

**CALCULUS**

---

1. Let  $(r, \theta)$  be polar coordinates. Find the area of the region  $\mathcal{R}$  that lies outside the cardioid  $r = 1 + \cos \theta$  and inside the circle  $r = 1$ .

2. Estimate

$$\int_0^1 \frac{\sin x}{x} dx$$

with an error of less than 0.001.

3. For a vector field  $\mathbf{F}(x, y, z) = (xyz, x^2 + z^2, y^2 + 2z^2)$  in three dimensions, evaluate

- (a)  $\operatorname{div} \mathbf{F}$
- (b)  $\operatorname{curl} \mathbf{F}$
- (c)  $\operatorname{div}(\operatorname{curl} \mathbf{F})$