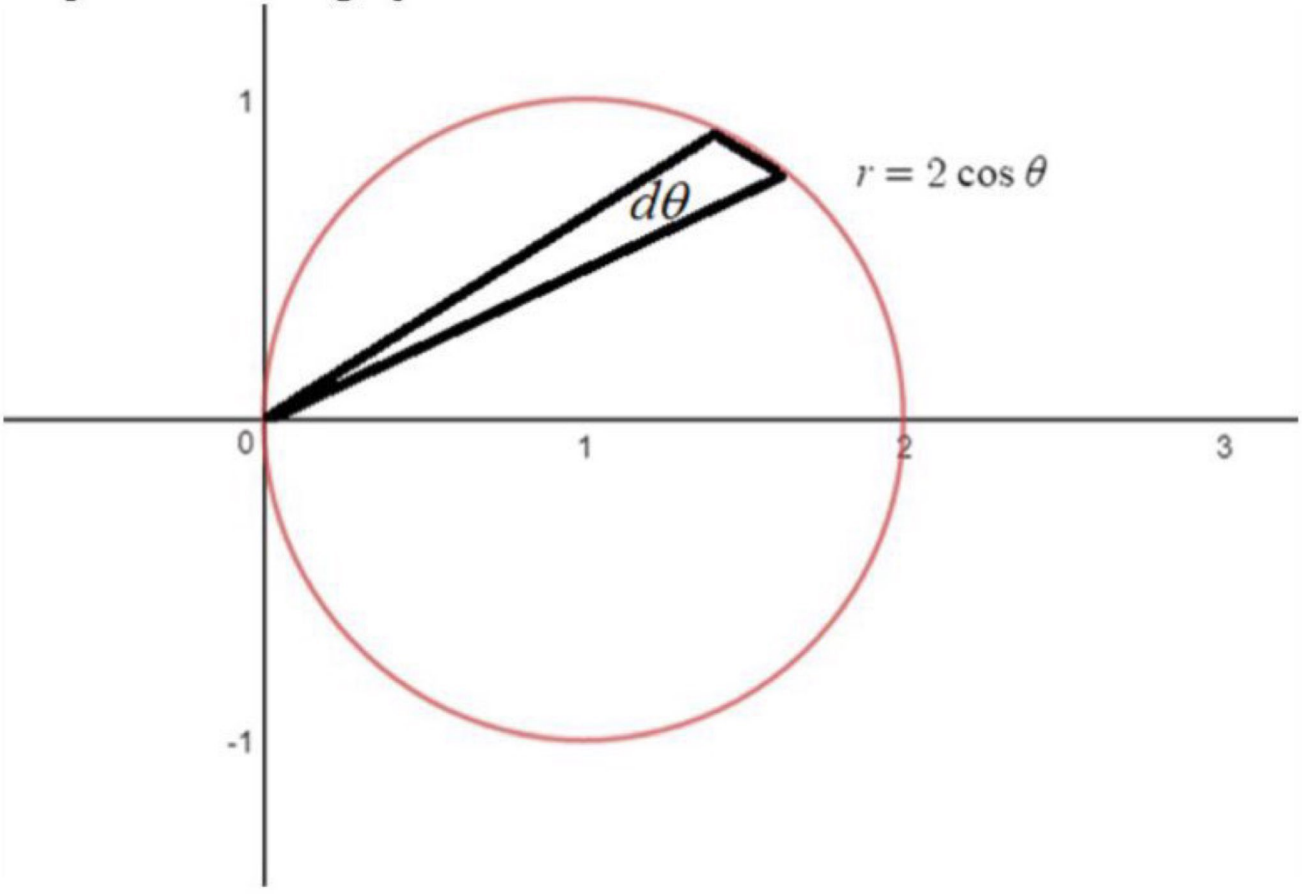
Consider, $r = 2\cos\theta$

Step 1: Draw the graph of $r = 2\cos\theta$.



Step 2: Take $\alpha = 0$ and $\beta = \frac{\pi}{2}$ for smallest and larger value of θ.

Step 3: Find the area of the area of the region bounded by $r = 2\cos\theta$ using $A = \frac{1}{2}\int_{\alpha}^{\beta} r^2 d\theta$

Required area $= 2A$

$$= 2\int_0^{\frac{\pi}{2}} \frac{1}{2}(2\cos\theta)^2 \, d\theta$$

$$= 4\int_0^{\frac{\pi}{2}} \cos^2\theta d\theta$$

$$= 4\int_0^{\frac{\pi}{2}} \left(\frac{1+\cos 2\theta}{2}\right) d\theta$$

$$= 2\int_0^{\frac{\pi}{2}} (1+\cos 2\theta) d\theta$$

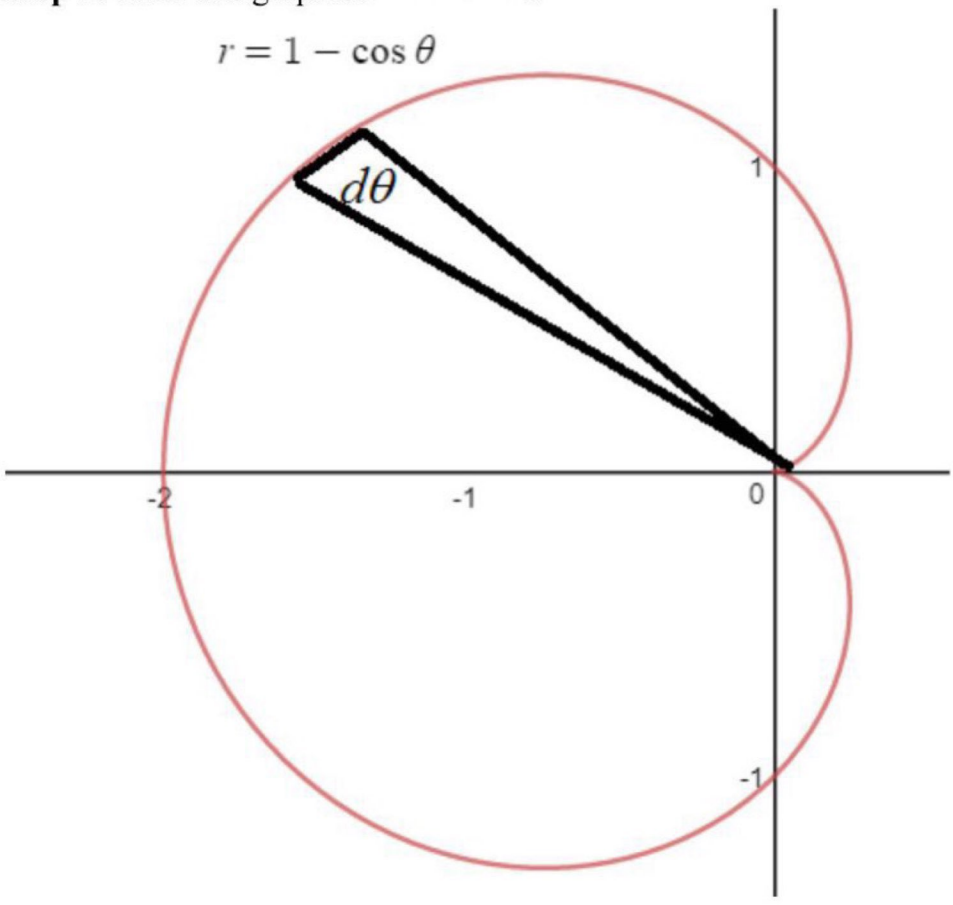
$$= 2\left[\theta + \frac{\sin 2\theta}{2}\right]_0^{\frac{\pi}{2}}$$

$$= 2\left(\frac{\pi}{2} - 0\right)$$

$$= \pi$$

Consider, $r = 1 - \cos\theta$

Step 1: Draw the graph of $r = 1 - \cos\theta$.



Step 2: Take $\alpha = 0$ and $\beta = \pi$ for smallest and larger value of θ.

Step 3: Find the area of the area of the region bounded by $r = 1 - \cos\theta$ using

$$A = \frac{1}{2}\int_{\alpha}^{\beta} r^2 d\theta$$

$$\text{Required area} = 2\int_0^{\pi} \frac{1}{2}(1-\cos\theta)^2 \, d\theta$$

$$= \int_0^{\pi} \left(1 + \cos^2\theta - 2\cos\theta\right) d\theta$$

$$= \int_0^{\pi} \left(1 + \frac{1+\cos 2\theta}{2} - 2\cos\theta\right) d\theta$$

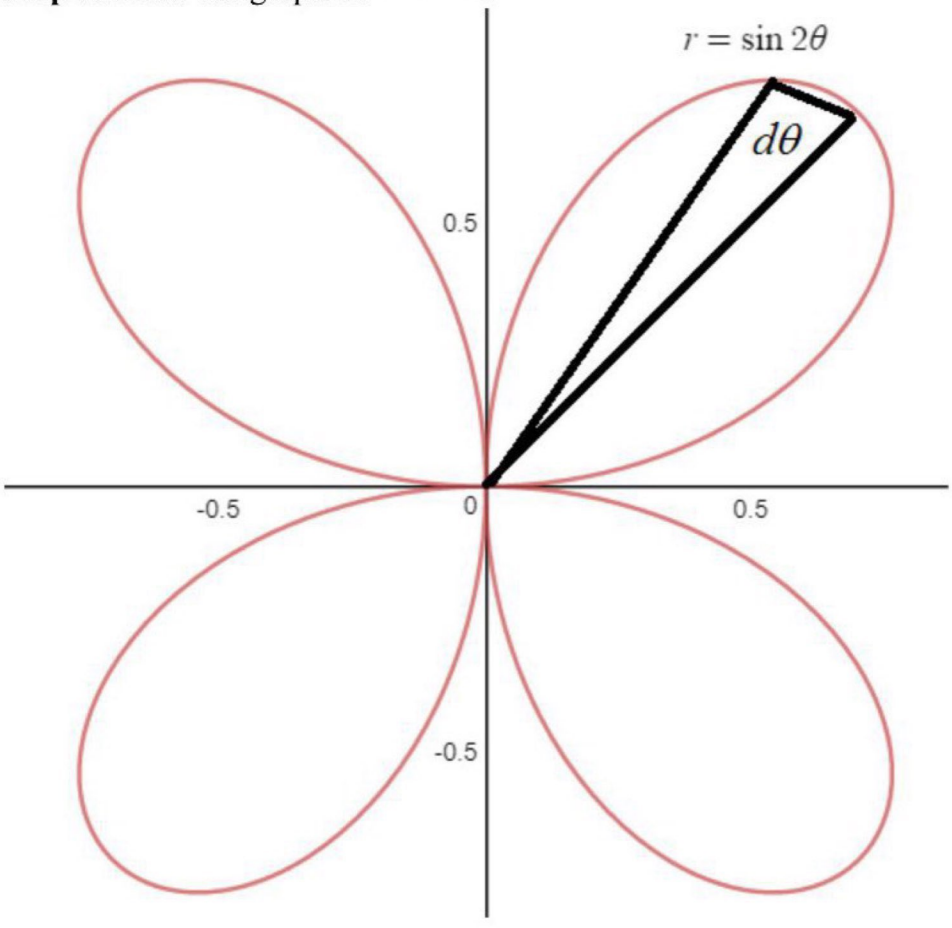
$$= \frac{1}{2}\int_0^{\pi} (3 + \cos 2\theta - 4\cos\theta) \, d\theta$$

$$= \frac{1}{2}\left[3\theta + \frac{\sin 2\theta}{2} - 4\sin\theta\right]_0^{\pi}$$

$$= \frac{3\pi}{2}$$

Consider, $r = \sin 2\theta$

Step 1: Draw the graph of $r = \sin 2\theta$.



Step 2: Take $\alpha = 0$ and $\beta = \frac{\pi}{2}$ for smallest and larger value of θ.

Step 3: Find the area of the area of the region bounded by $r = \sin 2\theta$ using $A = \frac{1}{2}\int_{\alpha}^{\beta} r^2 d\theta$

Required area $= 4A$

$$= 4\int_0^{\frac{\pi}{2}} \frac{1}{2}(\sin 2\theta)^2 \, d\theta$$

$$= 2\int_0^{\frac{\pi}{2}} \sin^2 2\theta d\theta$$

$$= 2\int_0^{\frac{\pi}{2}} \left(\frac{1-\cos 4\theta}{2}\right) d\theta$$

$$= \int_0^{\frac{\pi}{2}} (1-\cos 4\theta) d\theta$$

$$= \left[\theta - \frac{\sin 4\theta}{4}\right]_0^{\frac{\pi}{2}}$$

$$= \left(\frac{\pi}{2} - 0\right)$$

$$= \frac{\pi}{2}$$