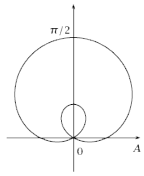
1. D Limacon



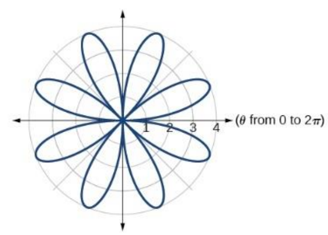
2. A When you draw the point, it graphs in the second quadrant. By Pythagorean Theorem, I can find the radius to be 4. Using my special right triangles, I can see this is a 30-60-90 triangle, which makes the reference angle 60 degrees. From the polar axis, this angle is 120 degrees. $(4, 120°)$

3. B First we solve for how much of the circle is intercepted: $\frac{\pi/_8\, rad}{x\ degrees} = \frac{2\pi\ rad}{360\ degrees}$;

$$x = 22.5\ degrees\ or \frac{1}{16} of\ a\ circle$$

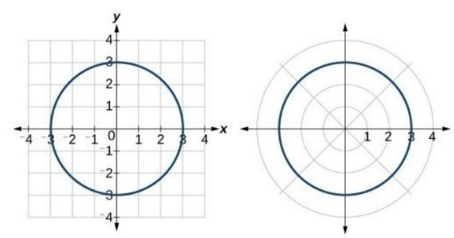
Then we can multiple that length by 16 to find the full circumference. We are asked for diameter, so we must divide by pi.

4. E Because the length of the petals are 4, that is the coefficient. Because there are 8 petals, that means we use 4θ.Because the petals are not on the polar axis, we use the sine function.



$r = 4\sin(4\theta)$

5. C The rectangular (a) and polar (b) equations for the graphs given:



(a) (b)

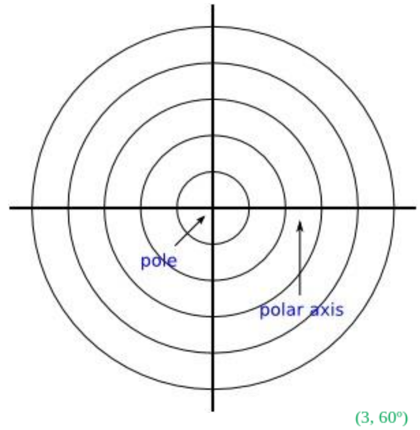
$x^2 + y^2 = 9\,; r = 3$

***Remember that in a rectangular equation, it is equal to the radius squared!*

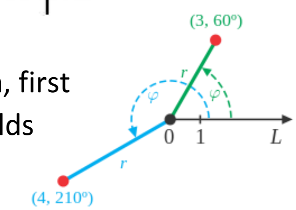
6. A $\sqrt{41 - 10\sqrt{2} + 10\sqrt{6}}$To find the distance between the following polar points: $\left(-4, \frac{\pi}{3}\right)$ and $\left(5, \frac{3\pi}{4}\right)$ we must use the law of cosines. The sides of the triangle are the two radii and the distance between the points. $c^2 = 5^2 + 4^2 - (2)(5)(4)cos105°$. To find the cosine of 105 degrees, we must use the sum formula: $\cos(105) = \cos(60 + 45) = cos60cos45 - sin45sin60 = \sqrt{2} - \sqrt{6}/_4$. $c^2 = 41 - 10(\sqrt{2} - \sqrt{6})$

7. A Hyperbola symmetric about x-axis

8. D The missing information for a polar graph:



9. D $\left(\frac{3}{4}-\sqrt{3},\frac{3\sqrt{3}}{4}-1\right)$



To find the midpoint between the two polar points in rectangular form, first we must find the points in rectangular form: $x = r\cos\theta \; y = r\sin\theta$ yields $\left(\frac{3}{2}, {}^{3\sqrt{3}}/_{2}\right)$ and $\left(-2\sqrt{3},-2\right)$. Then we use the midpoint formula by just averaging the x coordinates and then averaging the y coordinates.

10. A To simplify $[-4+4i]^4 = \left[4\sqrt{2}cis\, {}^{3\pi}/_{4}\right]^4 = \left[\left(4\sqrt{2}\right)^4 cis\, {}^{(4)3\pi}/_{4}\right] = 1024[cos\pi + isin\pi]$

****Note that 3pi and pi are on the same location on the unit circle.*

11. C $(3+3i)\left(-2-2\sqrt{3}i\right) = 12\sqrt{2}[cos285° + isin285°]$ and leave in the trigonometric form of a complex number.

12. B To find the largest wheel's angular speed: $\frac{4mi}{hr}\cdot\frac{5280ft}{1mi}\cdot\frac{2\pi rad}{4\pi ft}\cdot\frac{1hr}{60min}176$

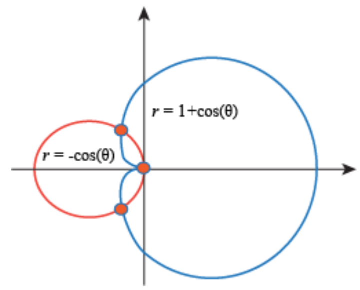
To find the smallest wheel's angular speed: $\frac{4mi}{hr}\cdot\frac{5280ft}{1mi}\cdot\frac{2\pi rad}{{}^{4}/_{3}\pi ft}\cdot\frac{1hr}{60min} = 528$

528-176=352

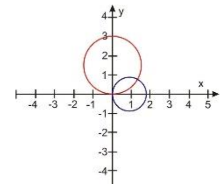
13. B From $\theta = {}^{-\pi}/_{12} = -15°$ to his terminal value of $\theta = {}^{2\pi}/_{9} = 40°$ is a difference of 55 degrees. $\frac{55}{360}2\pi(14) = {}^{77\pi}/_{18}$ is the portion of the circumference that he traveled on the circle.

14. B $-cos\theta = 1 + cos\theta$; $2cos\theta = -1$; $cos\theta = -\frac{1}{2}$

$\theta = {}^{2\pi}/_{3}, {}^{4\pi}/_{3}$ $\left(\frac{1}{2}, {}^{2\pi}/_{3}\right), \left(\frac{1}{2}, {}^{4\pi}/_{3}\right)$ $Sum = 2\pi + 1$



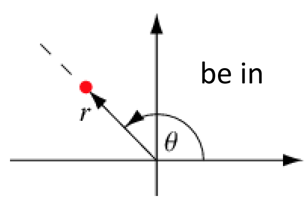
15. B To find the $\cos^2\theta$ of the point of intersection (r, θ) not at the pole for the circles with diameters of length 3 and $\frac{7}{4}$, $3sin\theta = \frac{7}{4}cos\theta$; $sin\theta = \frac{7}{12}cos\theta$; $\sin^2\theta + \cos^2\theta = 1$; $\frac{49}{144}\cos^2\theta \; + \cos^2\theta = 1$; $\cos^2\theta = \frac{144}{193}$



16. C To classify the polar conic section, you must solve for the eccentricity. The 3 in the equation must be a 1 to determine this, so we will divide everything by 3. That makes the coefficient of the sine function 2/3, which is the eccentricity. We have an ellipse! Then to find the polar coordinates of its vertex/vertices, we notice the graph will be on the y-axis because of the sine function. The unit circle values on the y-axis are 90 and 270 degrees. By substituting those values into the equation, we get the vertices: $Ellipse \; (24, {}^{\pi}/_{2}), ({}^{24}/_{5}, {}^{3\pi}/_{2})$

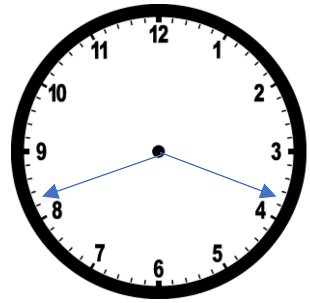
17. A The area enclosed by the following set of parametric equations can be found using the basic formula for a circle, $A = \pi r^2$. I can see this is a circle from the identity: $\sin^2 x + \cos^2 x = 1$; $\left(\frac{x}{6}\right)^2 + \left(\frac{y}{6}\right)^2 = 1$; $x^2 + y^2 = 36$

18. C You can tell which of the following polar coordinates would not be in the Quadrant shown by using the approximation for pi is 3.14. 5 radians is more than half way around the circle, so (4,5) is not in the second quadrant.



19. A Hyperbolic

20. C) Lemniscate of Bernoulli



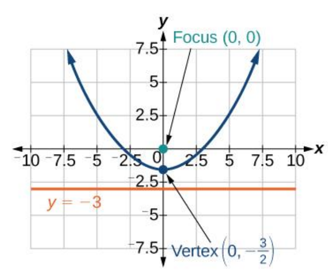
21. A A clock has hands with endpoints at polar coordinates $\left(-5, {}^{-\pi}/_{12}\right) = (-5, -15°$ and $\left(3, {}^{-\pi}/_{8}\right) = (3, -22.5°)$. You can graph an approximation to see the time to the nearest 15 minutes is 3:45.

22. B $d = rt \quad 310 = r\left(\frac{2}{3}hour\right) \quad r = 465mph$

*** The angles were unnecessary information. The plane is traveling along the path, so it is just a distance problem. If the plane farthest away reaches the axis, the plane closest will as well.*

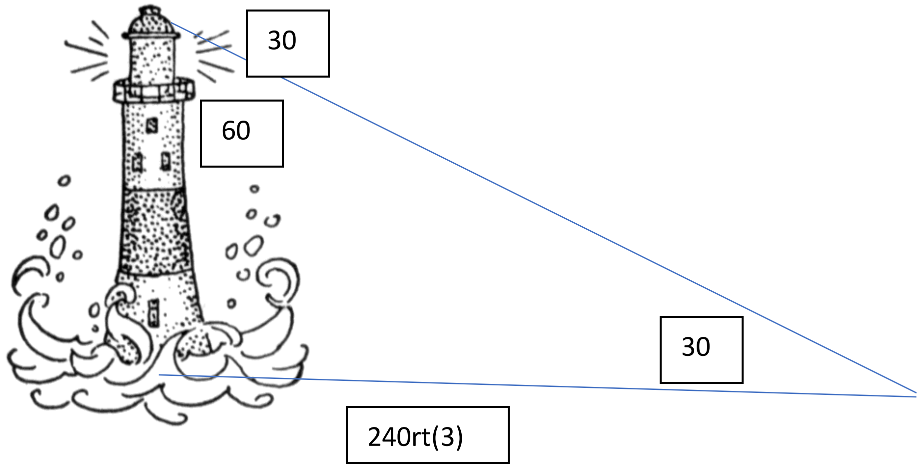
23. C To find the equation of the directrix on the graph of the following polar conic: $r = \frac{8}{1-cos\theta}$ first we should notice this is a parabola with eccentricity of 1. The equation has a cosine function, so I know the directrix has an equation with an "x". The equation is negative, so the directrix will be as well. The numerator is equal to ek, if e = 1, then k = 8. So I know in rectangular the equation of the directrix is x = -8. In polar, that equation is) $r = -8sec\theta$.

24. B A submarine's sonar sweeps an angle of ${}^{2\pi}/_{9}$ searching for ships. If an enemy ship is on the sonar screen, the probability that it will be within the swept area is just 1/9 because the entire unit circle is 2pi radians.



25. D $r = \frac{3}{1-sin\theta}$The given information from the graph: y = -3 tells me that k = 3, the sign of the equation is negative, and the trig function will be a sine function. Because it is a parabola, the eccentricity is automatically 1.

26. A $\left(240\sqrt{3}, 0\right)$



27. A To solve the polar equation for any zeroes of the graph: $0 = cos^3\theta - cos\theta = cos\theta(\cos^2\theta - 1); cos\theta = 0, -1, 1$
$\theta = 0, {}^{\pi}/_{2}, \pi, {}^{3\pi}/_{2}$

28. C To find the point of intersection of the polar graphs in rectangular coordinates:
$r = 4csc\theta : rsin\theta = 4 : y = 4 \qquad r = -2sec\theta : rcos\theta = -2 : x = -2$
$(-2, 4)$

29. B The complex number $2 - 2i$ is graphed on the Argand plane forming a 45-45-90 special right triangle in the fourth quadrant. That makes the radius 2rt(2) and the angle -45 degrees. $\left(2\sqrt{2}, {}^{-\pi}/_{4}\right)$

30. D The slope of the line with the polar equation: $\theta = {}^{-2018\pi}/_{6} = -336\frac{1}{3}\pi = -\frac{1}{3}\pi$; $\tan\left(-\frac{1}{3}\pi\right) = -\sqrt{3}$