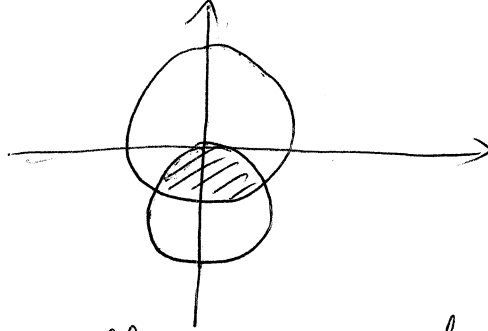
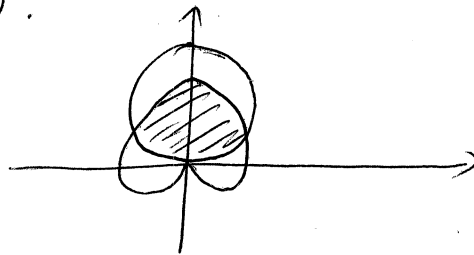


Area enclosed in polar curves

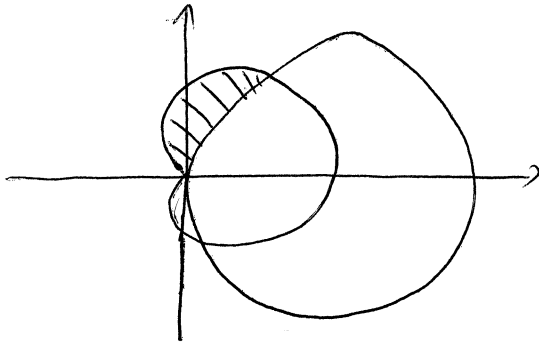
- ① Evaluate the area of the region inside the curves $r = 2 + \sin\theta$ and $r = -3\sin\theta$.



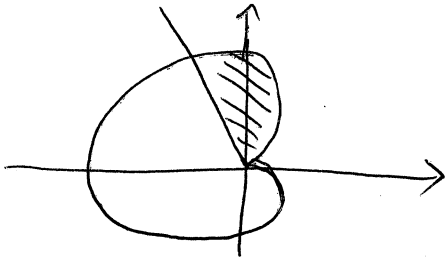
- ② Evaluate the area of the region inside the cardioid $r = \sin\theta - 1$ and the circle $r = 3\sin\theta$.



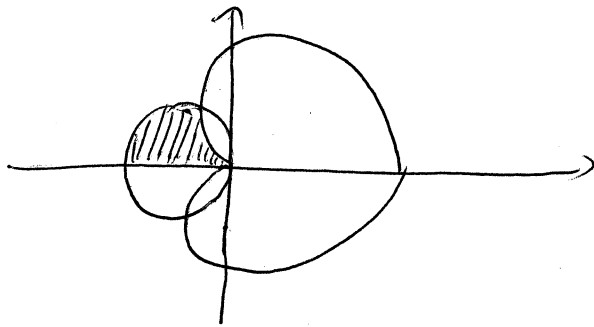
- ③ Evaluate the area of the region $\left\{ \begin{array}{l} \text{inside the cardioid } r = \cos\theta - 1, \\ \text{outside the circle } r = 3\cos\theta, \\ \text{above the } x\text{-axis.} \end{array} \right.$



- ④ Evaluate the area of the region $\left\{ \begin{array}{l} \text{inside the curve } r = -1 - \cos\theta, \\ \text{above the } x\text{-axis,} \\ \text{above the line } \theta = 3\pi/4. \end{array} \right.$



- ⑤ Evaluate the area of the region $\left\{ \begin{array}{l} \text{inside the curve } r = -\cos\theta, \\ \text{outside the curve } r = 1 + \cos\theta, \\ \text{in the third quadrant.} \end{array} \right.$



Answer key

1) $\frac{9\pi}{4} - 3\sqrt{3}$

4) $\frac{9\pi}{16} - \frac{\sqrt{2}}{2} - \frac{1}{8}$

2) $\frac{5\pi}{4}$

5) $\frac{\sqrt{3}}{2} - \frac{\pi}{6}$

3) $\frac{\pi}{8}$