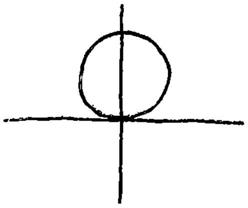
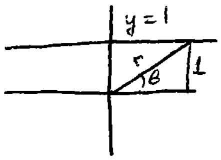
1.



parametric : $x=\cos t,\ y=1+\sin t$ or $x=\sin t,\ y=1+\cos t$

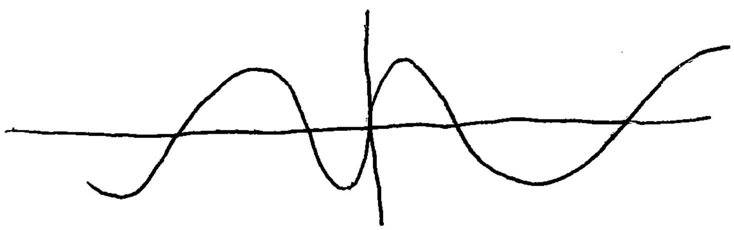
polar : $r=2\sin\theta$

2.



$\sin\theta=\frac{1}{r} \iff r=\frac{1}{\sin\theta}=\csc\theta \quad , \quad 0<\theta<\pi$.

3.



$x'=3t^2$
$y'=\cos t$

$t=\pi/4 \Rightarrow dy/dx=\frac{1/\sqrt{2}}{3(\pi/4)^2}=\frac{16}{3\sqrt{2}\,\pi^2}$ tang. line @ $t=\pi/4$: $y-\frac{1}{\sqrt{2}}=\frac{16}{3\sqrt{2}\pi^2}\left(x-\frac{\pi^3}{4^3}\right)$

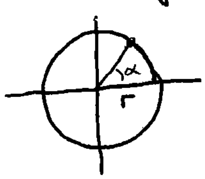
$x'=0 \iff t=0$

$y'=0 \iff t=\pi/2+n \quad (n=\ldots -3,-2,-1,0,1,2,3,\ldots)$

vert. tang @ $t=0$, i.e. $(x,y)=(0,0)$.

horiz. tang @ $t=\pi/2+n$, i.e. $(x,y)=\left((\frac{\pi}{2}+n)^3,\ \cos(\frac{\pi}{2}+n)\right)$

4.



parametric : $x=r\cos t$, $y=r\sin t$ $\Rightarrow$ arc len $=\int_0^\alpha \sqrt{\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2}\,dt$

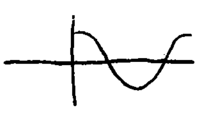
$=\int_0^\alpha \sqrt{r^2\sin^2 t+r^2\cos^2 t}\,dt$

$=\int_0^\alpha r\,dt = r\alpha$

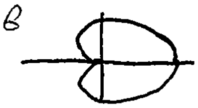
polar : $r=r_0$

$\Rightarrow$ arc len $=\int_0^\alpha \sqrt{r^2+\left(\frac{dr}{d\theta}\right)^2}\,d\theta=\int_0^\alpha\sqrt{r_0^2+0}\,d\theta=\int_0^\alpha r_0\,d\theta=\alpha r_0$.

5. $\cos\theta$



$r=1+\cos\theta$



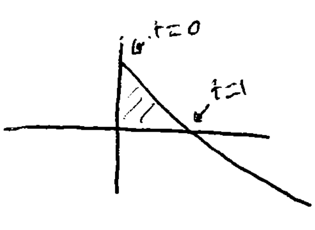
(cardioid)

$\cos^2\theta=\frac{1+\cos 2\theta}{2}$

area $=\int_0^{2\pi}\frac{1}{2}r^2\,d\theta=\frac{1}{2}\int_0^{2\pi}(1+\cos\theta)^2=\frac{1}{2}\int_0^{2\pi}\left[1+2\cos\theta+\cos^2\theta\right]d\theta$

$=\frac{1}{2}\cdot 2\pi+\cancel{\int_0^{2\pi}\cos\theta}^{\,0}+\frac{1}{4}\int_0^{2\pi}(1+\cancel{\cos 2\theta}^{\,0})\,d\theta \quad =\pi+\frac{1}{4}\int_0^{2\pi}d\theta=\pi+\frac{\pi}{2}=\frac{3\pi}{2}$

6.



area $=\int_{t=0}^{t=1} y\,dx=\int_0^1 \underbrace{(1-t^2)}_{y}\underbrace{(1+2t)dt}_{dx}=\int_0^1(1+2t-t^2-2t^3)\,dt$

$=\left[t+t^2-\frac{t^3}{3}-\frac{t^4}{2}\right]_0^1=1+1-\frac{1}{3}-\frac{1}{2}=7/6$