1. Sketch the following and find the intersection points
   (a) $r = \sin(\theta); r = \cos(\theta)$
   (b) $r = 2; r = 2\cos(2\theta)$
   (c) $r = 2; r = 3 + 2\sin(\theta)$
2. SET UP an integral that can be used to find the area described:
   (a) Inside both of the circles: $r = \sin(\theta); r = \cos(\theta)$
   (b) Inside both of the curves: $r = 2; r = 2\cos(2\theta)$
   (c) Inside the limacon and outside the circle: $r = 2; r = 3 + 2\sin(\theta)$
3. Sketch the following and find the intersection points
   (a) $r = \sin(\theta); r = \sin(2\theta)$
   (b) $r = \cos(\theta); r = 1 - \cos(\theta)$
   (c) $r = \sin(3\theta); r = \cos(3\theta)$
4. SET UP an integral that can be used to find various areas - you choose:) You may set up more than one area per problem!
   (a) $r = \sin(\theta); r = \sin(2\theta)$
   (b) $r = \cos(\theta); r = 1 - \cos(\theta)$
   (c) $r = \sin(3\theta); r = \cos(3\theta)$
5. SET UP an integral that can be used to find the area described:
   (a) Inside the cardioid $r = 1 + \cos(\theta)$.
   (b) Inside the four leaved rose $r = 2\cos(2\theta)$.
   (c) Inside the three-petaled rose $r = 2\sin(3\theta)$.
   (d) Shared by the circles $r = 1$ and $r = 2\sin(\theta)$.
   (e) Shared by the cardioids $r = 2(1 + \cos(\theta))$ and $r = 2(1 - \cos(\theta))$.
   (f) Inside the circle $r = 3\cos(\theta)$ and outside the cardioid $r = (1 + \cos(\theta))$.

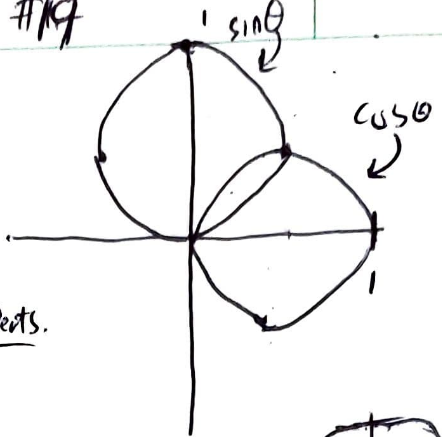
MATH 132 WS #19

Sketch

(a) $r = \sin\theta$
(a) $r = \cos\theta$

θ	$\sin\theta$	$\cos\theta$
0	0	1
$\pi/4$	$\sqrt{2}/2$	$\sqrt{2}/2$
$\pi/2$	1	0
$3\pi/4$	$+\sqrt{2}/2$	$-\sqrt{2}/2$
π	0	1
$5\pi/4$	$-\sqrt{2}/2$	$-\sqrt{2}/2$
$3\pi/2$	-1	0
2π	0	1

Repeats.

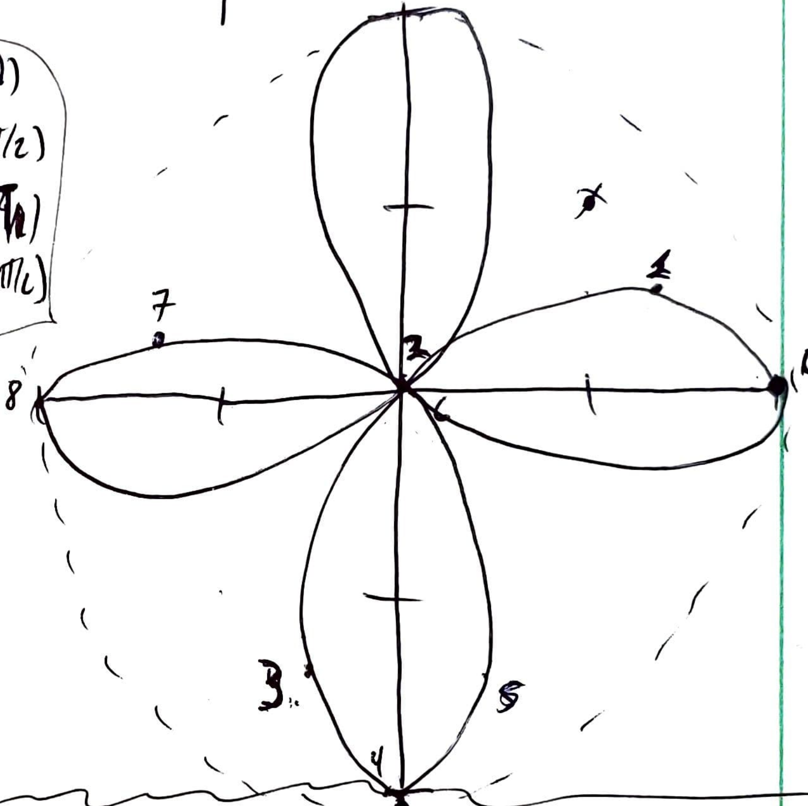


(0,0)
~~($\pi/4$, 0)~~
$P(\sqrt{2}/2, \pi/4)$

(b)

θ	$2\cos 2\theta$	2
0	2	2
$\pi/8$	$\sqrt{2}$	2
$\pi/4$	0	2
$3\pi/8$	$-\sqrt{2}$	2
$\pi/2$	-2	2
$5\pi/8$	$-\sqrt{2}$	2
$3\pi/4$	0	2
$7\pi/8$	$\sqrt{2}$	2
π	1	2

$P(2, 0)$
$P(-2, \pi/2)$
$P(2, \pi)$
$P(-2, 3\pi/2)$



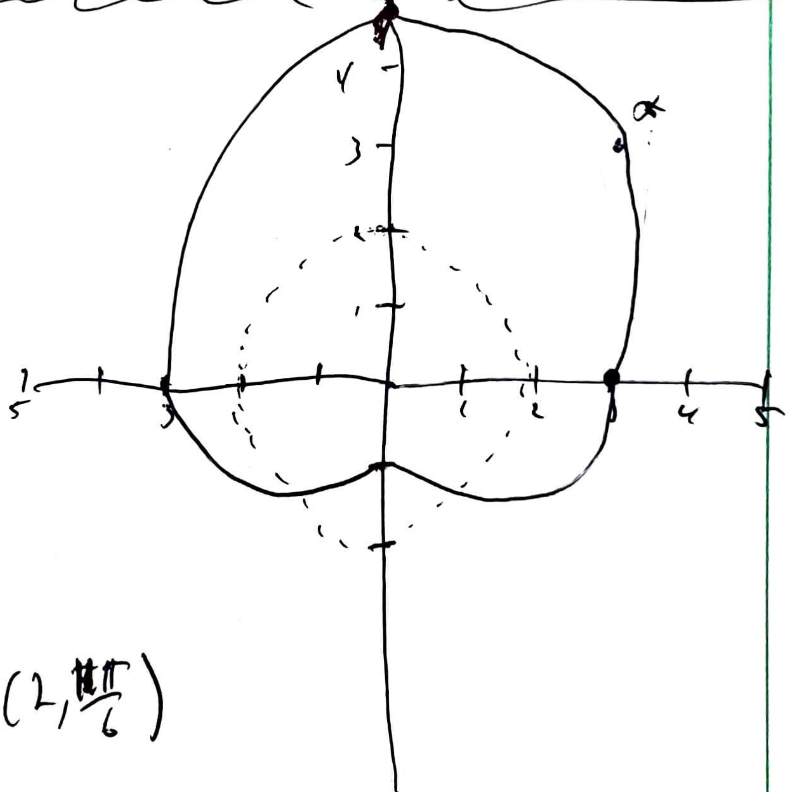
(c)

θ	$3+2\sin\theta$
0	3
$\pi/4$	$3+\sqrt{2}$
$\pi/2$	5
$3\pi/4$	$3+\sqrt{2}$
π	3
$5\pi/4$	$3-\sqrt{2} \sim 1.59$
$3\pi/2$	$3-2=1$
$7\pi/4$	~ 1.59
2π	3

$3+2\sin\theta = 2$
$2\sin\theta = -1$
$\sin\theta = -\frac{1}{2}$

$\theta = \frac{7\pi}{6}, \frac{11\pi}{6} = -\frac{\pi}{6}$

So $P(2, \frac{7\pi}{6})$ and $P(2, \frac{11\pi}{6})$



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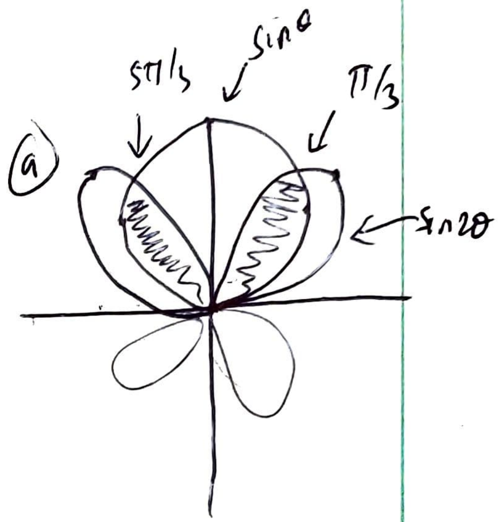
W3#17

Setup

(2) (a) $\frac{1}{2}\int_0^{\pi/4} \sin^2\theta \, d\theta + \frac{1}{2}\int_{\pi/4}^{\pi/2} \cos^2\theta \, d\theta$

(b) $\frac{8}{2}\int_0^{\pi/4} 4\cos^2 2\theta \, d\theta$

(c) $\frac{1}{2}\int_{-\pi/6}^{7\pi/6} (3+2\sin\theta)^2 - 4 \, d\theta$



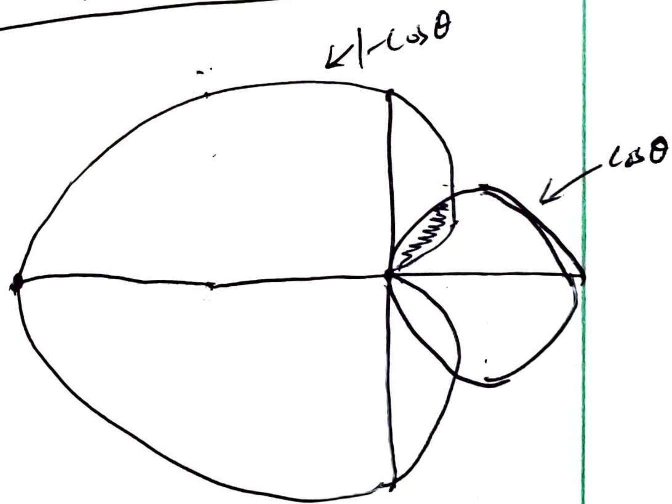
(3) sketch

(a) $r = \sin\theta$
$r = \sin 2\theta$

θ	$\sin 2\theta$
0	0
$\pi/4$	1
$\pi/3$	[illegible]

$\sin\theta = \sin 2\theta$

$\boxed{\theta = \cancel{\ }, \pi/3, 5\pi/3}$



(b) $r = \cos\theta$
$r = 1 - \cos\theta$

θ	$1-\cos\theta$
0	0
$\pi/4$	$1 - \sqrt{2}/2 \sim .3$
$\pi/2$	1
$3\pi/4$	$1 + \sqrt{2}/2 \sim 1.7$
π	$1+1=2$

$\cos\theta = 1 - \cos\theta$

$2\cos\theta = 1$

$\cos\theta = 1/2$

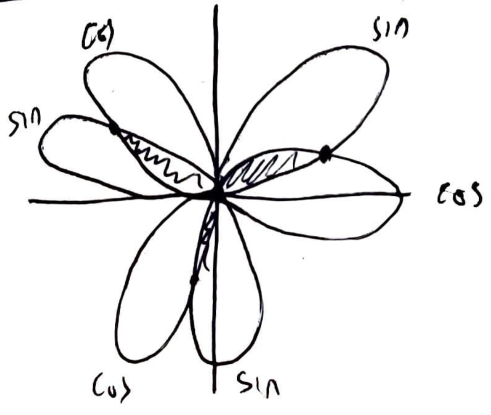
$\boxed{\theta = \pi/3, 5\pi/3}$

(c) $r = \sin 3\theta$
$r = \cos 3\theta$

$\sin 3\theta = \cos 3\theta$

$3\theta = \frac{\pi}{4}, \frac{5\pi}{4}, \frac{9\pi}{4}, \frac{13\pi}{4}, \ldots$

$\theta = \frac{\pi}{12}, \frac{5\pi}{12}, \frac{9\pi}{12}, \frac{13\pi}{12}, \ldots$



④ Setup

ⓐ $\frac{1}{2}\int_0^{\pi/3} \sin^2\theta \, d\theta + \frac{1}{2}\int_{\pi/3}^{\pi/2} \sin^2 2\theta \, d\theta$

ⓑ $\frac{1}{2}\int_0^{\pi/3} (1-\cos\theta)^2 \, d\theta + \frac{1}{2}\int_{\pi/3}^{\pi/2} \cos^2\theta \, d\theta$

ⓒ $\frac{1}{2}\int_0^{\pi/12} \sin^2 3\theta \, d\theta + \frac{1}{2}\int_{\pi/12}^{\pi/6} \cos^2 3\theta \, d\theta$

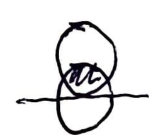
for 1 intersection area (see previous page)

⑤

ⓐ $2\times\frac{1}{2}\int_0^{\pi} (1+\cos\theta)^2 \, d\theta$ (using symmetry)

ⓑ $8\times\frac{1}{2}\int_0^{\pi/4} 4\cos^2 2\theta \, d\theta$ [same as 1b/2b] (using symmetry)

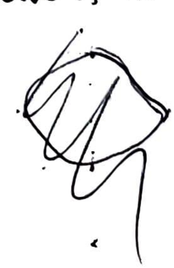
ⓒ $3\times\frac{1}{2}\int_0^{\pi/3} 4\sin^2(3\theta) \, d\theta = \pi$ (using symmetry)



ⓓ $1 = 2\sin\theta$, $\sin\theta = \frac{1}{2}$, $\theta = \pi/6, 5\pi/6$.

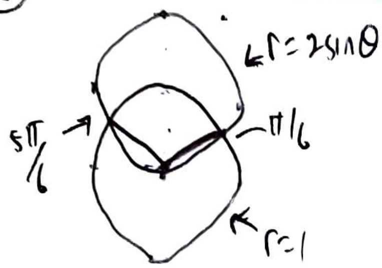
$\cancel{\frac{1}{2}\int_{\pi/6}^{5\pi/6} 4\sin^2\theta - 1 \, d\theta}$ $\cancel{\frac{1}{2}\int_{\pi/6}^{5\pi/6} 1 - 4\sin^2\theta \, d\theta}$

This one is tricky.



See next page

5 d



$$2\left[\frac{1}{2}\int_0^{\pi/6} 4\sin^2\theta \, d\theta + \int_{\pi/6}^{\pi/2} 1 \, d\theta\right]$$ using symmetry

e) If you draw it you will see that due to symmetry, it is

$$4 \times \frac{1}{2}\int_0^{\pi/2} 4(1-\cos\theta)^2 \, d\theta \quad \text{or} \quad 4\,\frac{1}{2}\int_{\pi/2}^{\pi} 4(1+\cos\theta)^2$$

f) They intersect at $\pi/3$ in the first quadrant, using symmetry we can get the area as

$$2\left[\frac{1}{2}\int_0^{\pi/3} (1+\cos\theta)^2 \, d\theta + \frac{1}{2}\int_{\pi/3}^{\pi/2} 9\cos^2\theta \, d\theta\right]$$

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