ferris wheel has a radius of 7 meters and turns at 6 revolutions per minute. The bottom of the Ferris wheel is 1 meter above the ground. The height h of a passenger above the ground varies sinusoidally with time t . Which of the following equations best describes the relationship between h and t ?
98. Which of the following is true about the relation $f(x) = x^2 + 2x + 2$?
99. How many leaves are in the "rose" curve graph of the polar equation $r = 3 - 4 \sin(2\theta + 5)$?
100. Which of the following is a reference angle for 1645° ?
101. If you start at $(-1.5, 0)$ on the x -axis and travel horizontally 12 radians to the right, how many times will you cross the graph of $y = \sin(3x)$?
102. Tye Guhr drops a golf ball from a height of 10 feet. It bounces back to a height of 60% of the distance it fell. How far has it traveled when it hits the ground the fourth time? (nearest inch)
103. Babe, Dizzy, and Yogi are playing "toss and catch" with a baseball. The bearing from Babe to Dizzy is 254° . The bearing from Yogi to Dizzy is 344° . The bearing from Yogi to Babe is 32° . The distance from Yogi to Dizzy is 20 feet. How far is it from Yogi to Babe? (nearest inch)
104. The equation $y = \text{_____}$ will produce this graph.

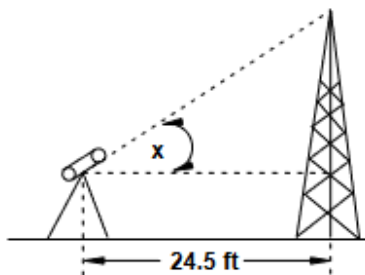


105. Which of the following is a reference angle for 456° ?
106. Which of the following polar equations will produce this graph on a polar grid?

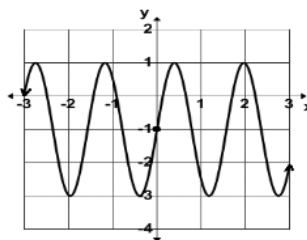


107. The graph of $4x^2 + 9y^2 - 16x + 18y = 2$ is a(n):
108. The eccentricity of the hyperbola $4x^2 - y^2 = 4$ is:
109. If $\cos \theta < 0$ and $\tan \theta < 0$ which quadrant will θ terminate in?
110. Let $\|V_1\| = 15$ and $\|V_2\| = 9$, where the direction angles of V_1 and V_2 are 20° and 80° , respectively. Find $\|V_1 + V_2\|$. (nearest tenth)
111. $\sin \theta \sec \theta + \cos \theta \csc \theta$ is equivalent to:
112. Willie Ketchit drops a golfball from a height of 10 meters. Each time it hits the ground it rebounds to a height of 50% of the distance it fell. Find the total distance the golfball travels when it reaches the ground the third time. (nearest tenth)
113. The graph of $x^2 - 2xy + y^2 + 0x + 0y + 0 = 0$ is a
114. Which of the following is equivalent to $\frac{\sin \theta \tan \theta}{\sin(90^\circ - \theta)} + \frac{\cot \theta}{\tan(90^\circ - \theta)}$?
115. If $\cos x - \sin x = a$ and $\cos x + \sin x = b$, then $\cos^2 2x = ?$
116. Let $\|V_1\| = 9$, $\|V_2\| = 8$, where the direction angles of V_1 and V_2 are 60° and 150° , respectively. Find the direction angle of $\|V_1 + V_2\|$. (nearest degree)
117. The focus of the figure given by the equation $x^2 + 6x - 12y + 57 = 0$ is (x, y) . Find x .
118. Sir Vayor is trying to find the height of a flagpole. His eyes are 1.7 meters above the ground and he is standing 10 meters from the base of the pole. The angle of elevation from his eyes to the top of the pole is 60° . Using this information, Sir Vayor computes the top of the flagpole to be: (nearest meter)
119. Using the equation $y = \frac{3}{4} \cos(2x - \frac{\pi}{3}) - 1$ which of the following has the largest numeric value?

120. The circles $(x - 3)^2 + (y + 1)^2 = 16$ and $(x - 4)^2 + (y - 2)^2 = 9$ intersect in two points. The slope of the line through the two points of intersection is:
121. Determine the range of $f(x) = 2 - 4 \cos(x + 3)$.
122. $\frac{\sin \theta}{1 + \cos \theta} + \frac{1 + \cos \theta}{\sin \theta}$ is equivalent to:
123. Captain Ed Inberg went sailing on Lake Falcon. He sailed his scow from the dock 8 km on a bearing of 40° . Then he changed course and sailed 5 km on a bearing of 120° . Then he decided to return to the dock. What bearing will Captain Ed have to sail to go straight back to the dock?
124. Given: $f(x) = 2 - 4 \sin(x + 3)$. What quadrant(s) would the graph of $f(x)$ be in if the amplitude is cut in half, the vertical displacement is decreased by 5 and the phase shift is increased by 1?
125. The Hole-In-One golf shop has periodic sales given by the function $G(m) = 5 + 5 \cos\left(\frac{\pi}{3}(m + 3)\right)$ where m is the number of months and $G(m)$ is the number of golf sets sold. If the store opened on Jan. 1, when did the maximum sales first occur?
126. If you start at $\left(\frac{7\pi}{2}, 0\right)$ on the x -axis and travel horizontally 15.7 radians to the left, how many times will you cross the graph of $y = 2 \sin(3x)$?
127. Given: $f(x) = 3 \cos[4\pi(x + 1)] - 2$. Find the sum of the numeric values of the period and the vertical displacement.
128. Meagan Money invested some money in the stock market. Her investment increased 8% by the end of the first year, decreased 2% by the end of the second year, and increased 12% by the end of the third year. What was Meagan's average rate of return over the three year period? (nearest tenth)
129. The vertex of a parabola is located at $(3, 1)$ and the focus is located at $(3, 3)$. Find the directrix of the parabola.
130. Given the function $f(x) = \sin x$, find the slope of the secant line between $x = 0$ and $x = \frac{\pi}{2}$.
131. Sir Benjamin Hall was looking at the circular face of the famous Big Ben clock. He noted that the time was 5:43 pm. What was the measure of the acute angle formed by the big hand and the little hand at that time?
132. Chip Shought hit his gold ball over a pond onto the edge of the green. He had to walk around the pond to his ball. He walked 70 yards on a bearing of 250° from the tee. Then he walked 90 yards on a bearing of 50° to his ball. What was the straight line distance from the tee to his ball? (nearest yard)
133. I. C. Itt spotted a plane flying over his house. He noted that the angle of elevation from him to the plane was $32^\circ 40'$ and he was 1,530 meters from his house. Using this information I. C. was able to determine the altitude of the plane. What was the altitude of the plane? (nearest meter)
134. If x is in QIII then $\frac{1 - \cos(2x)}{\sin(2x)} = \tan kx$ and k equals:
135. Given: $f(x) = 3 - 2 \sin(x + 4)$, where the domain is $x | x \in \text{Reals}$ and the range is $\{f(x) | a \leq f(x) \leq b \text{ and } y \in \text{Reals}\}$. Which of the following is not in the range?
(A) 1.5 **(B)** 3.124 **(C)** 2.04 **(D)** 5.333... **(E)** 4.75
136. The expression $(1 - \cos \theta)(1 + \cos \theta)(1 + \cot^2 \theta)$ is equivalent to:
137. $e^{3i} = \cos(3) + i \sin(3)$ is an example of _____ formula.
138. A circle with its center at the origin on the Cartesian x - y coordinate system has a radius of 3 units. If you start at $(-3, 0)$ and travel on the circle $\frac{8\pi}{3}$ radians in a clockwise direction, where on the x - y coordinate plane will you stop at?
139. Sir Vayor used his theodolite to measure the height of the tower to be 17 ft 4" tall. His theodolite was 5 ft from the level ground. What angle x did he use to compute the height? (nearest second)



140. The graph of $f(x)$ shown below has a frequency of $0.6366197\dots$. Find $f(5.7)$. (nearest tenth)

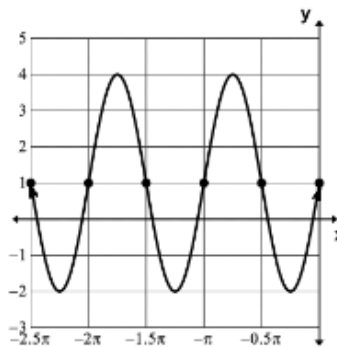


141. The center of a circle is in quadrant IV and the circumference of the circle is 16π . The equation of the circle is $x^2 + y^2 + ax + 8y - 39 = 0$. The value of a is _____.
142. If the distance from the point $(e, -12)$ to the line $y = \frac{3}{5}x + 6$ is $\frac{66}{\sqrt{34}}$, then $e =$ _____. ($e > -15$)
143. Consider the conic with equation $9x^2 - 4y^2 - 36x - 24y - 36 = 0$. If the coordinates of the foci are (a, b) and (c, b) then $a + b + c =$ _____. (nearest tenth)
144. Two cables are attached to a vertical tower from a point on the ground. The angle between the cables is 20° . The longer cable is 270 feet long and is attached to the top of the tower. The shorter cable is attached to the tower 105 feet below the top of the tower. Find the length of the shorter cable. (nearest whole number)
145. Assume the temperature on a typical day in January in Idaho Falls varies sinusoidally with a low of 12°F at 5:00 AM and a high of 29°F at 5:00 PM. What is the expected temperature at midnight? (nearest tenth)
146. Angle A is in quadrant II and angle B is in quadrant III. If $\sin A = \frac{3}{5}$ and $\cos B = -\frac{5}{13}$, then $\tan(A+B) =$ _____. (nearest hundredth)
147. Find the angle between the vectors $u = \langle 4, -6 \rangle$ and $v = \langle 12, 8 \rangle$ is _____.rad. (nearest hundredth)
148. Consider the sequence $1, 5, 12\frac{1}{2}, 20\frac{5}{6}, 26\frac{1}{24}, \dots$. Find the eight term in the sequence (nearest hundredth)
149. A ball is dropped from a height of six feet and begins bouncing. Each bounce is three-fourths of the height of the previous bounce. Which bounce is the first bounce in which the height of the bounce is less than one foot?
150. Consider an ellipse in which the vertices are $(0, 4)$ and $(10, 4)$ and the endpoints of the minor axis are $(5, 2)$ and $(5, 6)$. What is the eccentricity of the ellipse? (nearest hundredth)
151. A boat is 2000 km in front of you at an angle of 60° East of North. If you want to reach the boat in 4 hours, at what speed should you travel? (nearest tenth)
152. $y^2 - x^2 = 0$ is an equation of a degenerate conic. Which of the following is the best graphical representation of this equation?
153. What is the wavelength of $y(x) = a + b \sin\left(\frac{n\pi x}{L}\right)$?
154. Where V_1 and V_2 are vectors in \mathbb{R}^2 , if the norm of V_1 is 6, the norm of V_2 is 9, and the angle between them is 30 , what is the norm of $V_1 + V_2$? (nearest tenth)

155. Rachel accepted a job with a salary of \$95,000 the first year. During the next 19 years, she was given a 6% raise each year. Find the total compensation she received over the 20-year period. (nearest dollar)
156. Given: $\sin(u) = -\frac{24}{25}$ and $\cos(v) = -\frac{3}{5}$. Both u and v are in quadrant III. Evaluate $\sec(u - v)$.
157. Audrey invested \$100,000 for 4 years. If the interest was compounded monthly rather than quarterly, she would have made \$345.93 more. What was the annual interest rate? (nearest hundredth)
158. Assume July temperatures vary sinusoidally in Denali National Park with a low of 48° at 4:00 AM and a high of 68° at 4:00 PM. The number N of brown bears that are visible from Keith's campsite is given by $N(t) = (T - 46^\circ)$, $48^\circ \leq T \leq 68^\circ$, where $N(t)$ = the number of brown bears visible at time t and T is the temperature. How many brown bears are visible from Keith's campsite at 12:00 PM?
159. The circle $(x - 6)^2 + (y - 12)^2 = 20$ is tangent to the circle $x^2 + y^2 = 80$. The common internal tangent is a line with x -intercept $(a, 0)$ and y -intercept $(0, b)$. $a + b = \dots\dots\dots$ (nearest whole number)
160. Justin obtained a sample of radioactive plutonium 234 at 5:00 AM on Wednesday. Only 1.510 g remained at 5:00 AM on Thursday and only 0.501 g remained at 7:00 PM on Thursday. Find the amount of plutonium Justin originally obtained. (nearest thousandth)

For questions 161 and 162, consider the graph of a parabola with vertex $V(2, -6)$. Points $P(0, -4)$ and $Q(0, -8)$ both lie on the graph of the parabola.

161. The equation of the directrix of the graph of the parabola is $x = \dots\dots\dots$.
162. Point $T(a, 0)$ lies on the graph of the parabola and point $F(e, f)$ is the focus of the graph of the parabola. $FT = \dots\dots\dots$ (nearest tenth)
163. Ship A leaves port at 1:00 PM and travels at an average speed of 18 mph on a bearing of 144° . Ship B leaves port at 3:00 PM and travels at an average speed of 24 mph on a bearing of 284° . At what time will the ships be 155 miles apart? (nearest minute)
164. Consider an ellipse such that for any point $P(e, f)$ that lies on the ellipse, the distance from P to the point $(2, 4)$ plus the distance from P to the point $(14, 4)$ equals 40. If the equation of the ellipse is $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$, then $b = \dots\dots\dots$ (nearest tenth)
165. The graph of $4x^2 + 5xy + 2y^2 - 16 = 0$ is an ellipse in which the axes have been rotated $\dots\dots\dots^\circ$. (nearest whole number)
166. The expression $(\sin \theta + \cos \theta)^2 - 1$ is equivalent to:
167. Which of the following equations is represented by the graph shown?



168. Find the sum of the x -values in $\{x \mid 2 \cos^4(x) - 3 \cos^2(x) + 1 = 0, x \in [-\pi, \frac{3\pi}{2}]\}$. (nearest hundredth)
169. A parabola has a vertical axis of symmetry with a vertex at $(1, 4)$ and focus at $(1, 2)$. Find the equation of the directrix of this parabola.

170. The Wind Gust electric company erected a wind turbine 1500 yards from the main station on a bearing of 110° . They erected a second wind turbine 800 yards from the main station at a bearing of 300° . How far apart were the two turbines? (nearest yard)
171. Kanyu Emahjun changed the rectangular point $(-1, 4)$ to the polar point (r, θ) . Kanyu found the sum of r and θ to be: (nearest whole number)
172. How many points of intersections are there for the curves $r = 1 + 3 \cos \theta$ and $\theta = \frac{1}{3}$?

Solutions

1. 6.3 units
2. $-\frac{24}{25}$
3. 2
4. 9
5. 217 ft
6. $\sec \theta$
7. $x^2 - y^2 = 2$
8. $6\frac{1}{4}$
9. 0.66
10. $2 \csc(x)$
11. 76.0 s
12. 148
13. 203 ft
14. cardioid
15. 4
16. 81
17. -3.4
18. 294 rpm
19. -5.00
20. 24i
21. 1286
22. 16 in
23. 21
24. 6
25. D
26. 69.8°
27. cardioid
28. 24
29. 523.6

30. 11
31. D
32. 19.9 min
33. -4
34. $-\frac{57}{8}$
35. 4
36. 1.8
37. 68 ft
38. 40.6
39. 33.66
40. 153.9
41. 1.07 ft
42. 11.1
43. 2π
44. not a function
45. 62 ft
46. \$400
47. -34
48. 175
49. 556 mi
50. 75.4
51. 8.9
52. 39.75
53. 1.2
54. 40°
55. eccentricity
56. 69.8°
57. $-3\frac{3}{7}$
58. D
59. $8 + 8i$
60. 1.2°
61. $\frac{3}{4}$
62. -3.75
63. 1
64. \$520.00
65. $5 - 2 \sin \frac{1}{3}(-4x + 5\pi)$

- 66. line
- 67. 8π
- 68. 1
- 69. 2
- 70. 15°
- 71. 6
- 72. $11' 2''$
- 73. $x + 2y = 17$
- 74. $(\frac{8}{17}, \frac{15}{17})$
- 75. $-\frac{1}{2}$
- 76. 3.6 km
- 77. $2 \sec(\frac{\pi}{2}x)$
- 78. directrix
- 79. $16^\circ 41' 57''$
- 80. $\frac{5\pi}{3}$
- 81. $\sin^2 \theta$
- 82. $y = -1$
- 83. $r = 2 - 3 \sin \theta$
- 84. 2.5 miles
- 85. $3x^2 + y^2 = 6$
- 86. $\frac{1}{6}$
- 87. 172.5°
- 88. intersecting lines
- 89. $-\frac{8}{9}$
- 90. $y = 1 + 3 \cos(x)$
- 91. QII
- 92. 195
- 93. $[-1, 5]$
- 94. $4' 8.52''$
- 95. 143°
- 96. 3.6
- 97. $h = 8 - 7 \cos(\frac{\pi}{5}t)$
- 98. neither even nor odd function
- 99. 4
- 100. 25°
- 101. 11

- 102. 33' 6"
- 103. 29' 11"
- 104. $2 + 3 \sin(x - 1)$
- 105. 84°
- 106. $r = 2 - 2 \sin \theta$
- 107. ellipse
- 108. $\sqrt{5}$
- 109. QIII only
- 110. 21.0
- 111. $\frac{\sec^2 \theta}{\tan \theta}$
- 112. 25.0 m
- 113. hyperbola
- 114. $\sec^2 \theta$
- 115. $2ab$
- 116. 48°
- 117. $(-3, 4)$
- 118. 13 m
- 119. period
- 120. $-\frac{1}{3}$
- 121. $[-2, 6]$
- 122. $2 \csc \theta$
- 123. 249°
- 124. III & IV
- 125. 3 months
- 126. 15
- 127. -1.5
- 128. 5.8%
- 129. $y = -1$
- 130. $\frac{2}{\pi}$
- 131. 86.5°
- 132. 34 yds
- 133. 981 meters
- 134. 1
- 135. D
- 136. 1
- 137. Euler's

138. Quadrant I
139. $26^\circ 43' 15''$
140. -2.4
141. -6
142. -8
143. 1.0
144. 204 ft
145. 18.3°F
146. 0.59
147. 1.57
148. 15.50
149. 7
150. 0.92
151. 8.3 km/min
152. intersecting lines
153. $2L/n$
154. 11.6
155. \$3,494,631
156. $\frac{125}{117}$
157. 8.66%
158. 17
159. 30
160. 10.008 g
161. $\frac{5}{2}$
162. 18.5
163. 6:04 PM
164. 19.1
165. 34
166. $\sin 2\theta$
167. $3 \cos(2x - \frac{\pi}{2}) + 1$
168. 3.93
169. $y = 6$
170. 2,292 yds
171. 6
172. 3