1. a.) Calculate the length of the curve $y = \ln x$, $1 \leq y \leq \sqrt{3}$.

b.) Find the area of the surface resulting from rotating the curve in part a. about the y-axis. (the calculation in part a. can come in handy).
2. Find the centroid of the region bounded by the curves $y = x^2$ and $y = 1$. Use symmetry where possible. Recall, for the region trapped between $y = f(x)$, $y = g(x)$, $a \leq x \leq b$, with uniform density $\rho = 1$ we have $M_x = \frac{1}{2} \int_a^b f(x)^2 - g(x)^2 \, dx$, $M_y = \int_a^b x(f(x) - g(x)) \, dx$. 
3. Given the polar equation $r = 2\cos(3\theta)$ of the 3-leaved rose, find the area enclosed by one loop.
4. Consider the polar equation $r = 3 \sin \theta$
   a.) Write the given equation in Cartesian Coordinates.
   
   b.) Find the slope of the tangent line to the given polar curve at $\theta = \frac{\pi}{8}$. 
5. Find the area bounded by the curve \( x = \cos t \) and \( y = e^t \) and the lines \( y = 1 \) and \( x = 0 \).
6. A triangular plate was placed vertically at the bottom of a water tank 15 meters deep in an upright position. Knowing that the height of the triangle is 10 meters and the base is 4 meters. Compute the hydrostatic force of the water on the plate. (note that the density of the water is $\rho = 1000 \text{kg/m}^3$ and the acceleration of the gravity $g = 9.8 \text{m/s}^2$).