

2. [13 points] Leia and Han are imprisoned in a cell whose door is made out of steel and has a thickness of 3 feet. Luke uses his lightsaber to cut through the door in the shape of the curve given by the polar coordinates equation

$$r = \frac{5}{3 + 2 \cos \left( \theta + \frac{\pi}{4} \right)}$$

where  $r$  is measured in feet.

- a. [6 points] Write an expression involving integrals for the volume of the piece that Luke cuts out of the door.

- b. [7 points] Still considering the polar curve

$$r = \frac{5}{3 + 2 \cos \left( \theta + \frac{\pi}{4} \right)}$$

graphed in the  $xy$ -plane, write an explicit expression involving integrals for the length of the **part** of the curve that lies **to the right** of the  $y$ -axis.