1. Consider the parametric curve \( x = \sin^2 t, \ y = \sin 3t, \ 0 \leq t \leq \pi/3 \). Set up but do not evaluate integrals which represent the following:
   a) The area under the curve.

   b) The surface area created by rotating the curve about the \( x \)-axis.

   c) The surface area created by rotating the curve about the line \( y = 5 \).

   d) The surface area created by rotating the curve about the \( y \)-axis.

2. A sphere of radius \( r \) is formed by rotating the semicircle

   \[ x = r \cos \theta, \quad y = r \sin \theta, \quad -\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2} \]

   about the \( y \) axis. Sketch a graph. Then compute the surface area of the sphere.
3. Sketch the regions
   a) $1 \leq r \leq 2, \ -\frac{\pi}{3} \leq \theta \leq \frac{\pi}{4}.$
   b) $r \leq 0, \ \frac{4\pi}{3} \leq \theta \leq \frac{5\pi}{3}.$

Recall: To convert from polar to rectangular (Cartesian) coordinates, we use
\[ x = r \cos \theta, \quad y = r \sin \theta. \]

To convert from rectangular to polar coordinates, we use
\[ \frac{y}{x} = \tan \theta, \quad x^2 + y^2 = r^2. \]

4. Identify each polar curve by finding a Cartesian equation.
   a) $\theta = \frac{\pi}{3}$

   b) $r = 2 \sin \theta$

5. Find a simple polar equation which represents each of the following.
   a) $y = 3x$

   b) $y = 4x^2$