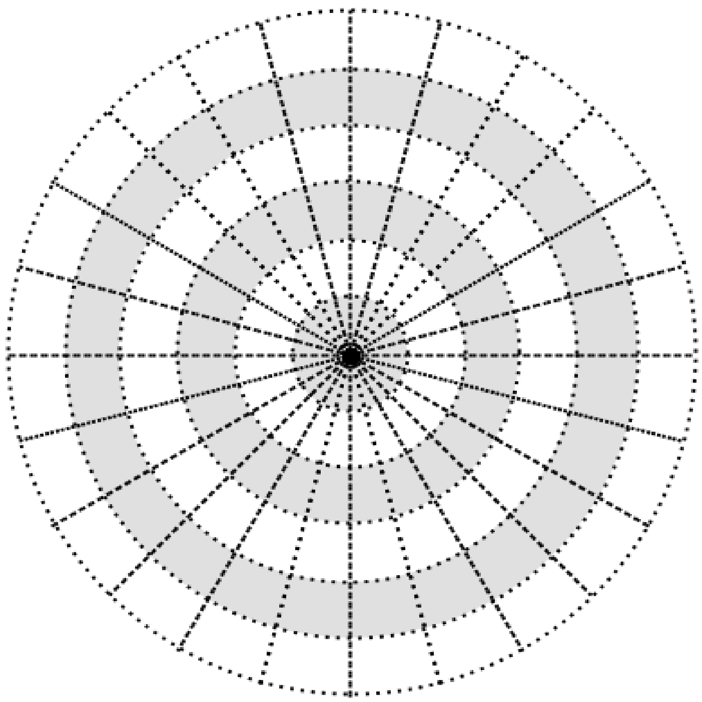
Part 1 – Plotting Coordinates & Exploring Polar Graphs

The coordinates of a polar curve are given as (θ, r).

1. On page 1.3, grab and drag the head of the arrow r so that it is at (a) (15°, 4), (b) (270°, 5), (c) $\left(\frac{\pi}{6}, 3\right)$ and (d) $\left(\frac{3\pi}{2}, 6\right)$. Plot and label these points on the graph below.



2. If $r(\theta) = \cos(\theta)$, what is $r\left(\frac{\pi}{3}\right)$?

3. Let $r(\theta) = 2 - 2\cos(\theta)$. Plot points of $r(\theta)$ by entering values of r into the spreadsheet on page 1.6. What is the shape of the graph?

4. Use page 2.2 to explore the graph of a polar function. Grab and drag the open point on the circle. Confirm your values for r on page 1.5. Double-click on **r1**(θ) to change the equation. Explore different equations. Which of the following did you make? Write the equation next to the graph shape.

- circle
- rose with even number of petals
- rose with odd number of petals
- limaçon with an inner loop

Part 2 – Slopes of Polar Graphs

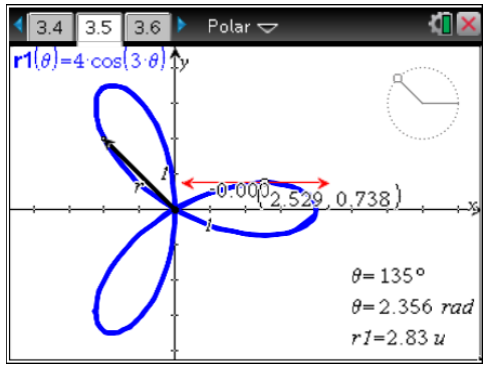
5. How do you find the slope of a line tangent to a polar graph?

6. Recall the polar graph from page 1.3. When r and θ are known, how can you find the corresponding x- and y-coordinates?

7. a. What are the criteria that determine when a horizontal tangent will occur?

b. How many horizontal tangents occur on the polar rose to the right?

c. Find the angle θ of the point where the horizontal tangent is shown to the right?



d. Consider how CAS was used on page 3.7 to solve for all θ between 0 and π for the horizontal tangent of **r1**(θ) = 4cos(3θ). Use this *Calculator* application to similarly find the angle for the vertical tangents. Show the setup and answers.

8. Find $\frac{dy}{dx}$ when $\theta = \frac{2\pi}{3}$ for **r1**(θ) = 4cos(3θ). Show you work. Do not use a calculator to solve this problem. (Hint: Use your answer to Problem 6 to help you.)

Part 3 – Area of Polar Graphs

The equation for the area inside a polar curve is $\frac{1}{2}\int_{\theta_1}^{\theta_2} \left(r\left(\theta\right)\right)^2 d\theta$ where θ_1 and θ_2 are the "first" two times $r = 0$.

9. What are the limits of integration to find the area of one petal of **r1**(θ) = 4sin(3θ)?

10. Use CAS to find the area of the first petal of **r1**(θ) = 4sin(3θ).