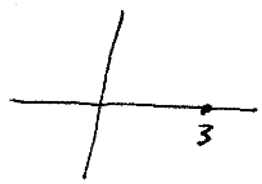
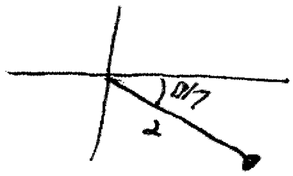
p. 504

2. a.



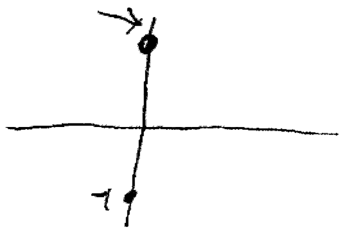
$(3,0) = (-3,\pi) = (3,2\pi)$

b



$(2, -\pi/7) = (-2, 6\pi/7) = (2, 13\pi/7)$

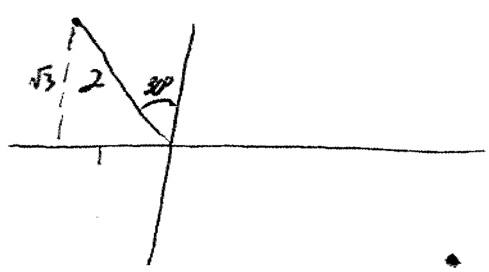
c.



$(-1, \pi/2) = (1, -\pi/2) = (1, -3\pi/2)$

$= (-1, 5\pi/2)$

4a

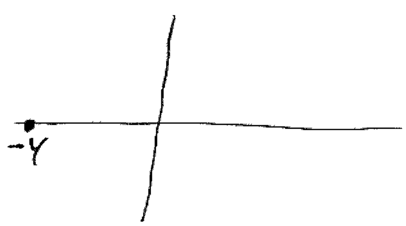


$x = 2\cos(2\pi/3) = -1$

$y = 2\sin(2\pi/3) = \sqrt{3}/2$

$\boxed{(-1, \sqrt{3}/2)}$

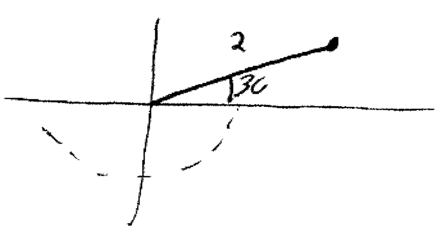
b



$(-4, 0)$

$(-2, -5\pi/6)$ polar

c.



$x = -2\cos(-5\pi/6) = \sqrt{3}$

$y = -2\sin(-5\pi/6) = 1$

$(\sqrt{3}, 1)$

6.a. $(-1, -\sqrt{3})$ polar cart.

$r = \sqrt{1+3} = 2$

$\theta = \tan^{-1}(\sqrt{3}) \approx 1.047$ radians

$(2, \tan^{-1}(\sqrt{3}))$

b. $(-2, 3)$

$r = \sqrt{4+9} = \sqrt{13}$

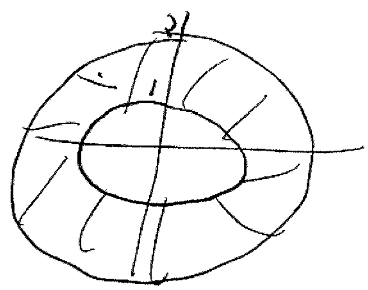
$\theta = \tan^{-1}(-\frac{3}{2}) \sim -.9827$ radians Not between $0 \le \theta < 2\pi$

so add 2π

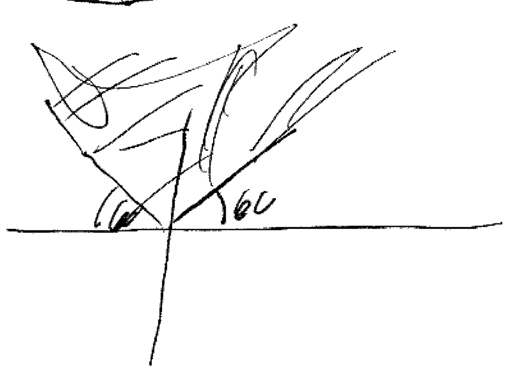
$\theta = 2\pi + .9827 = 5.30034$

$(\sqrt{13}, 5.3004)$

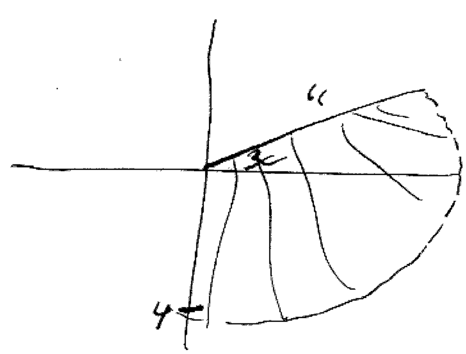
7.



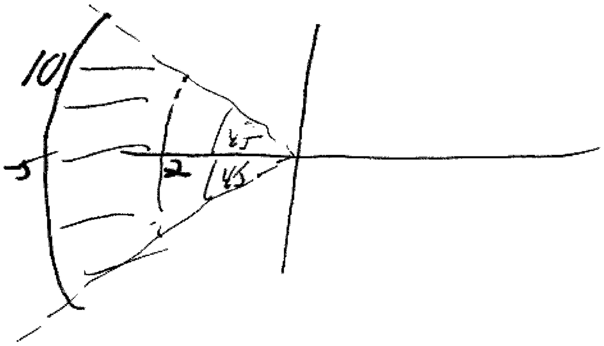
8.



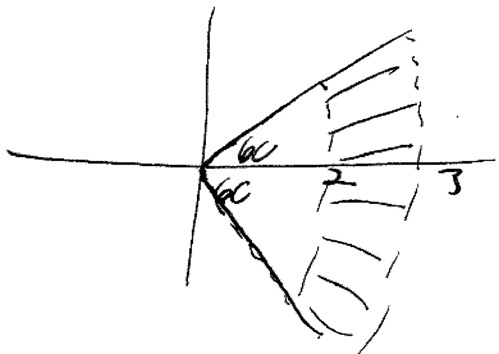
9.



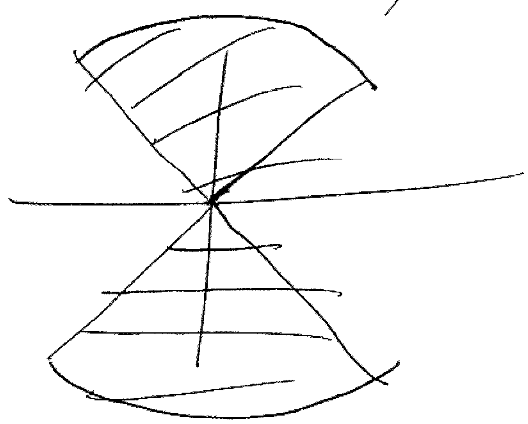
10



11.



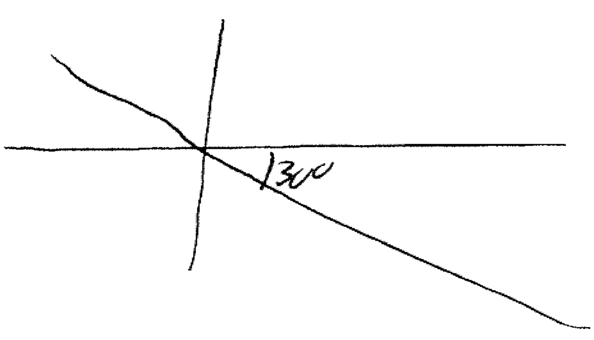
12.



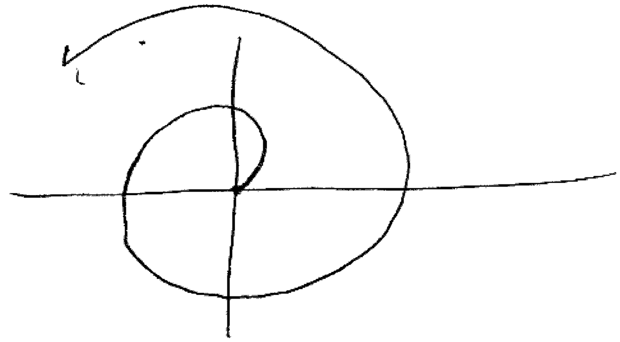
19. $x^2+y^2=2cx \longrightarrow r^2=2cr\cos\theta$

$r=2c\cos\theta$

23



29.



48. $r=2-\sin\theta \qquad \theta=\pi/3$

$$\text{Slope}=\frac{\frac{dr}{d\theta}\sin\theta+r\cos\theta}{\frac{dr}{d\theta}\cos\theta-r\sin\theta}=\frac{-\cos\theta\sin\theta+r\cos\theta}{-\cos^2\theta-r\sin\theta}$$

$\theta=\pi/3$

$\sin\theta=\sqrt{3}/2 \qquad \cos\theta=1/2$

$r=2-\frac{\sqrt{3}}{2}$

$$\text{Slope}=\frac{-\frac{\sqrt{3}}{4}+1-\frac{\sqrt{3}}{4}}{-1/4-\sqrt{3}+3/4}=\frac{-\frac{\sqrt{3}}{2}+1}{-1+\sqrt{3}}$$

$$=\frac{-\frac{\sqrt{3}}{2}+1}{\frac{1}{2}-\sqrt{3}}=\frac{2-\sqrt{3}}{1-2\sqrt{3}}=\frac{-\sqrt{3}+2}{-2+2\sqrt{3}}=\frac{-3\sqrt{3}+4}{4\sqrt{3}-7}$$

Nv 54. $r^2=\sin 2\theta \qquad 2r\frac{dr}{d\theta}=2\cos 2\theta \qquad \frac{dr}{d\theta}=\frac{\cos 2\theta}{r}$

$$\text{slope}=\frac{\frac{\sin\theta\cos 2\theta}{r}+r\cos\theta}{\frac{\cos\theta\cos 2\theta}{r}+r\sin\theta}=\frac{r^2\cos\theta+\sin\theta\cos 2\theta}{r^2\sin\theta+\cos\theta\cos 2\theta}$$

#54

Horizontal $r^2\cos\theta + \sin\theta\cos 2\theta = 0$

$r^2\cos\theta + \sin\theta\cos 2\theta = 0$ but $r^2 = \sin 2\theta$

$\sin 2\theta\cos\theta + \sin\theta\cos 2\theta = 0$

$\tan 2\theta = -\tan\theta$

$\frac{2\tan\theta}{1-\tan^2\theta} = -\tan\theta \Rightarrow \tan\theta = 0$

$\frac{2}{1-\tan^2\theta} = -1$

$-1 + \tan^2\theta = 2$

$\tan^2\theta = 3$

$\tan\theta = \pm\sqrt{3}$

$\theta = \pi/3, -\pi/3, 0$

Now plug in.

Vertical $r^2\sin\theta + \cos\theta\cos 2\theta = 0$

$\sin 2\theta\sin\theta + \cos\theta\cos 2\theta = 0$

$\sin 2\theta\sin\theta = -\cos\theta\cos 2\theta$

$\tan 2\theta = -\cot\theta =$

$\frac{2\tan\theta}{1-\tan^2\theta} = \frac{-1}{\tan\theta}$

$2\tan^2\theta = -1 + \tan^2\theta$

$\tan^2\theta = -1/2$ NO SOLUTIONS

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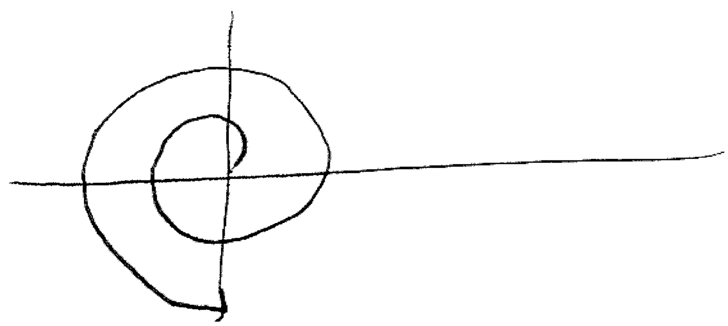
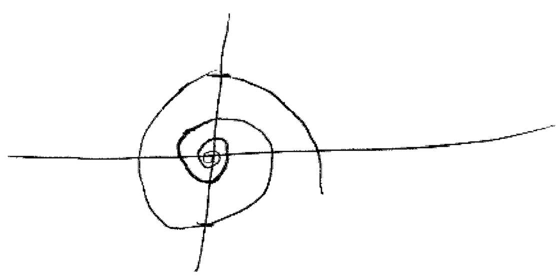
21. a. Polar $\theta = \pi/6$
b. Cartesian $x = 3$

22. ~~b~~ a. Cartesian $(x-2)^2+(y-3)^2=25$
b. Polar $r=4$

30. $r = \ln\theta \quad \theta \geq 1$



38. $r^2\theta = 1 \quad r^2 = \frac{1}{\theta}$



46. a. ~~θ~~ VI
b. III
c. IV
d. ~~II~~ V
e. II
f. I

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1. $r=\sqrt{\theta}$ $\quad \int_0^{\pi/4} \frac{1}{2}\theta\, d\theta = \frac{1}{4}\theta^2\Big|_0^{\pi/4} = \pi^2/64$

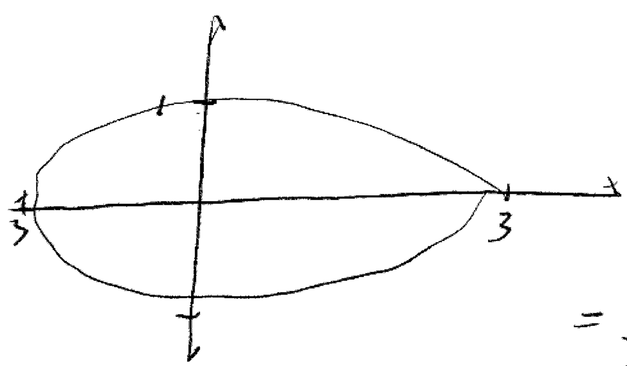
2. $r=e^{\theta/2}$ $\quad \int_{\pi}^{2\pi} \frac{1}{2}e^{\theta}\, d\theta = \frac{1}{2}e^{\theta}\Big|_{\pi}^{2\pi} = \frac{1}{2}(e^{2\pi}-e^{\pi})$

8. $\int_0^{\pi/4} \frac{1}{2}\sin^2 4\theta\, d\theta = \frac{1}{2}\int_0^{\pi/4} \frac{1}{2}(1-\cos 8\theta)$

$= \frac{1}{4}(\theta - \frac{1}{8}\sin 8\theta\Big|_0^{\pi/4}$

$= \frac{1}{4}(\pi/4 - 0) = \pi/16$

12. $r = 2+\cos 2\theta$



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

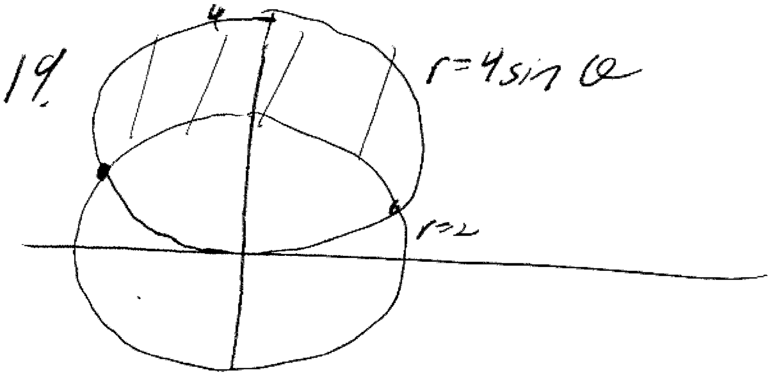
$= \frac{1}{2}\int_0^{2\pi} 4 + 4\cos 2\theta + \cos^2 2\theta\, d\theta$

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

$= \frac{1}{2}(4\theta + 2\sin 2\theta + \frac{\theta}{2} + \frac{1}{8}\sin 4\theta)\Big|_0^{2\pi}$

$= \frac{1}{2}((8\pi + \pi) - (0)) = 9\pi/2$

19.



Find intersection $\quad 2 = 4\sin\theta$

$\frac{1}{2} = \sin\theta \quad \theta = \pi/6, -\pi/6$

redo!

$$\int_{-\pi/6}^{\pi/6} \frac{1}{2}\cdot 16\sin^2\theta - 2 \, d\theta$$

$$= \int_{-\pi/6}^{\pi/6} 4 - 4\cos 2\theta - 2 \, d\theta = 2\theta - 2\sin 2\theta \Big|_{-\pi/6}^{\pi/6}$$

$$= (\pi/3 - \sqrt{3}) - (-\pi/3 + \sqrt{3})$$

$$= 2\pi/3 - 2\sqrt{3}$$

34. $r = e^{2\theta} \quad 0 \le \theta \le 2\pi \qquad \frac{dr}{d\theta} = 2e^{2\theta}$

$$L = \int_0^{2\pi} \sqrt{e^{4\theta} + 4e^{4\theta}} \, d\theta = \int_0^{2\pi} \sqrt{5e^{4\theta}} \, d\theta$$

$$= \int_0^{2\pi} \sqrt{5}\, e^{2\theta} \, d\theta$$

$$= \frac{\sqrt{5}}{2} e^{2\theta} \Big|_0^{2\pi}$$

$$= \sqrt{5}/2 \,(e^{4\pi} - 1)$$

35. $r = \theta^2 \quad 0 \le \theta \le 2\pi \qquad \frac{dr}{d\theta} = 2\theta$

$$\int_0^{2\pi} \sqrt{4\theta^2 + \theta^4}\, d\theta$$

$$= \int_0^{2\pi} \theta\sqrt{4+\theta^2}\, d\theta$$

$u = 4+\theta^2 \quad du = 2\theta\, d\theta$

$$= \int_4^{4+4\pi^2} \tfrac{1}{2}\sqrt{u}\, du = \tfrac{1}{3}u^{3/2}\Big|_4^{4+4\pi^2}$$

$$= \tfrac{1}{3}(4+\theta^2)^{3/2}\Big|_0^{2\pi}$$

$$= \tfrac{1}{3}\left((4+4\pi^2)^{3/2} - 8\right)$$