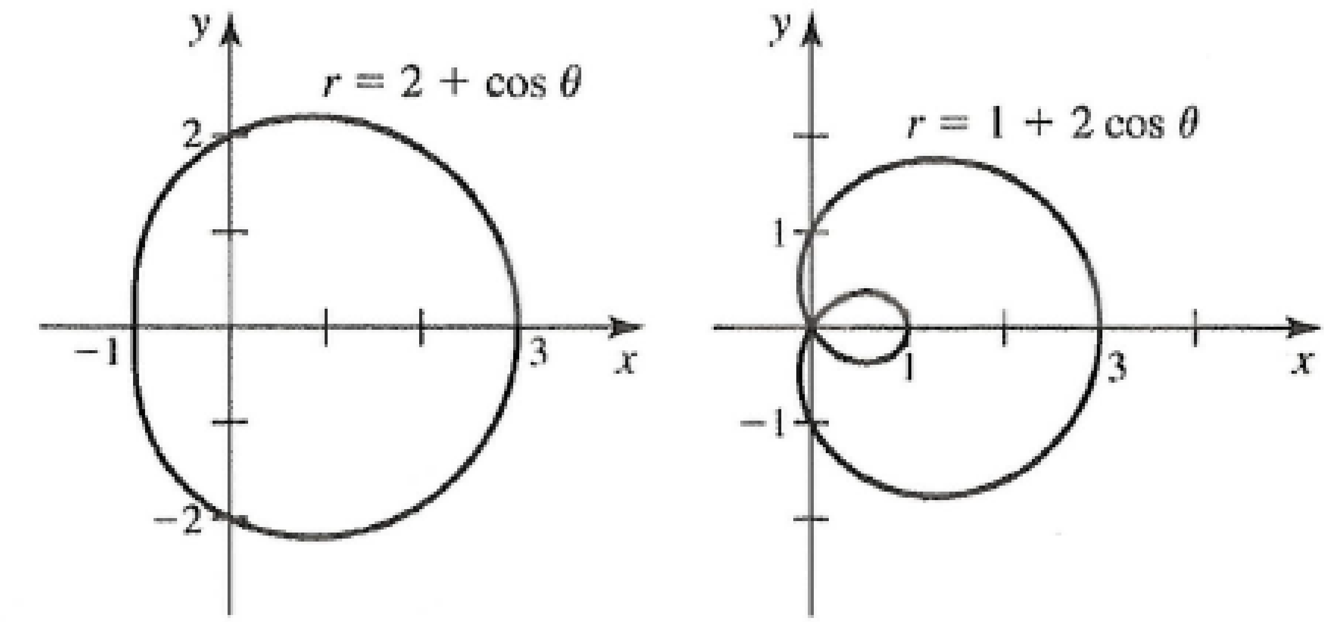
Problem 1: Let R be the region in the xy-plane that is bounded by the spiral $r = \theta$ for $0 \leq \theta \leq \pi$ and the x-axis. Find the volume of the 3-dimensional solid S that lies above the region R and underneath the surface $z = x^2 + y^2$.

Problem 2: The limaçon $r = b + a\cos(\theta)$ has an inner loop if $b < a$ and no inner loop if $b > a$.



(a) Find the area of the region bounded by the limaçon $r = 2 + \cos(\theta)$.
(b) Find the area of the region outside the inner loop and inside the outer loop of the limaçon $r = 1 + 2\cos(\theta)$.
(c) Find the area of the region inside the inner loop of the limaçon $r = 1 + 2\cos(\theta)$.

Problem 3: Let R be the region inside both the cardiod $r = 1 + \sin(\theta)$ and the cardiod $r = 1 + \cos(\theta)$. Sketch a picture of the region R, or create an image of the region R using a graphing program, then use double integration to find the area of R.

Problem 4: Write an iterated integral for $\iiint_D f(x,y,z)dV$, where D is a sphere of radius 9 centered at $(0,0,1)$. Use the order $dV = dzdydx$.

Hint: Start by finding the equation of the the surface of the sphere of radius 9 *centered at* $(0,0,1)$.

Problem 5: Sketch by hand or graph with a computer program the region of integration for the integral

$$\int_0^1 \int_0^{\sqrt{1-z^2}} \int_0^{\sqrt{1-y^2-z^2}} f(x,y,z)dxdydz. \tag{1}$$

Note: You may also describe the region of integration in writing instead. If you choose to do this, please write complete sentences and provide a thorough description.

Problem 6: Evaluate

$$\int_{1}^{\ln(8)} \int_{1}^{\sqrt{z}} \int_{\ln(y)}^{\ln(2y)} e^{x+y^2-z}\,dx\,dy\,dz. \tag{2}$$