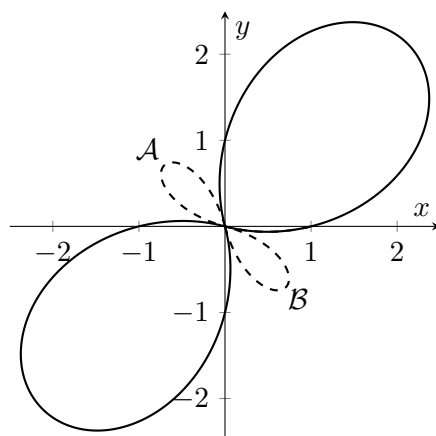


5. [16 points] The following problems relate to the polar graph shown below, defined by the polar curve  $r(\theta) = 2 \sin(2\theta) + 1$ , on the domain  $[0, 2\pi]$ . Both the dashed and solid curves are part of the graph of  $r(\theta)$ .



- a. [4 points] Find all  $\theta$  values in the interval  $[0, 2\pi]$  such that  $r(\theta) = 0$ .

Answers: \_\_\_\_\_

- b. [4 points] Determine the  $\theta$  intervals corresponding to the dashed portions  $\mathcal{A}$  and  $\mathcal{B}$  of the curve above.

Interval for  $\mathcal{A}$ : \_\_\_\_\_ Interval for  $\mathcal{B}$ : \_\_\_\_\_

- c. [4 points] Write an expression involving one or more integrals for the area of the region enclosed by the **solid** curves only (do not include the region enclosed by the dashed curves).
- d. [4 points] Write an expression involving one or more integrals for the total arc length of the **dashed** curves in the graph above.