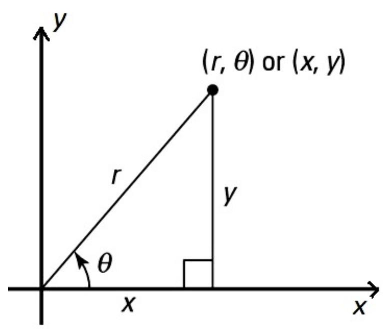
1. We can describe the surface $2x^2 + 4y^2 = 45 - z^2$ using by writing it as $F(x, y, z) = 0$, where $F(x, y, z) = 2x^2 + 4y^2 + z^2 - 45$. We have a theorem that tells us that $\nabla F(x, y, z)$ is normal (perpendicular) to the surface. Use this fact to find the tangent plane to this surface at the point $(2, -3, 1)$.

2. The following set of problems is about graphing regions in polar coordinates. Recall that r represents distance from the origin (and maybe be negative, which denotes going in the opposite direction), and θ represents the angle with the positive x-axis in the counterclockwise direction (a negative angle represents the clockwise direction).

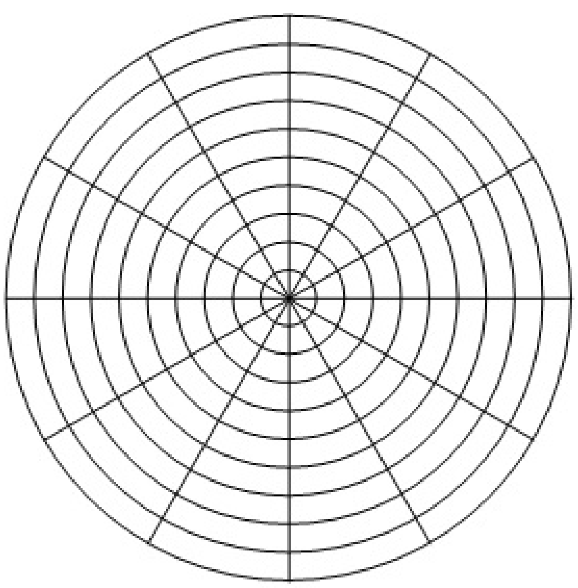


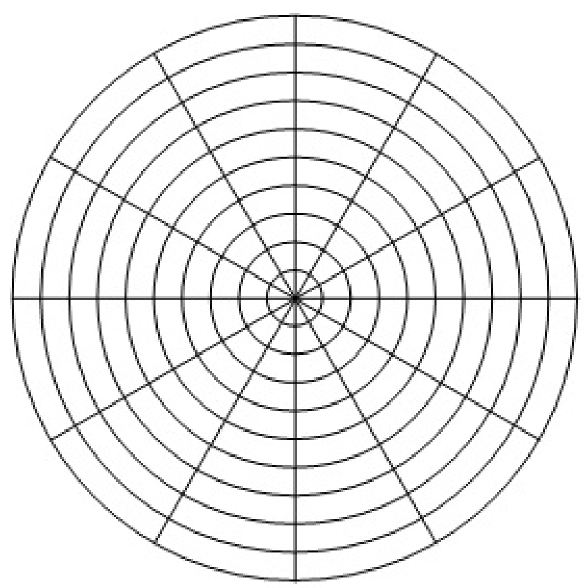
   (a) Give three different ways to represent the point $(x, y) = (2, 2)$ in polar coordinates (r, θ).

   (b) Each of the circular regions have rings 1 unit apart, and the lines are drawn at the "standard" angles used in trigonometry. Graph the indicated regions.

      i. $2 < r \leq 5,\ \dfrac{3\pi}{4} \leq \theta \leq \dfrac{5\pi}{4}$

      ii. $-1 \leq r \leq 1,\ \dfrac{\pi}{4} \leq \theta \leq \dfrac{3\pi}{4}$





3. Graph the set of points in $\mathbb{R}^2$.

(a) $1 \leq r \leq 2$

(b) $r \geq 1$

(c) $0 \leq \theta \leq \pi,\ r = 1$

(d) $\theta = \dfrac{11\pi}{4},\ -1 \leq r$

(e) $\dfrac{\pi}{4} \leq \theta \leq \dfrac{3\pi}{4},\ 1 \leq r < 2$

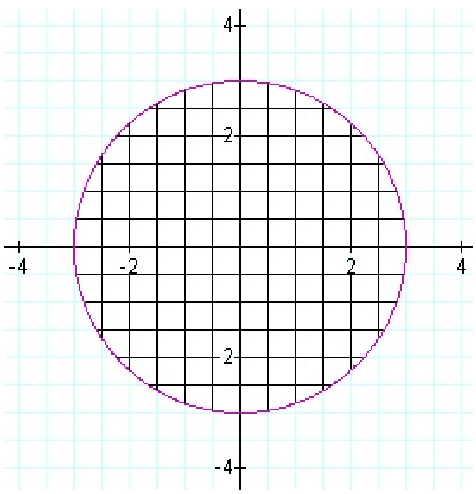
(f) $\dfrac{-\pi}{4} < \theta < \dfrac{\pi}{6},\ 2 \leq r \leq 4$

(g) $\dfrac{-\pi}{2} \leq \theta \leq \dfrac{\pi}{6},\ 0 < r \leq 4$

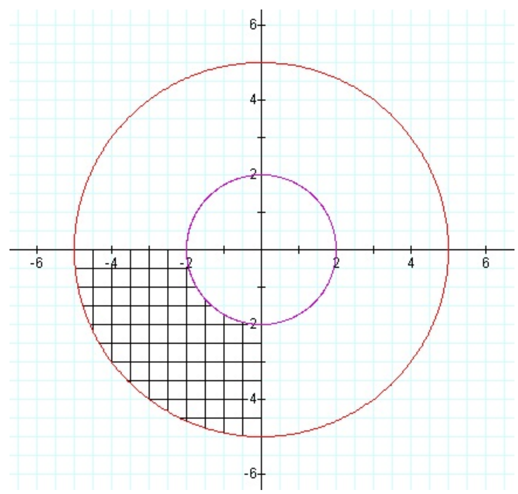
(h) $\dfrac{-3\pi}{4} \leq \theta \leq \dfrac{-\pi}{6},\ r = 8$

4. Give the polar equation(s) or inequalities that describe the checkered region. All angles are one of the "special angles" that we know from trigonometry.

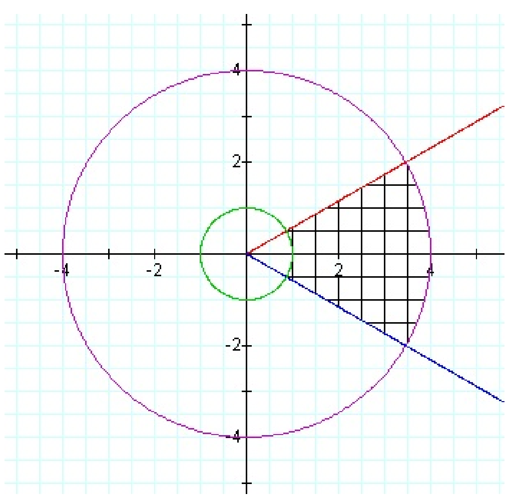
a)



b)



c)



d)