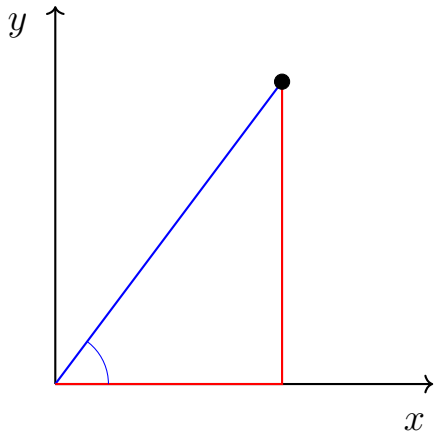
Daily Announcements & Reminders:

Goals for Today: Sections 15.4, 15.5

- Introduce the polar coordinate system
- Convert double integrals to iterated polar integrals
- Compute iterated polar integrals
- Define triple integrals and compute basic triple integrals

Polar Coordinates:



Cartesian coordinates: Give the distances in _____ and _____ directions from _____

Polar coordinates:

- r = distance from _____ to _____
- θ = angle between the ray _____ and the positive _____

We can use trigonometry to go back and forth.

Polar to Cartesian:

$$x = r\cos(\theta) \qquad y = r\sin(\theta)$$

Cartesian to Polar:

$$r^2 = x^2 + y^2 \qquad \tan(\theta) = \frac{y}{x}$$

Example 83. a) Find a set of polar coordinates for the point $(x, y) = (1, 1)$.

b) Graph the set of points (x, y) that satisfy the equation $r = 2$ and the set of points that satisfy the equation $\theta = \pi/4$ **in the** xy**-plane.**

c) Write the function $f(x, y) = \sqrt{x^2 + y^2}$ in polar coordinates.

d) [Poll] Write a Cartesian equation describing the points that satisfy $r = 2\sin(\theta)$.

15.4: Double Integrals in Polar Coordinates

Goal: Given a region R in the xy-plane described in polar coordinates and a function $f(r, \theta)$ on R, compute $\iint_R f(r, \theta)\ dA$.

Example 84. Compute the area of the disk of radius 5 centered at $(0, 0)$.

Remember: In polar coordinates, the area form $dA =$_____

Example 85. Compute $\iint_D e^{-(x^2+y^2)}\, dA$ on the washer-shaped region $1 \leq x^2+y^2 \leq 4$.

Example 86. Compute the area of the smaller region bounded by the circle $x^2 + (y-1)^2 = 1$ and the line $y = x$.

Example 87 (Poll)**.** Write an integral for the volume under $z = x$ on the region between the cardioid $r = 1 + \cos(\theta)$ and the circle $r = 1$, where $x \geq 0$.