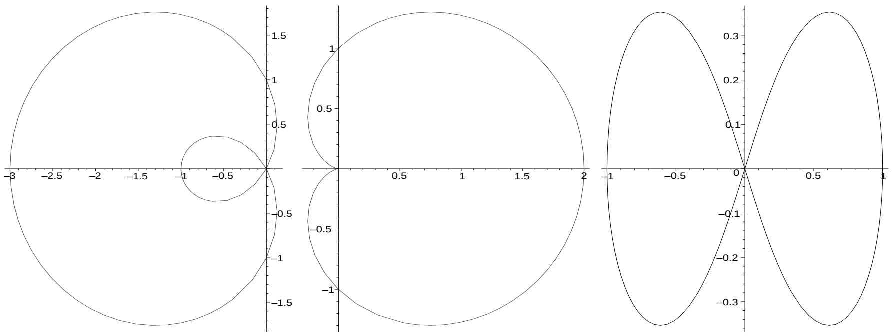
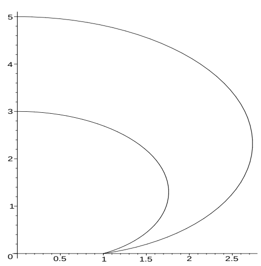
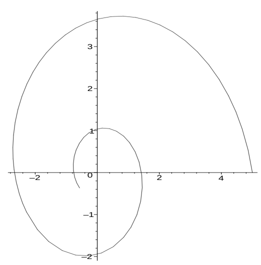
1. Match the polar curve with its graph and determine the area enclosed.
   A) $r(\theta) = 1 + \cos\theta$ B) $r^2(\theta) = \cos 2\theta$ C) $r(\theta) = 1 - 2\cos\theta$



2. Determine the area of the polar region bounded by the curves $r(\theta) = 1 + 2\sin\theta$ and $r(\theta) = 1 + 4\sin\theta$ and the line $\theta = \dfrac{\pi}{2}$.



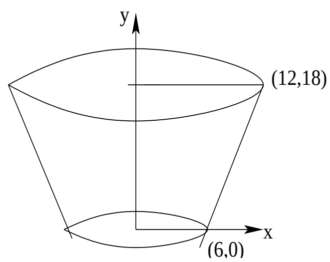
3. Determine the arclength of the spiral $< x(t), y(t) >=< e^{-0.5t}\cos(2t), e^{-0.5}sin(2t) >$ for which $0 \le \theta \le 5$.



4. Note that in (1), the second graph is $r(\theta) = 1 + \cos\theta$ for $0 \le \theta \le 2\pi$. If one should walk this path, what is the distance traveled? (Tip: By symmetry, you could double the evaluation of the integral from 0 to π that would eliminate $\sqrt{\cos^2 2t} = |\cos 2t|$ that you would get when you apply the half-angle identity $1 + \cos 2t = 2\cos^2 t$.)

5. Determine the area of the region enclosed by the inner loop of the polar curve $r(\theta) = 1 - 2\cos\theta$ in the first graph of (1). (Hint: First determine the interval of θ which determines the inner loop by finding the values of θ for which $r(\theta) = 0$.)

6. Determine the work applied to empty a tank of water (62.4 lb/ft^3) from the top. The tank (in feet) is a truncated cone with bottom radius 6 ft, top radius 12, and height 18. See picture. (Hint: Determine the equation of the line connecting the two points shown.)



7. An object moves from $(-1, 0)$ to $(1, 0)$ on the graph of $y = x^3 - x$ (Note: $< x(t), y(t) >=< t, t^3 - t >$, acted on by a force that attracts it toward the point $(1, 0)$ and has magnitude proportional to the distance between the object and $(1, 0)$. Calculate the work done by the force. Note: $||\vec{F}|| = k\sqrt{(t-1)^2 + (t^3 - t)^2}$.
If $\vec{F}$ is in the direction of $(1, 0)$ from $< t, t^3 - t >$ then it is in the direction of $< 1 - t, t - t^3 >$ and $||\vec{F}||$ times a unit vector in this direction would be the force proportional to the distance between the object and $(1, 0)$.

8. Integrate the following:

   (a) $\int x^4 \ln x \, dx$

   (b) $\int \frac{3e^t}{\sqrt{1 + 2e^t}} \, dt$

   (c) $\int (\ln x)^2 \, dx$

   (d) $\int \sin^2(3t) \, dt$

   (e) $\int_0^4 \sqrt{16 - x^2} \, dx$

   (f) $\int \frac{2x - 3}{x^3 - 4x^2 + 4x} \, dx$