```
> restart:
> with (student):with(plots):

Warning, the name changecoords has been redefined
```

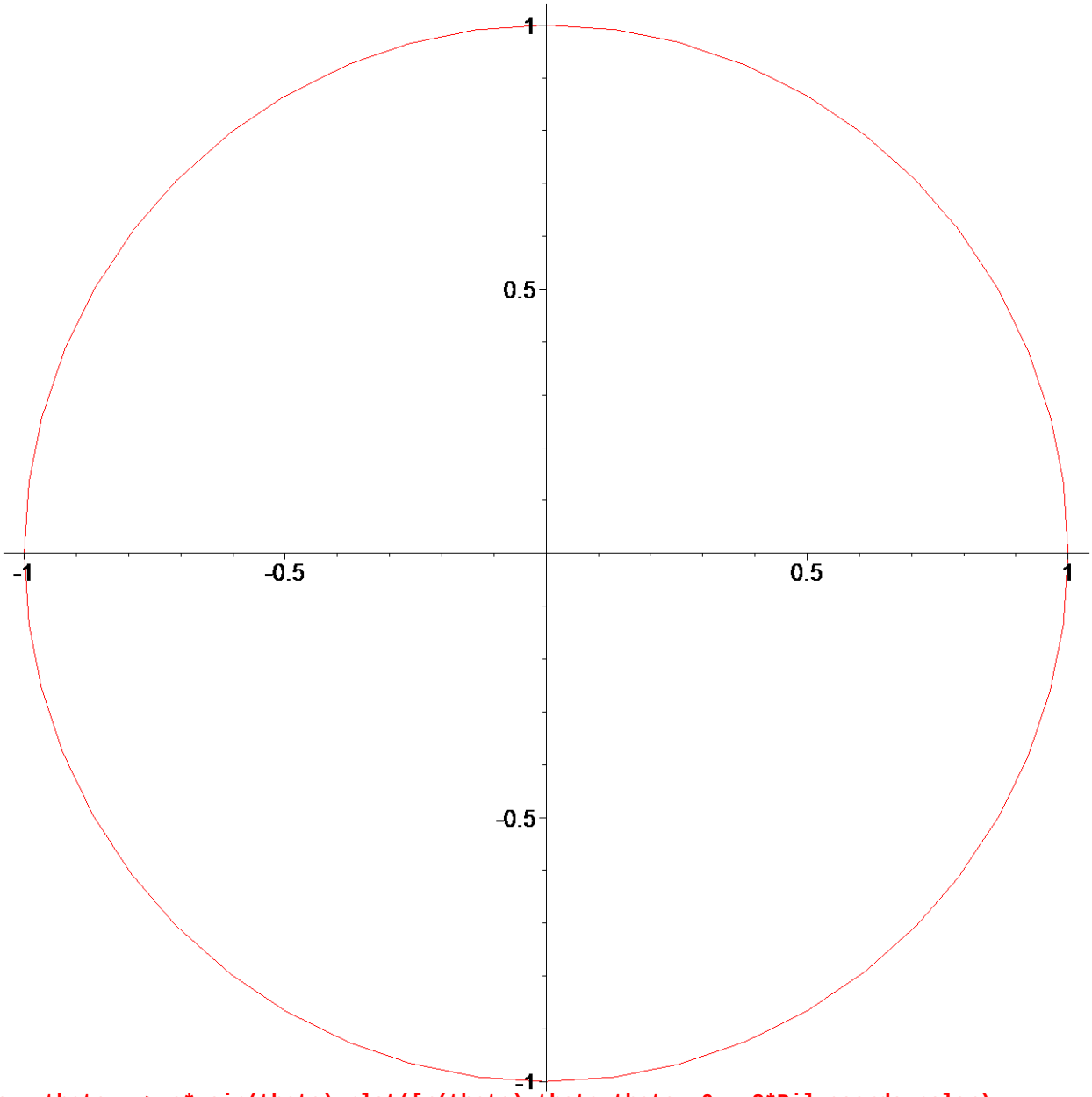
I. Circles

```
> a:=1;
```

$$a := 1$$

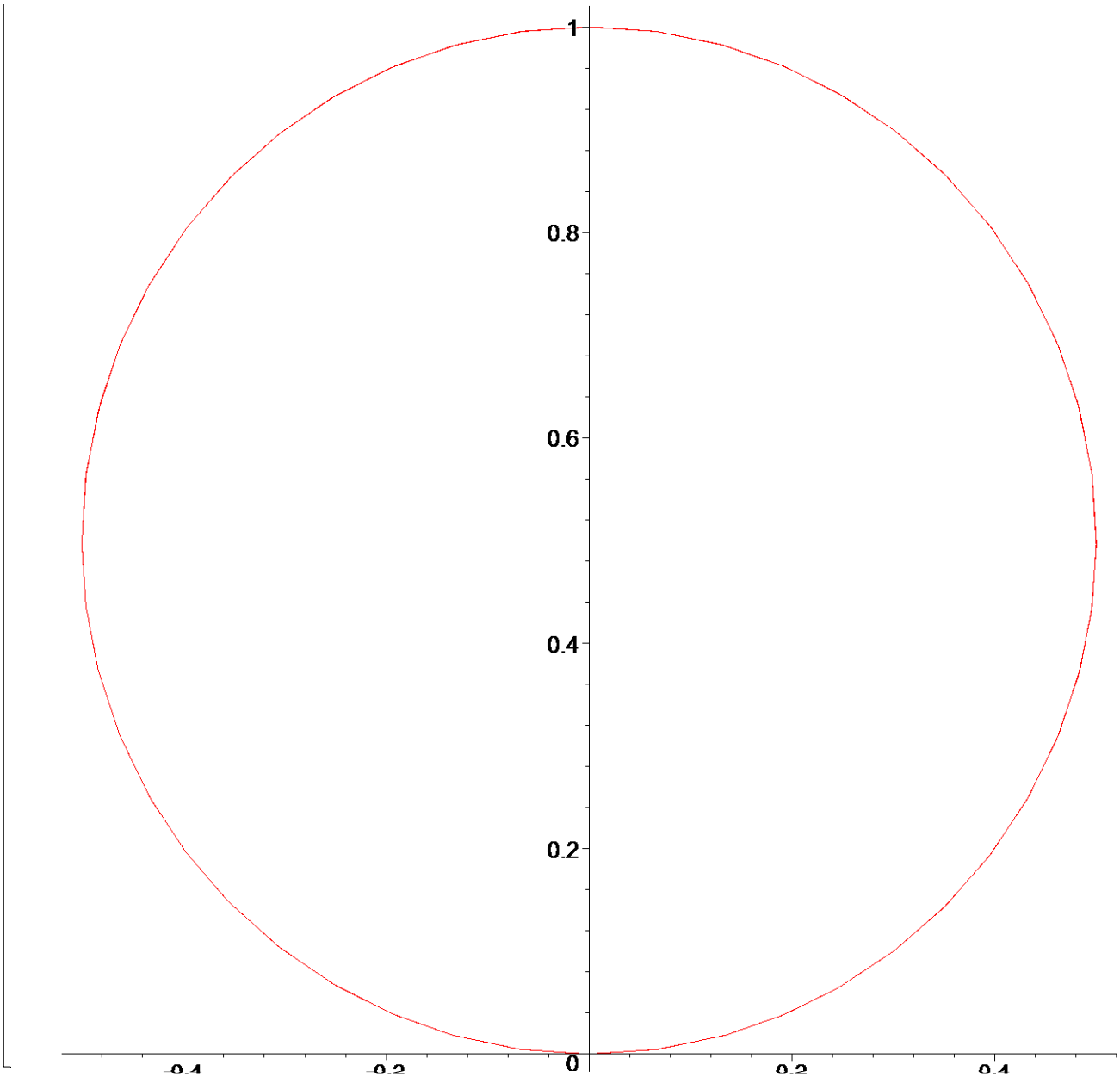
```
> r:= theta  -> a;plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a$$



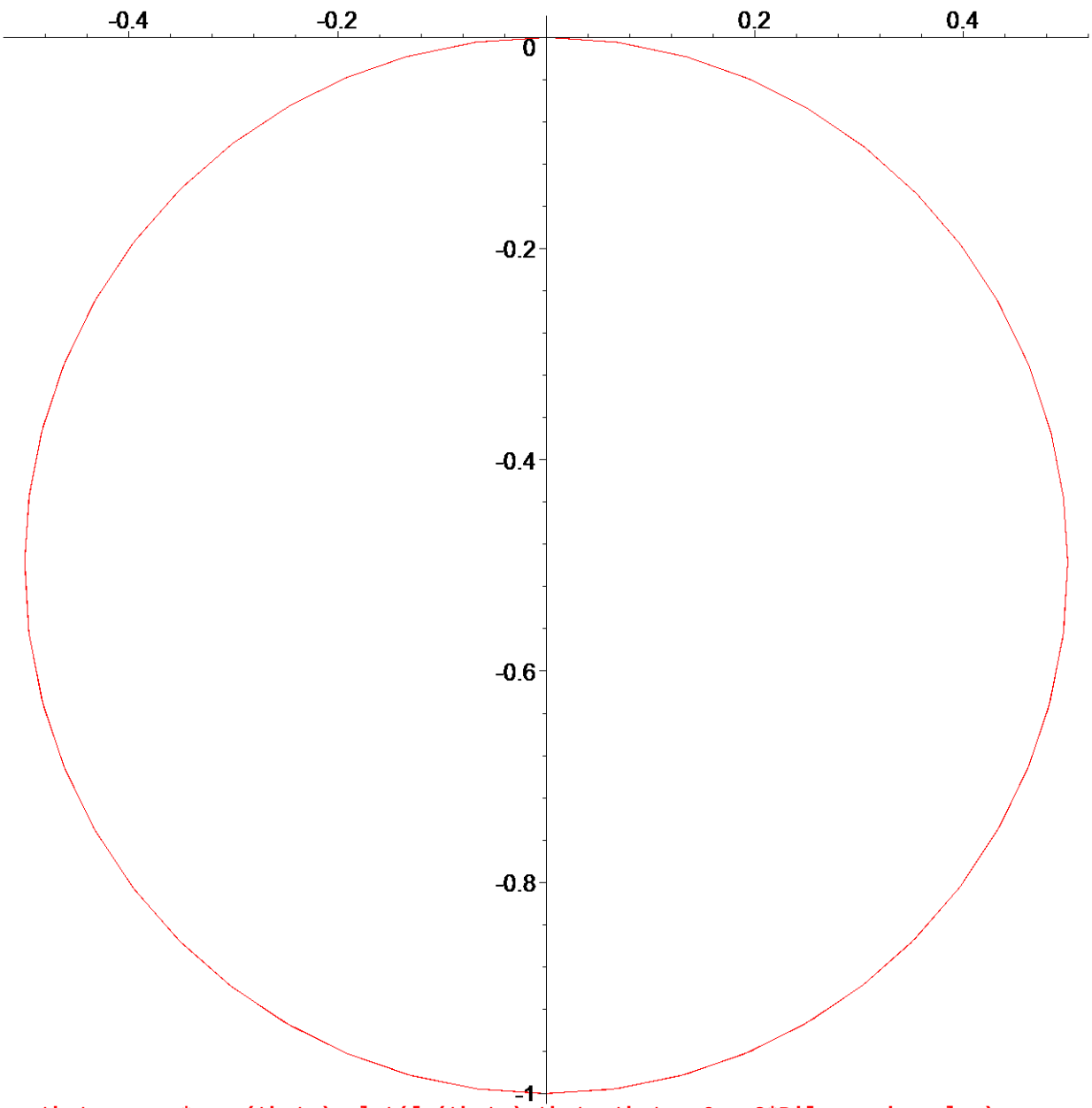

```
> r:= theta  -> a* sin(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \sin(\theta)$$



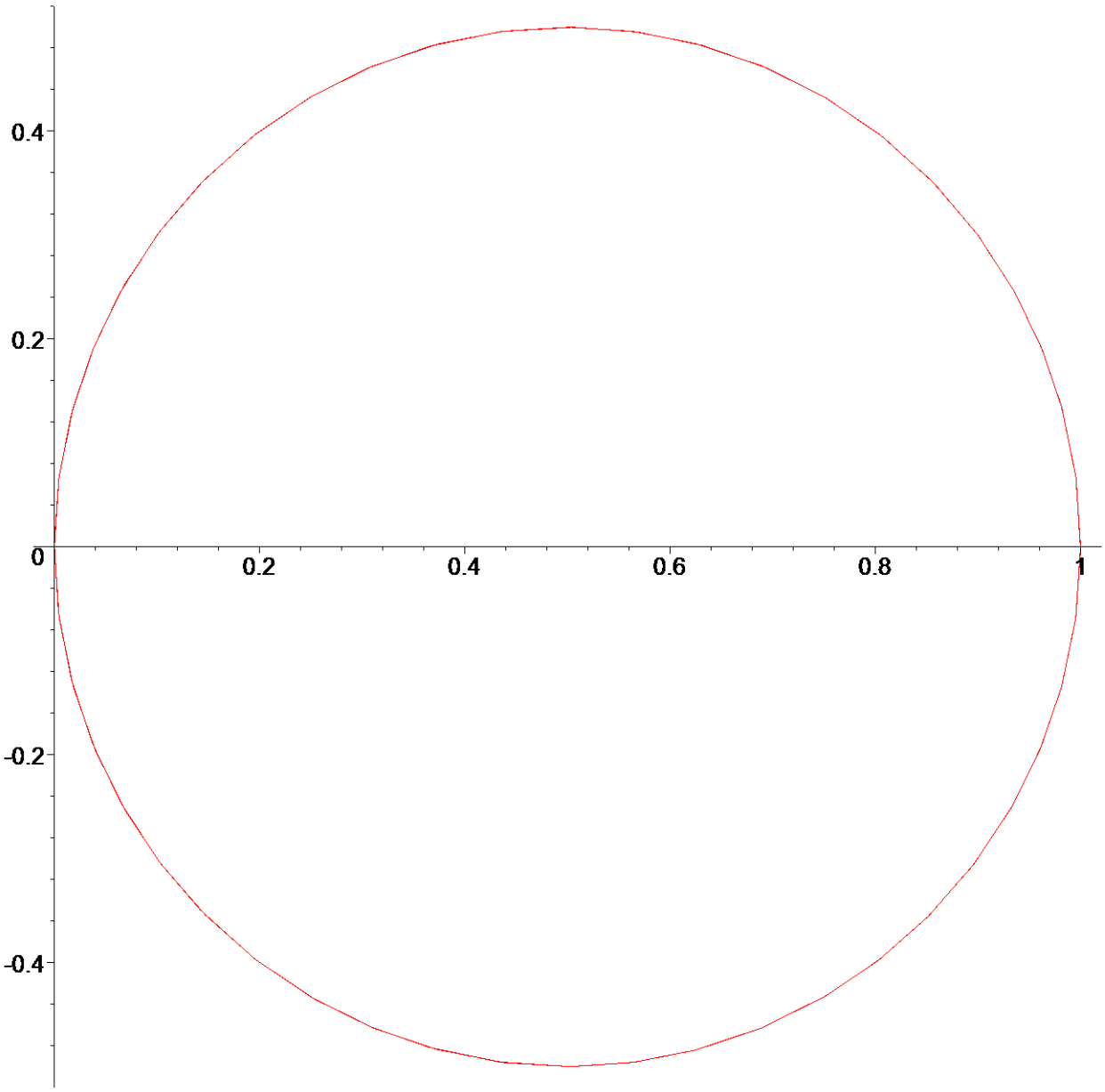

```
> r:= theta  -> -a* sin(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to -a \sin(\theta)$$



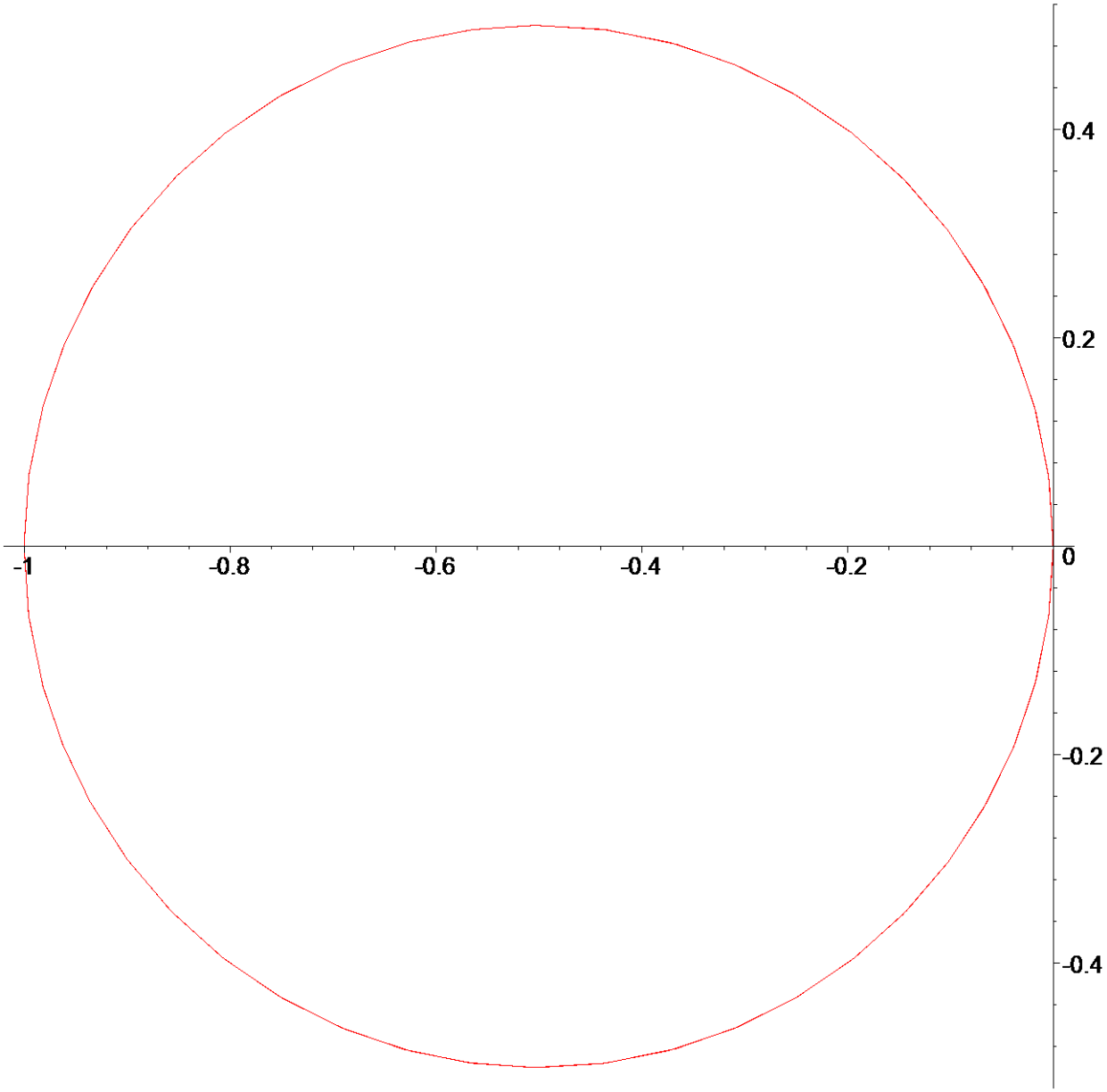

```
> r:= theta  -> a* cos(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \cos(\theta)$$




```
> r:= theta  -> -a* cos(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to -a \cos(\theta)$$



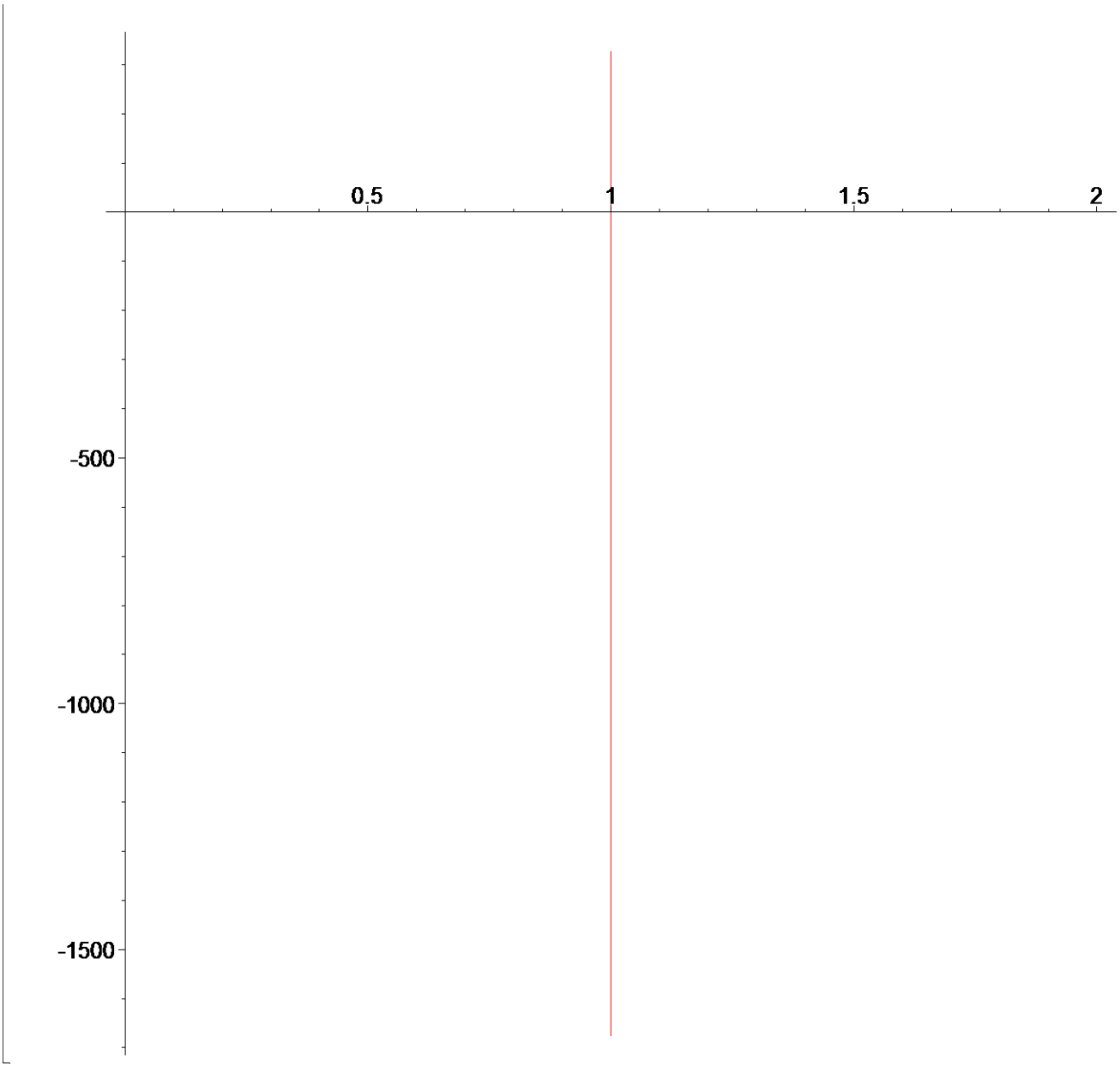
II Lines

```
> a:=1;
```

$$a := 1$$

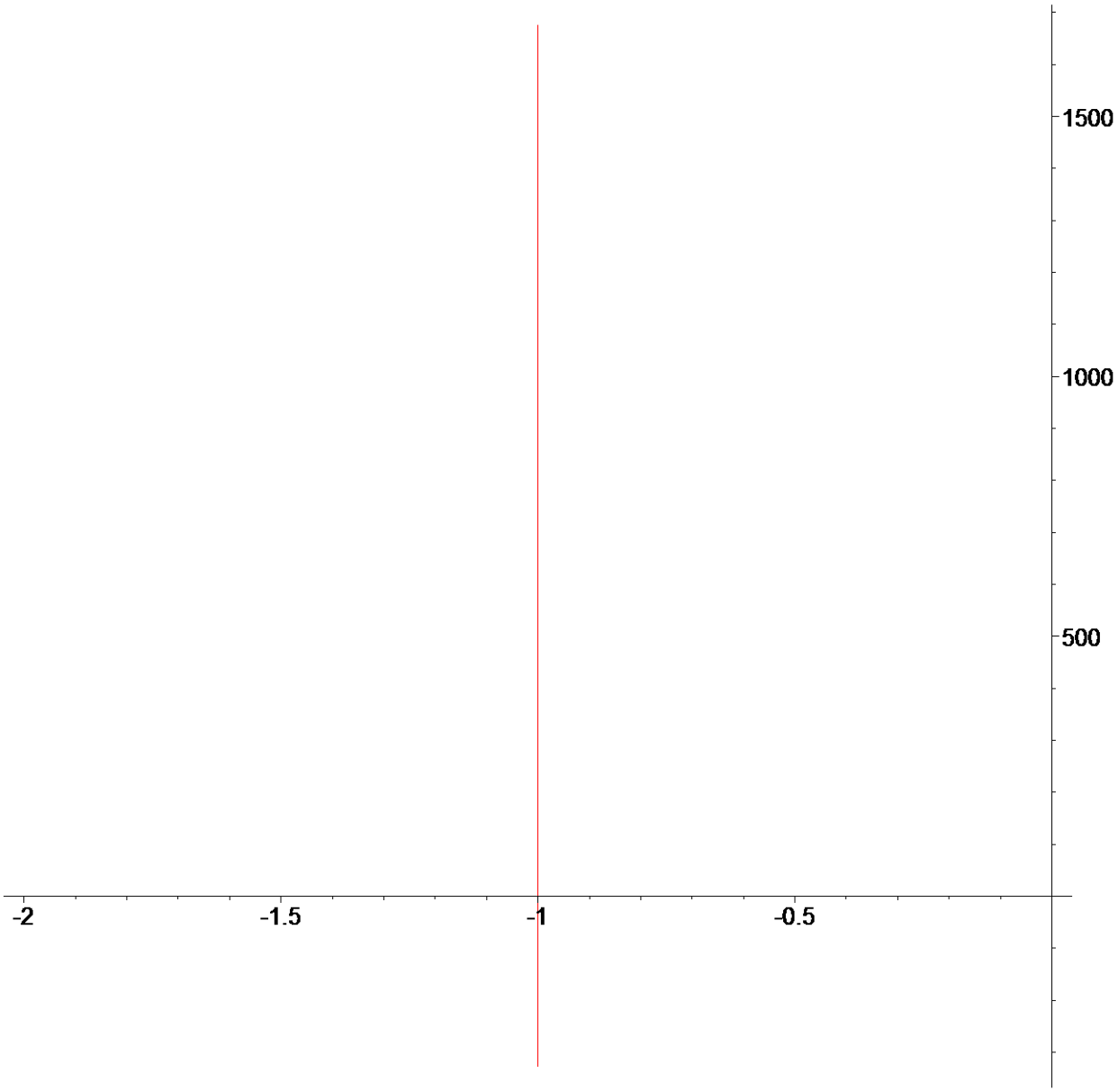
```
> r:= theta  -> a*sec(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \rightarrow a \sec(\theta)$$



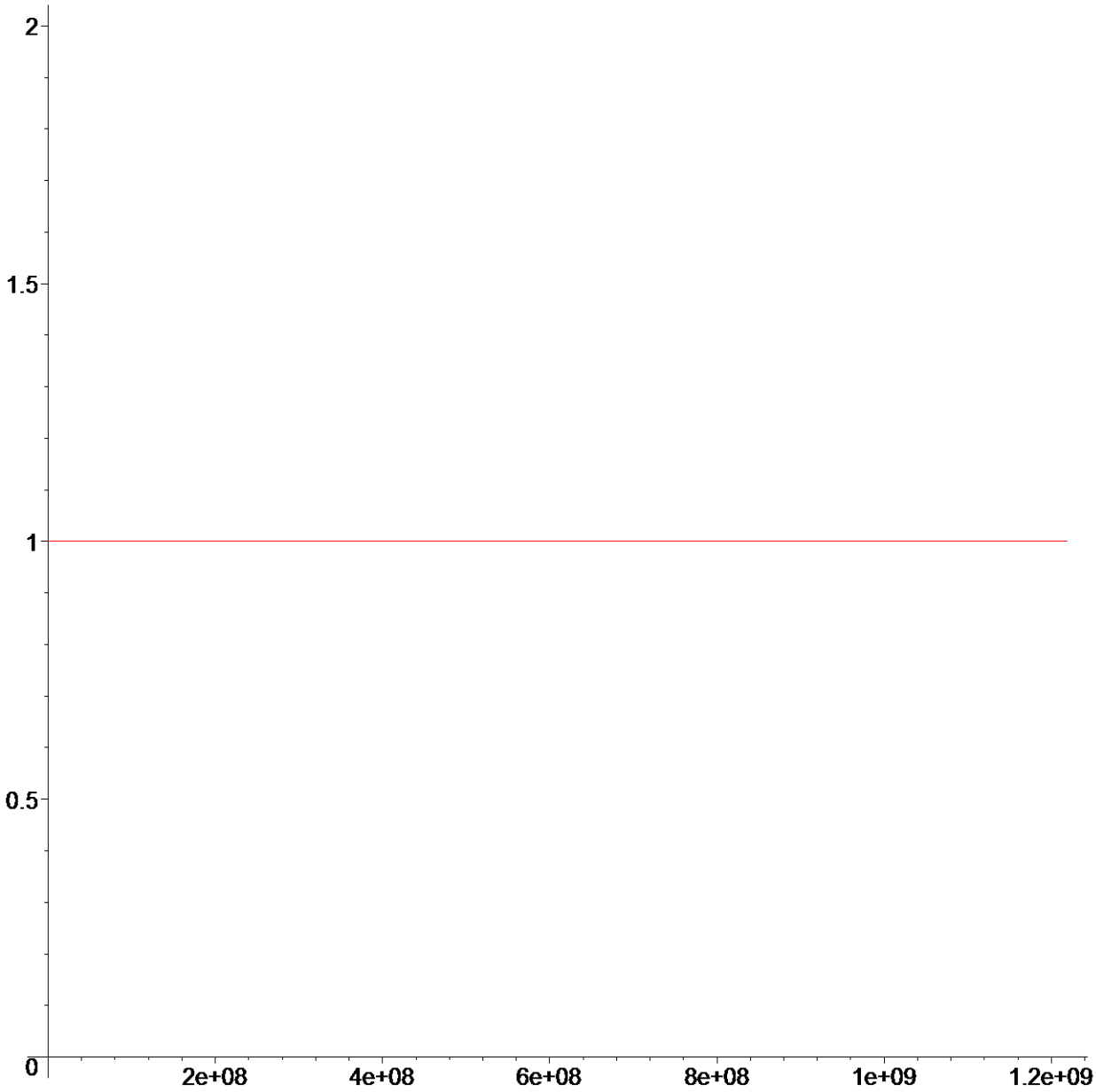

```
> r:= theta  -> -a* sec(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to -a \sec(\theta)$$



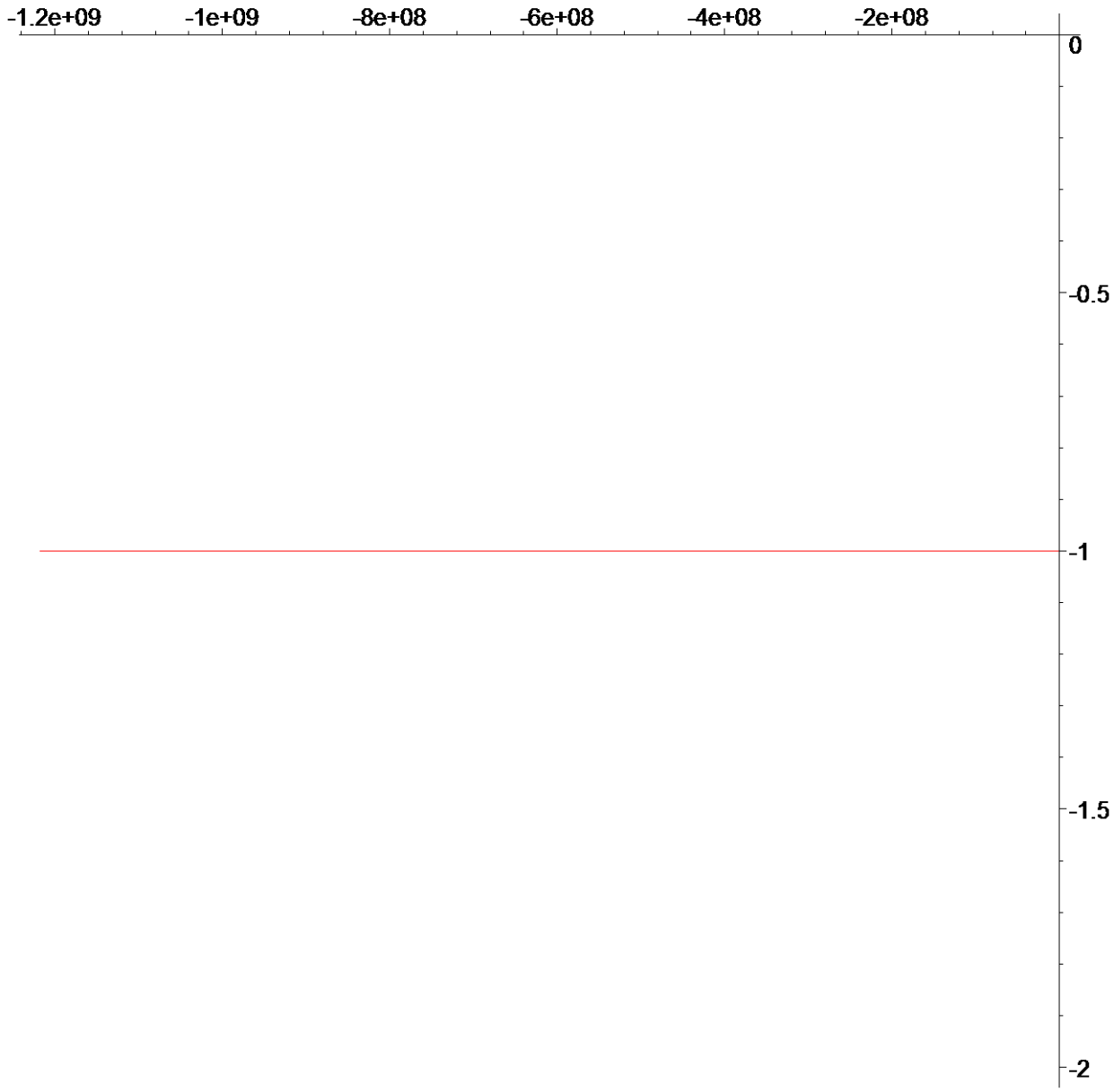

```
> r:= theta  -> a* csc(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \csc(\theta)$$




```
> r:= theta  -> -a* csc(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to -a \csc(\theta)$$



III

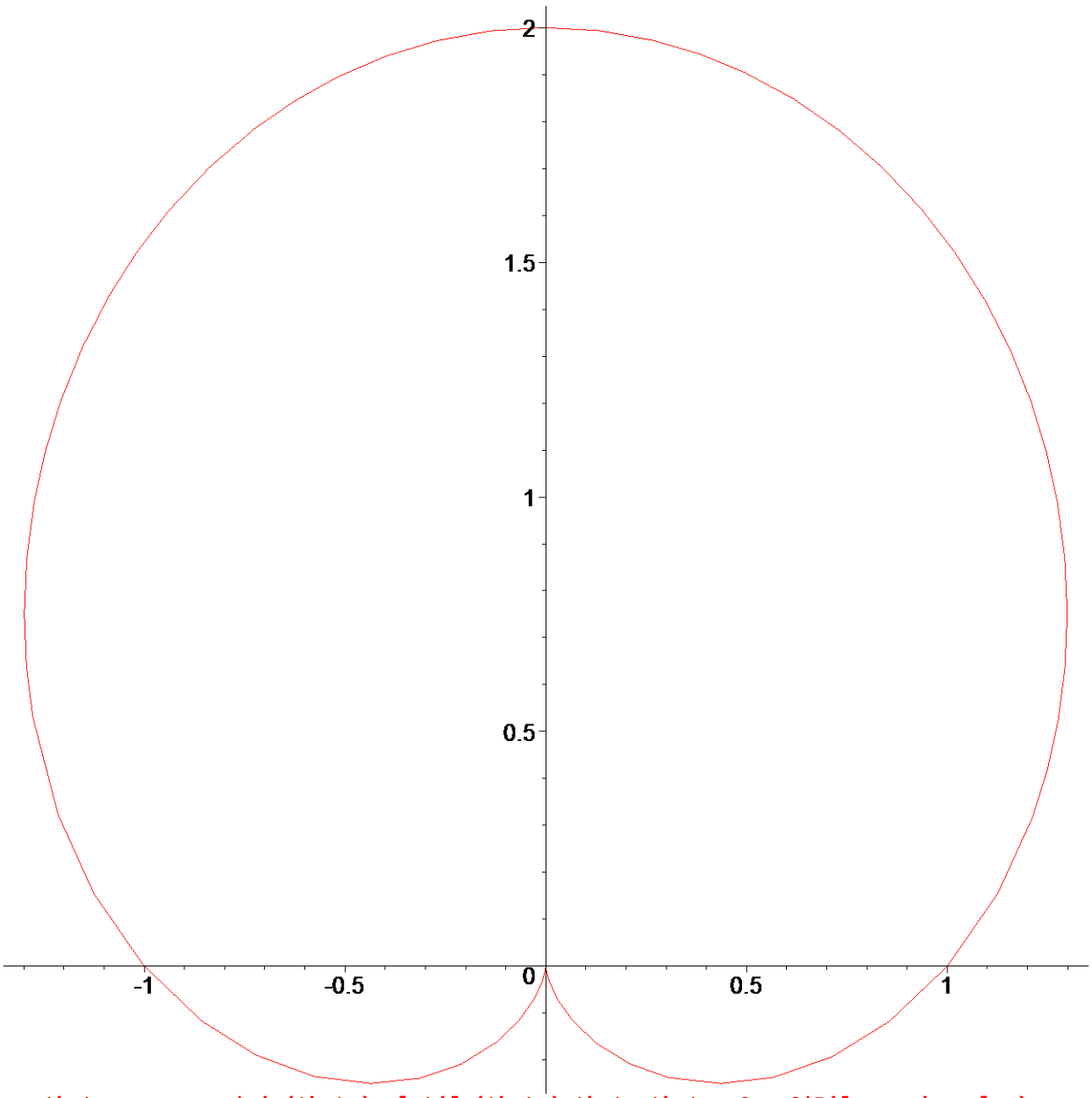
Cardiods: { Form r = a +/- a sin(theta) or r = a +/- cos(theta)

```
> a:=1;
```

$$a := 1$$

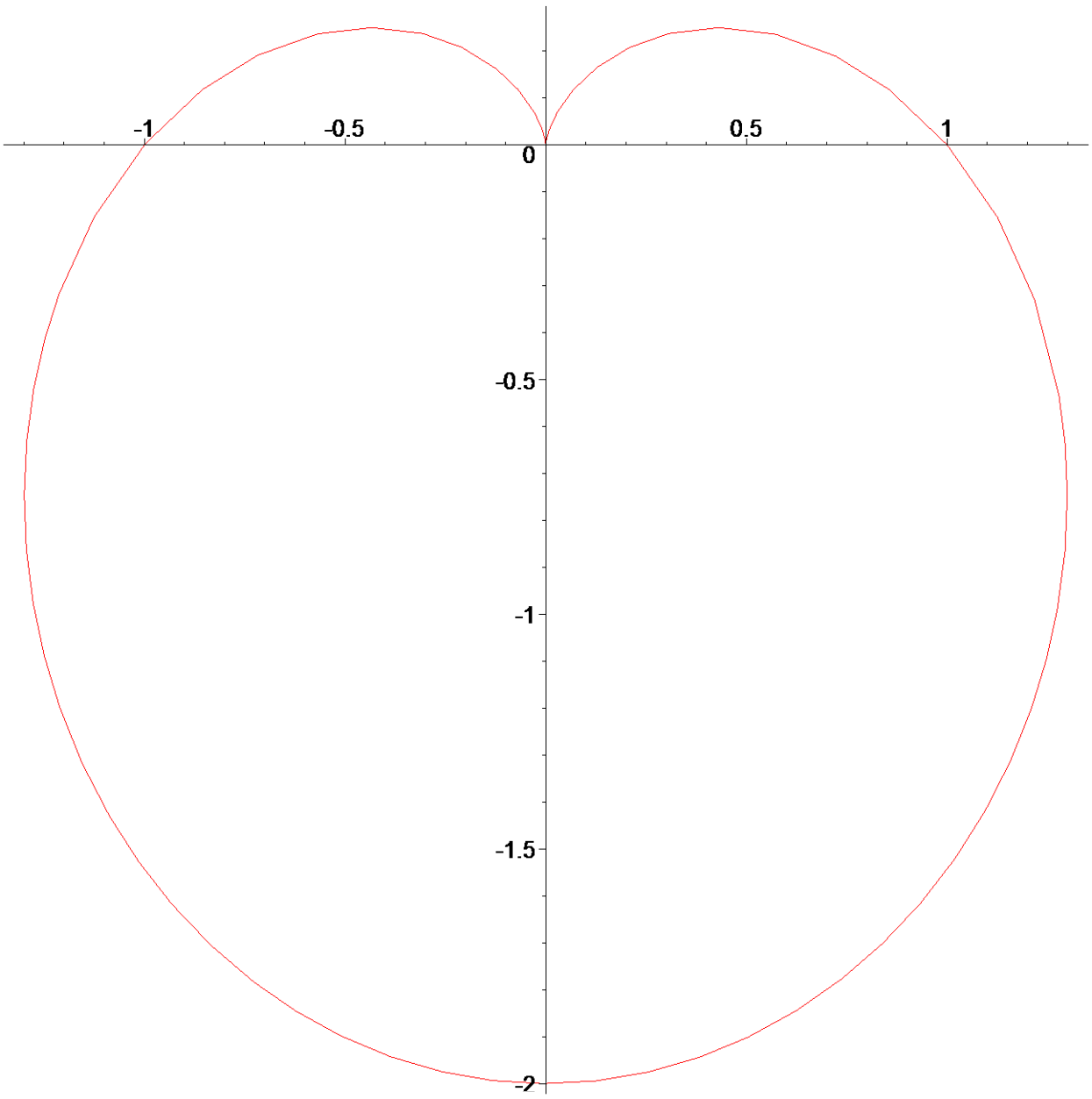
```
> r:= theta  -> a + a*sin(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \rightarrow a + a \sin(\theta)$$



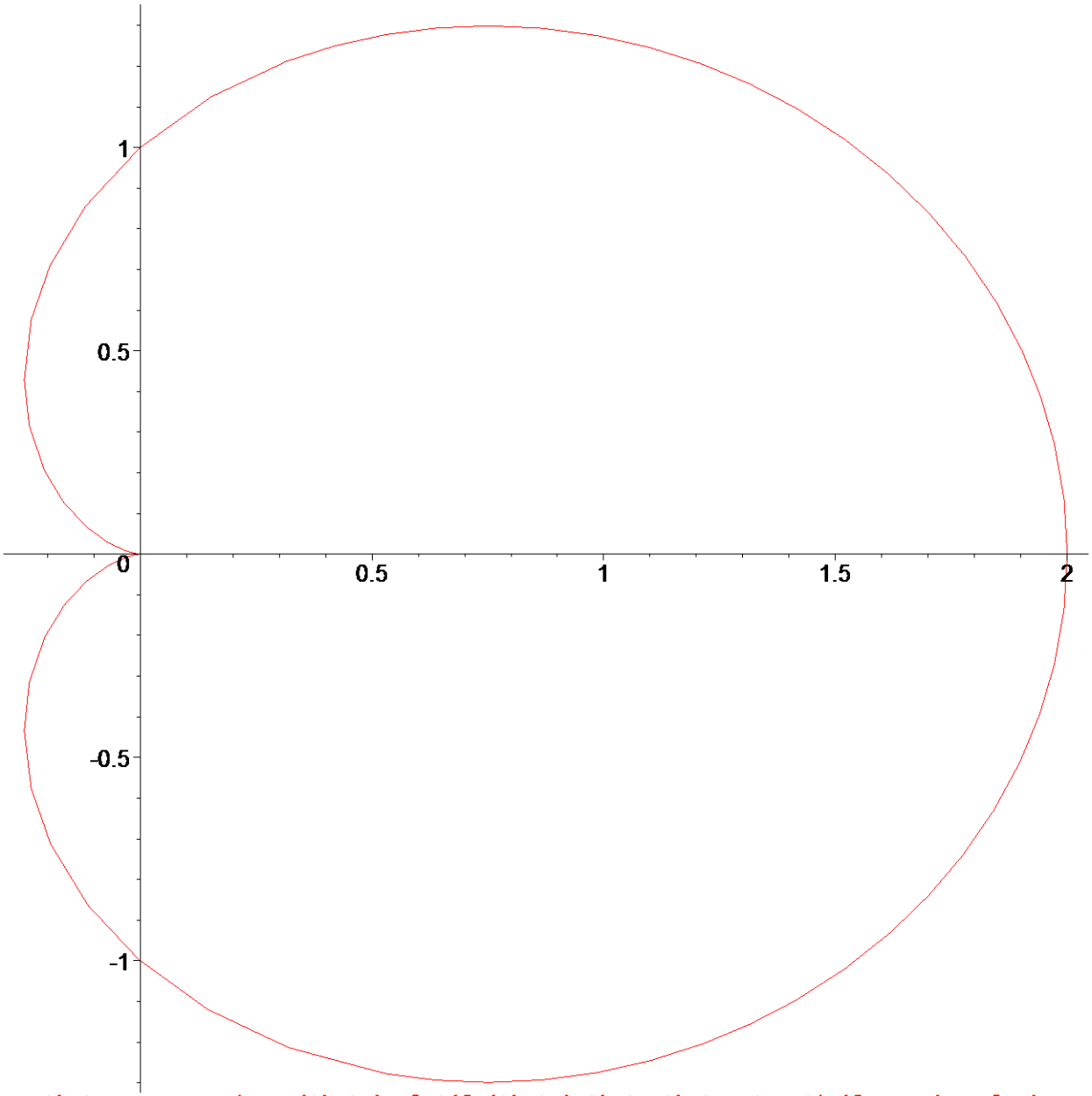

```
> r:= theta  -> a - a*sin(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a - a \sin(\theta)$$



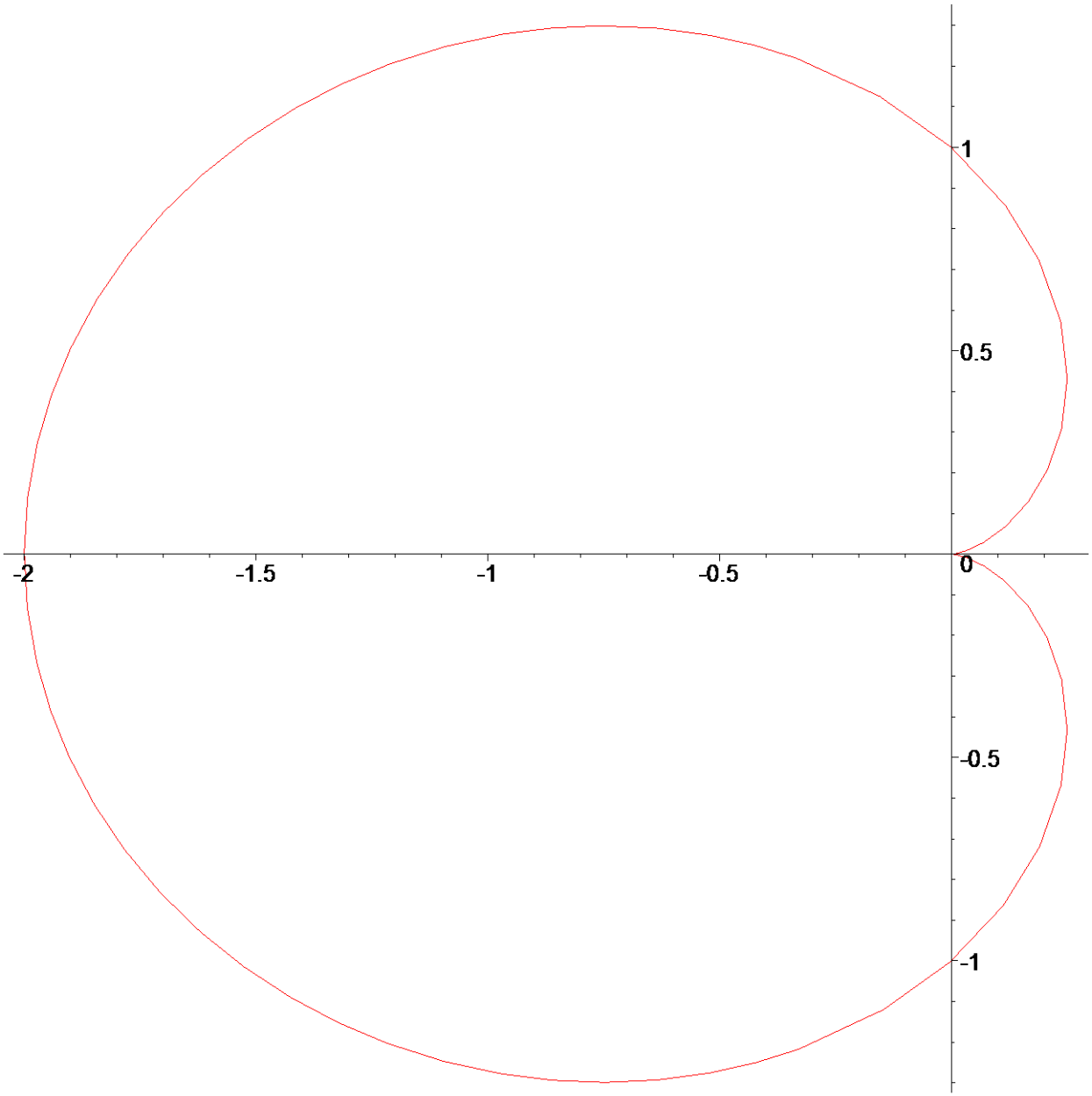

```
> r:= theta  -> a + a* cos(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a + a \cos(\theta)$$




```
> r:= theta  -> a - a* cos(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a - a\cos(\theta)$$



IV Limacons { Form r = a +/- b sin(theta), r = a +/- b cos(theta) . there are two cases a , b and a > b and a > b

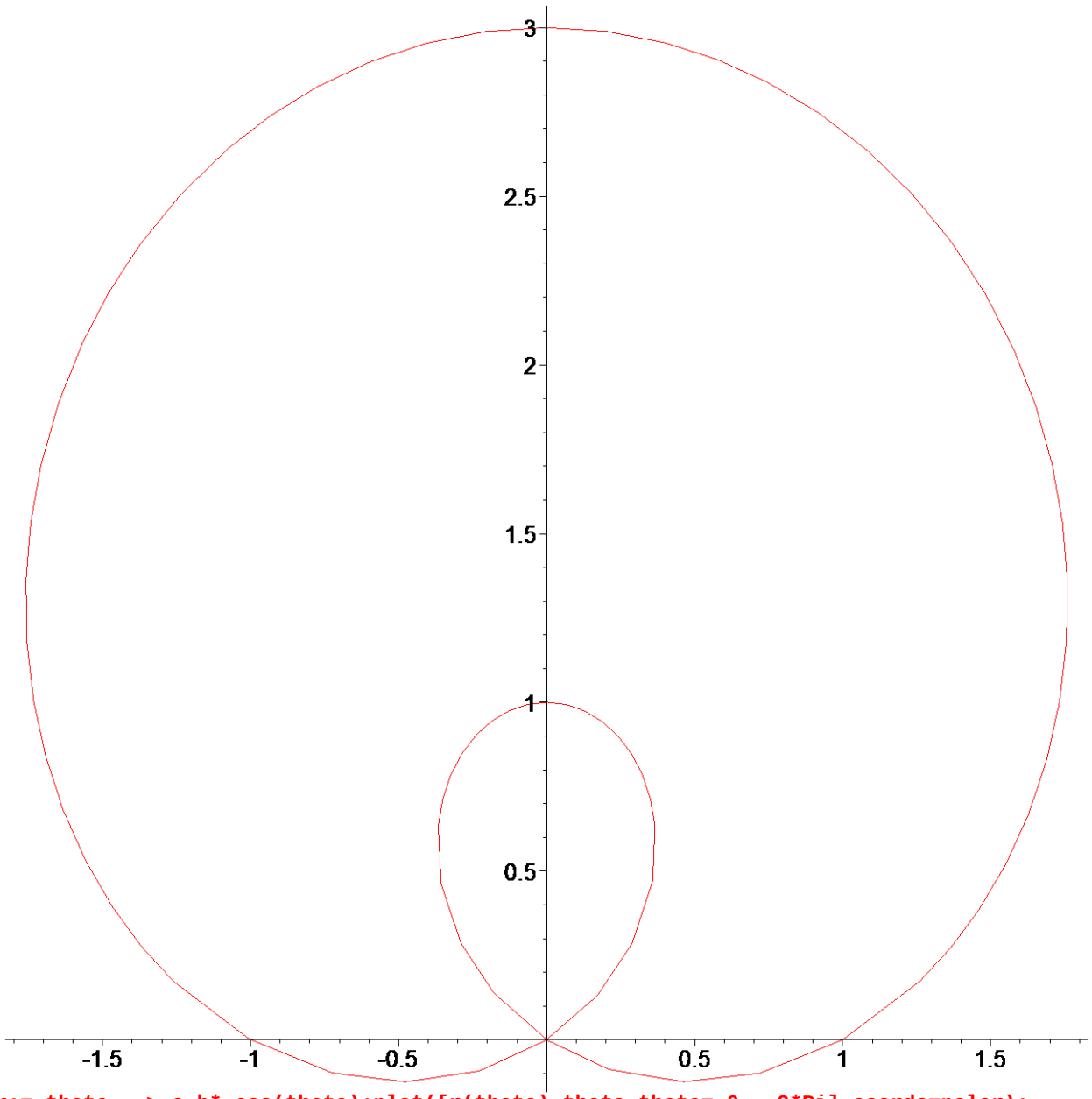
```
> a:=1;b := 2; #( Case a <> b)
>
```

$$a := 1$$

$$b := 2$$

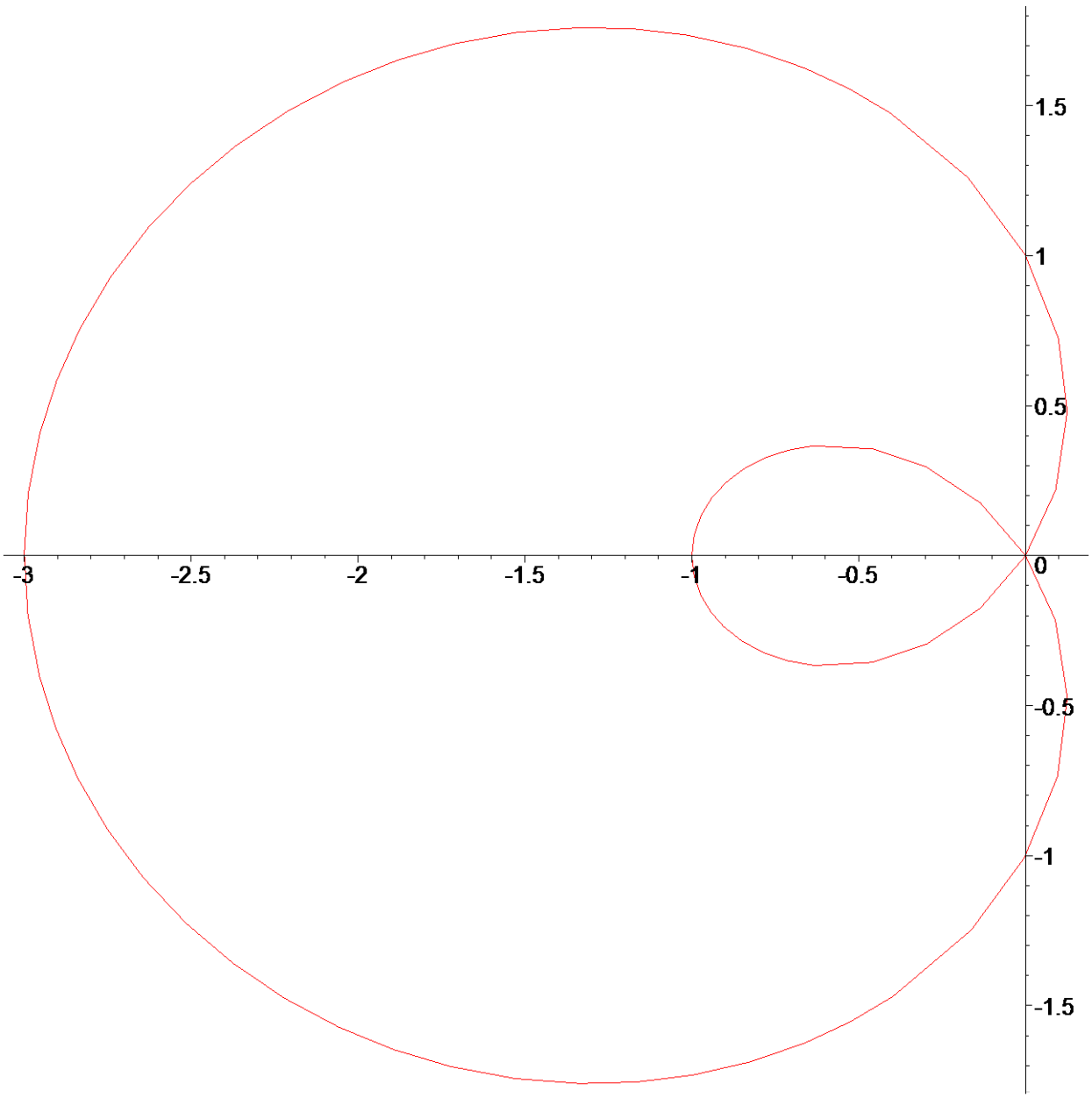
```
> r:= theta  -> a + b * sin(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \rightarrow a + b \sin(\theta)$$




```
> r:= theta  -> a-b* cos(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a - b\cos(\theta)$$



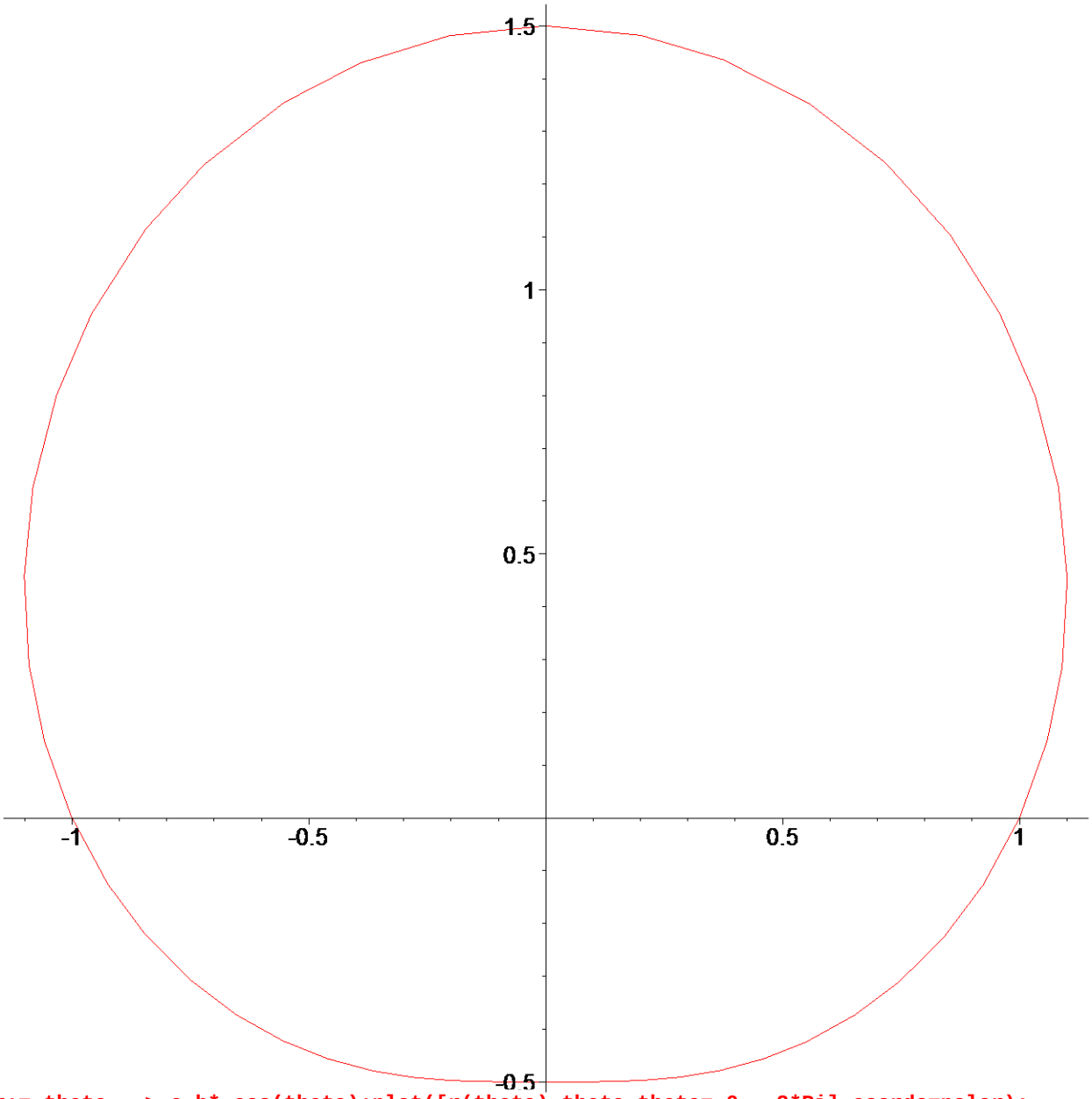

```
>
>
> a:=1;b := .5; #( Case a > b)
>
```

$$a := 1$$

$$b := 0.5$$

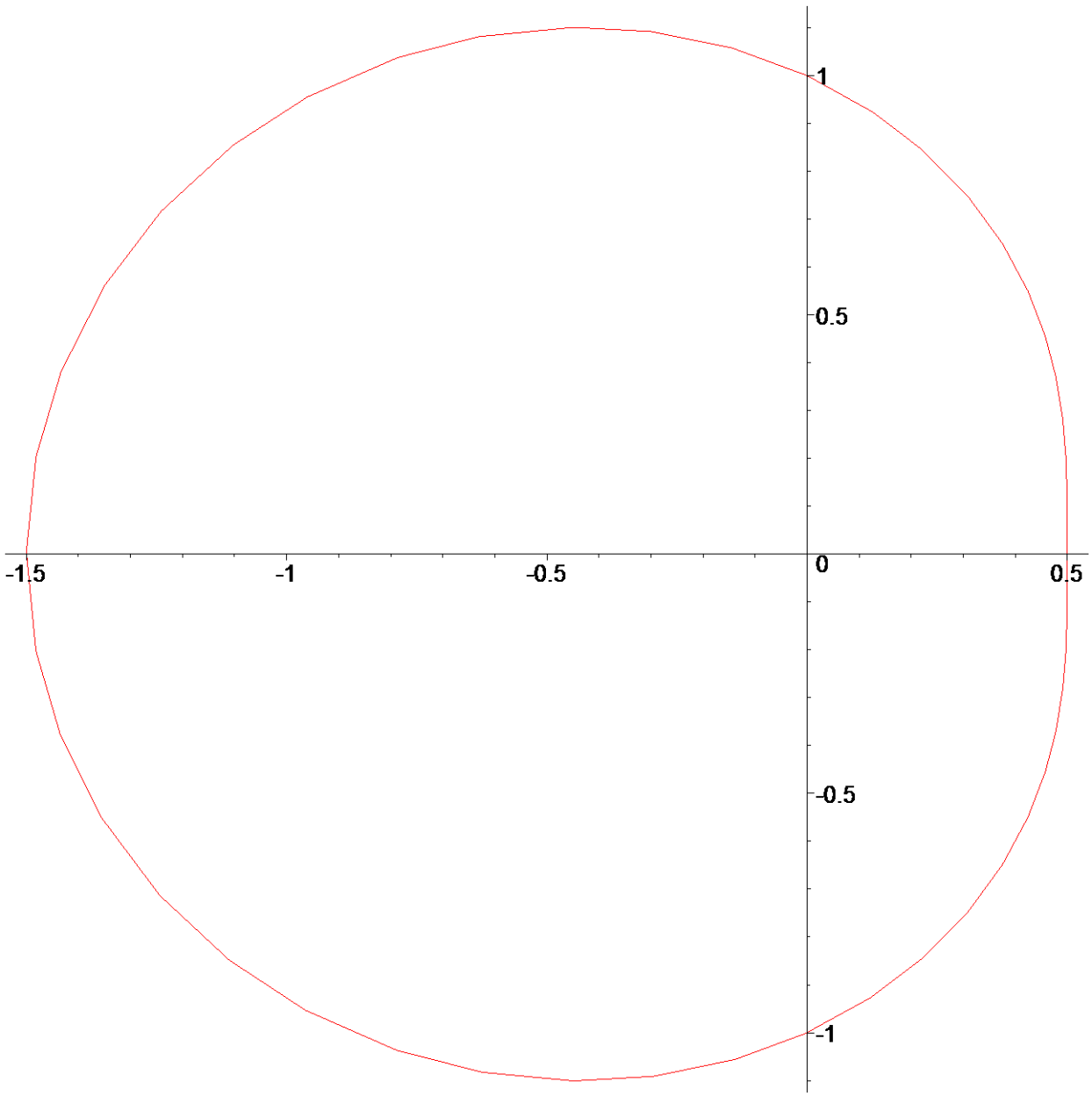
```
> r:= theta  -> a + b * sin(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a + b \sin(\theta)$$




```
> r:= theta  -> a-b* cos(theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a - b\cos(\theta)$$




```
>
```

V Roses Limacons { Form r = a sin(n* theta), or r = a cos(n*theta) . there aren leaves if n is odd; 2n leaves if n is even

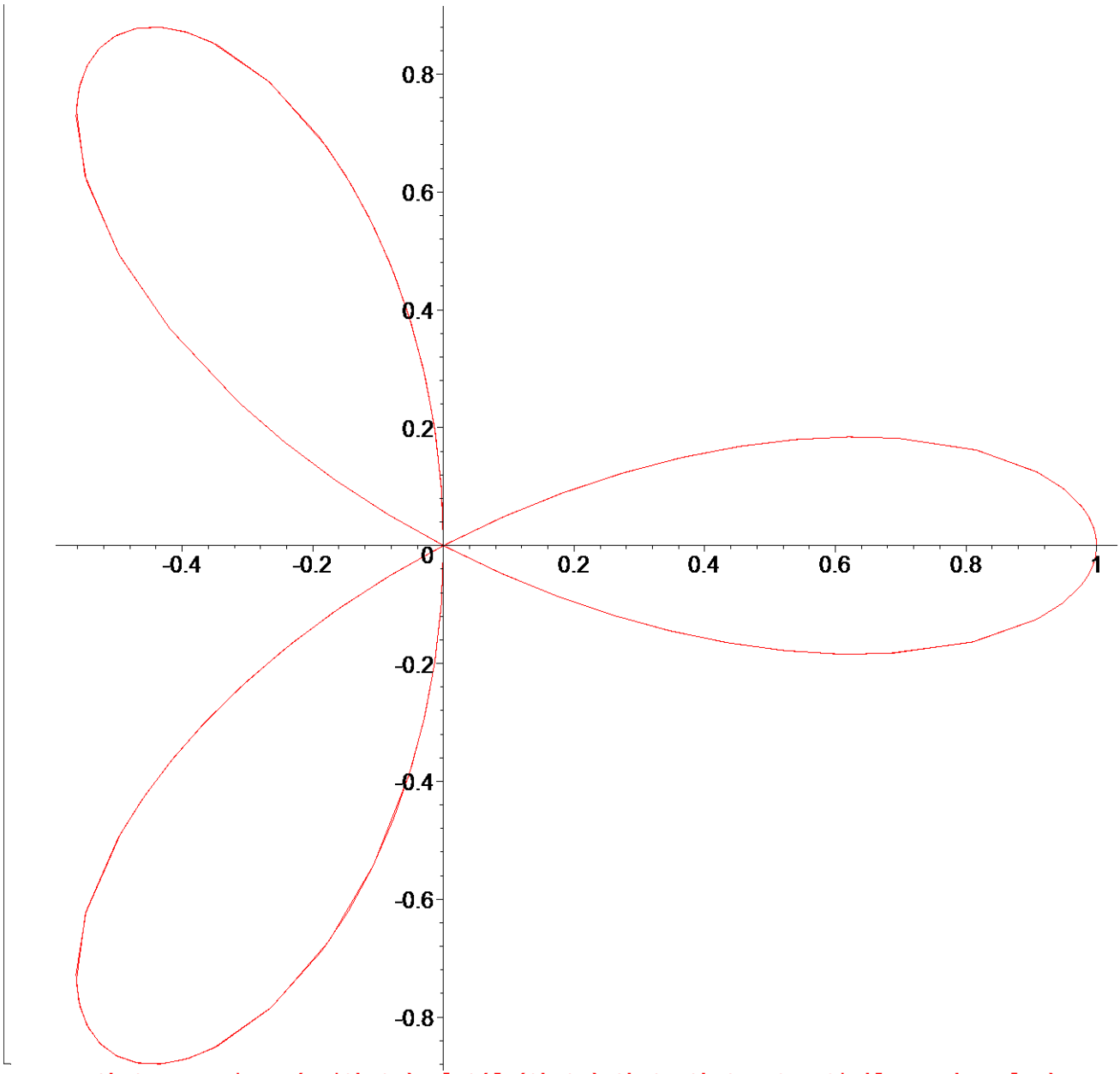
```
> a:=1;n := 3;
>
```

$$a := 1$$

$$n := 3$$

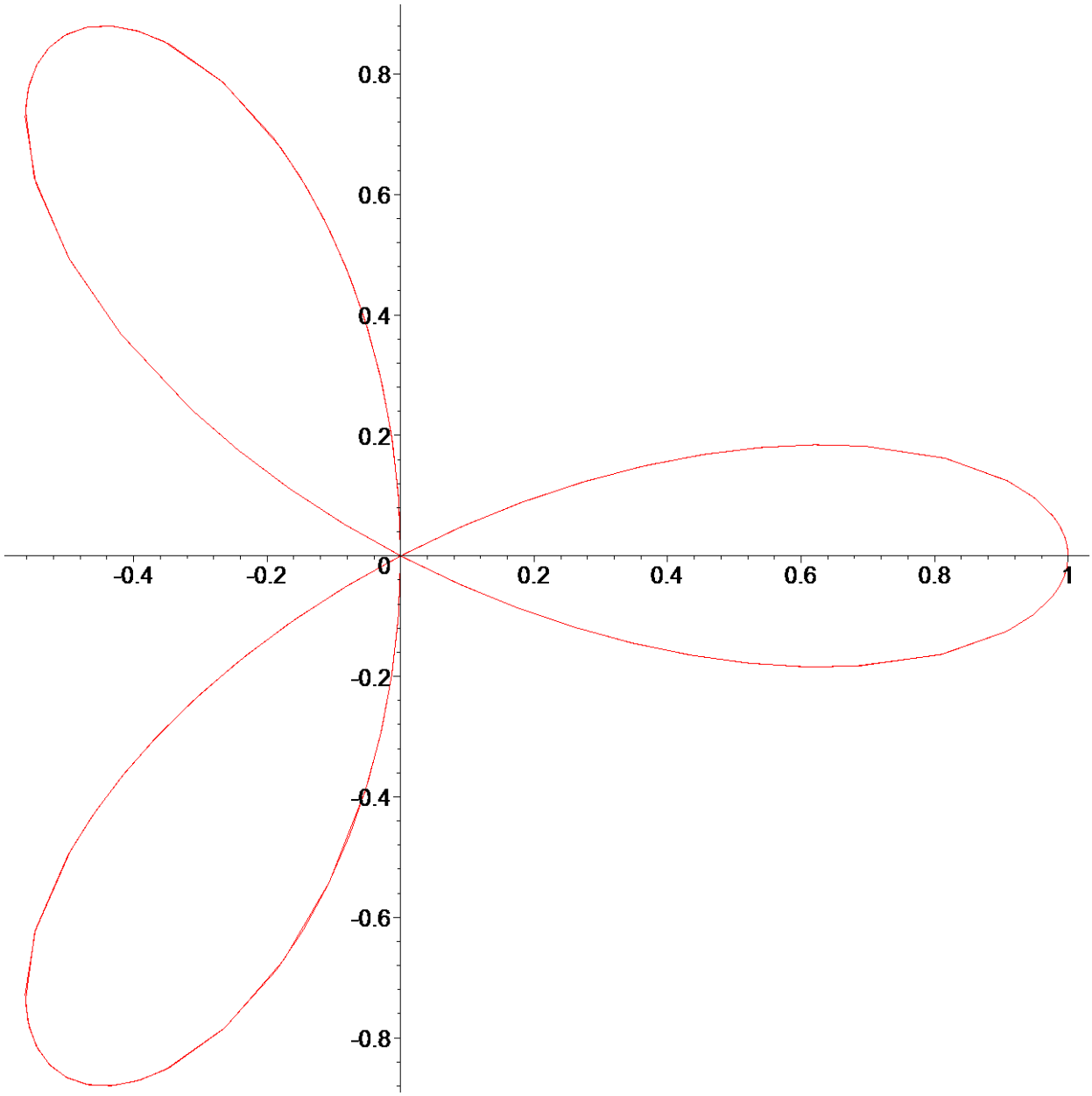
```
> r:= theta  -> a * cos(n*theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \cos(n\,\theta)$$




```
> r:= theta  -> a* cos(n *theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \cos(n\,\theta)$$




```
>
```

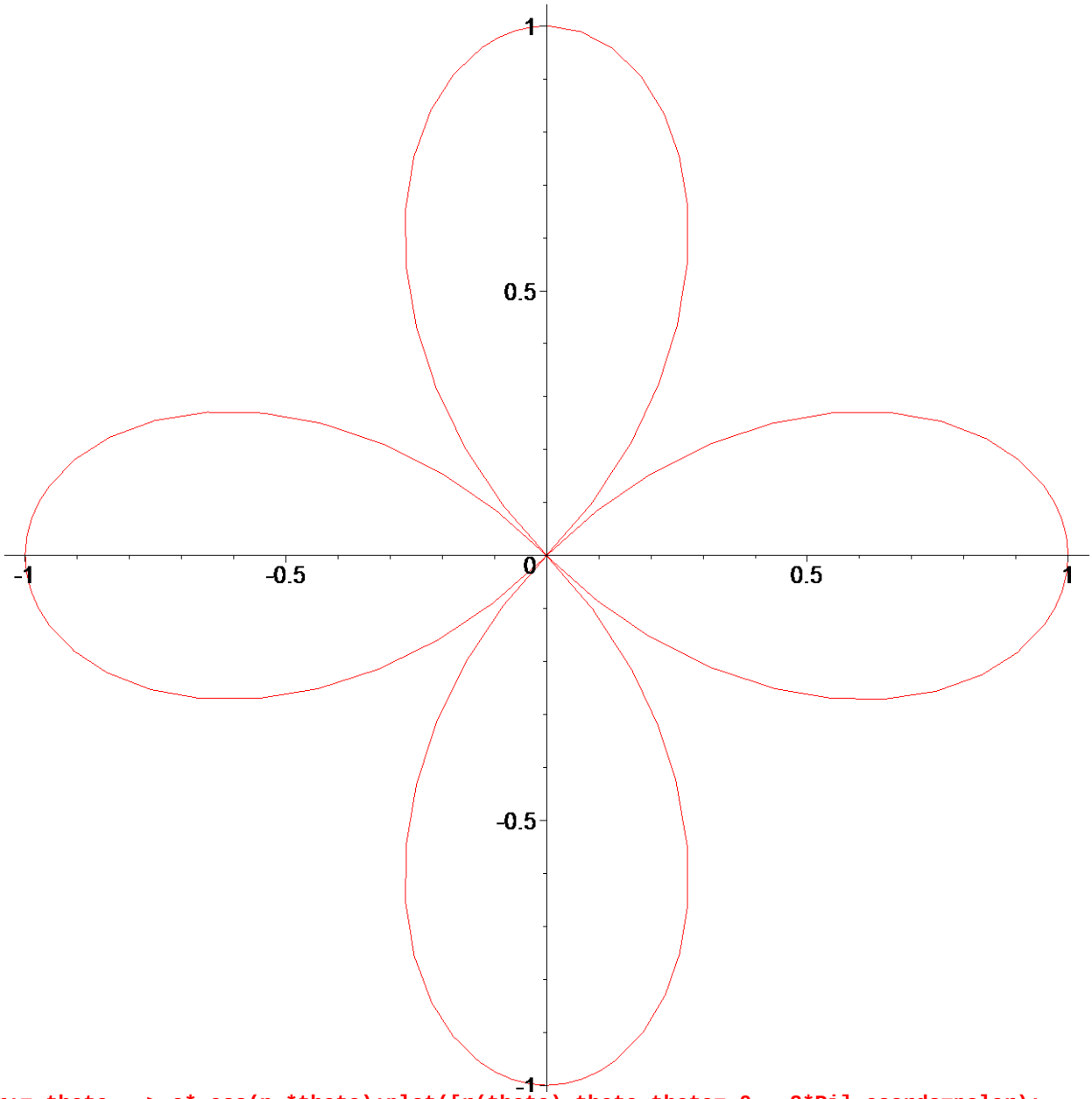
```
> a:=1;n := 2;
>
```

$$a := 1$$

$$n := 2$$

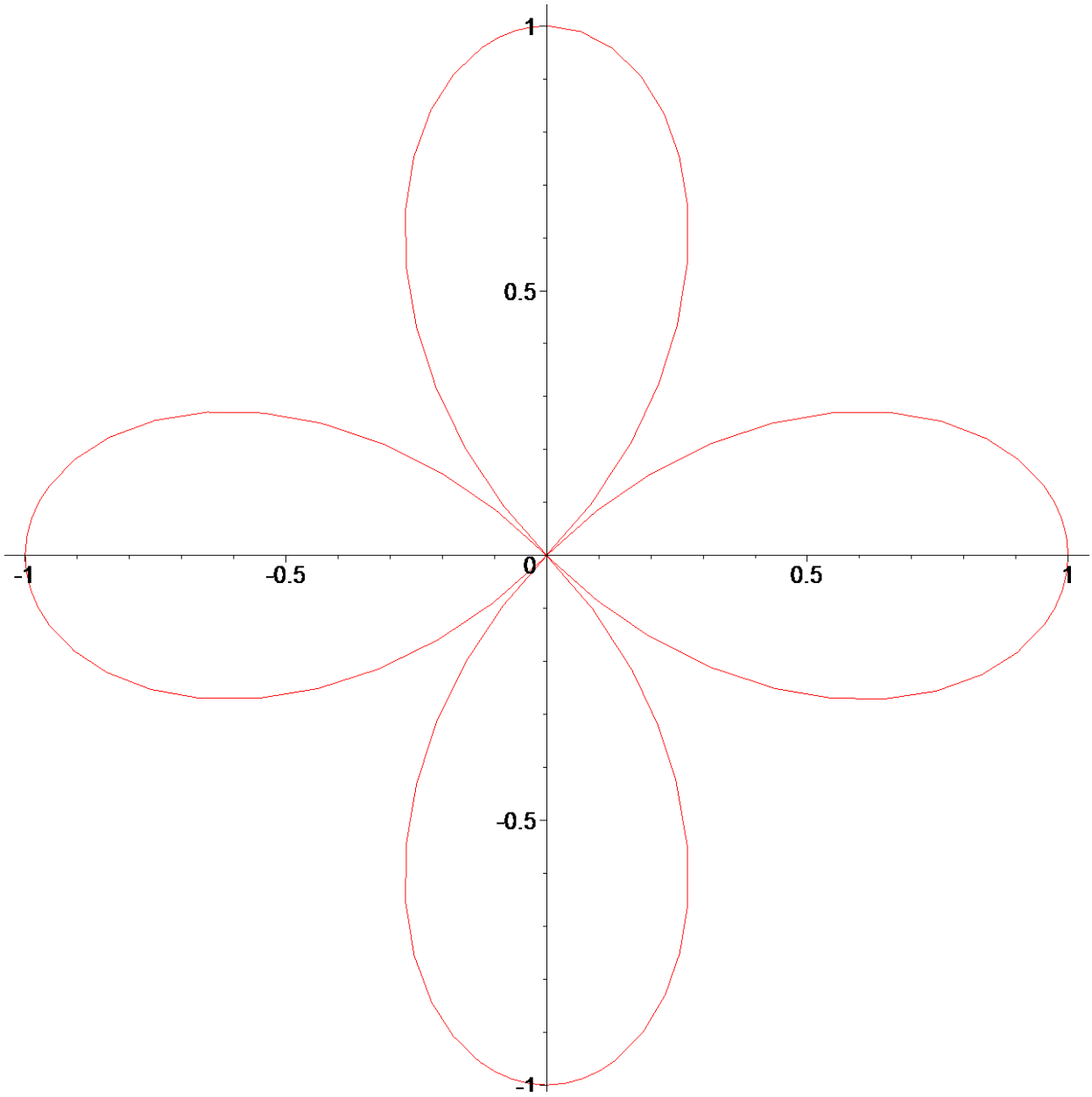
```
> r:= theta  -> a * cos(n*theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \cos(n\,\theta)$$




```
> r:= theta  -> a* cos(n *theta);plot([r(theta),theta,theta= 0 ..2*Pi],coords=polar);
```

$$r := \theta \to a \cos(n\,\theta)$$



V Lemniscate { Form r^2 = a sin(2* theta), or r^2 = a cos(2*theta) .

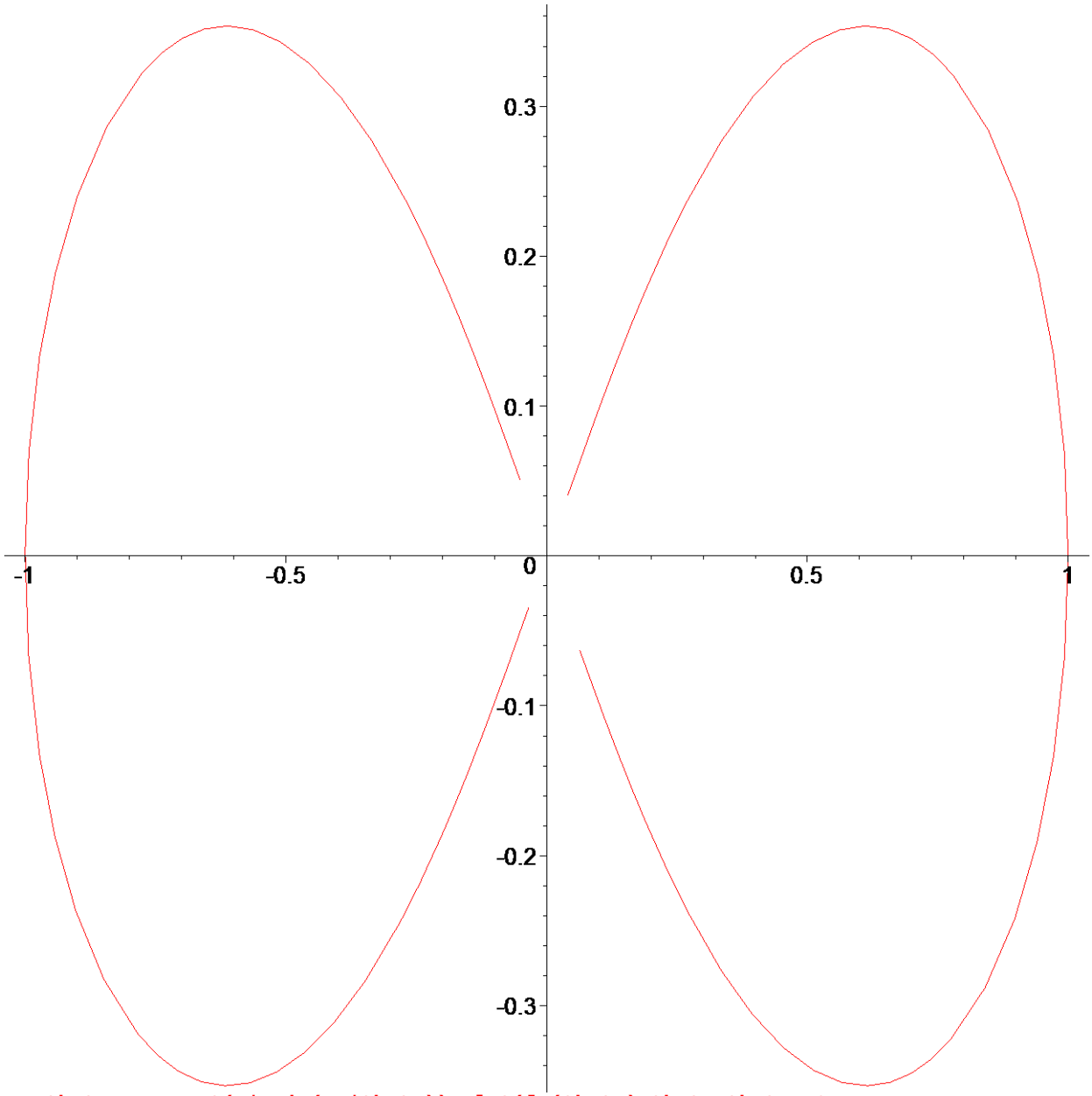
```
> a:=1;n :=2;
>
```

$$a := 1$$

$$n := 2$$

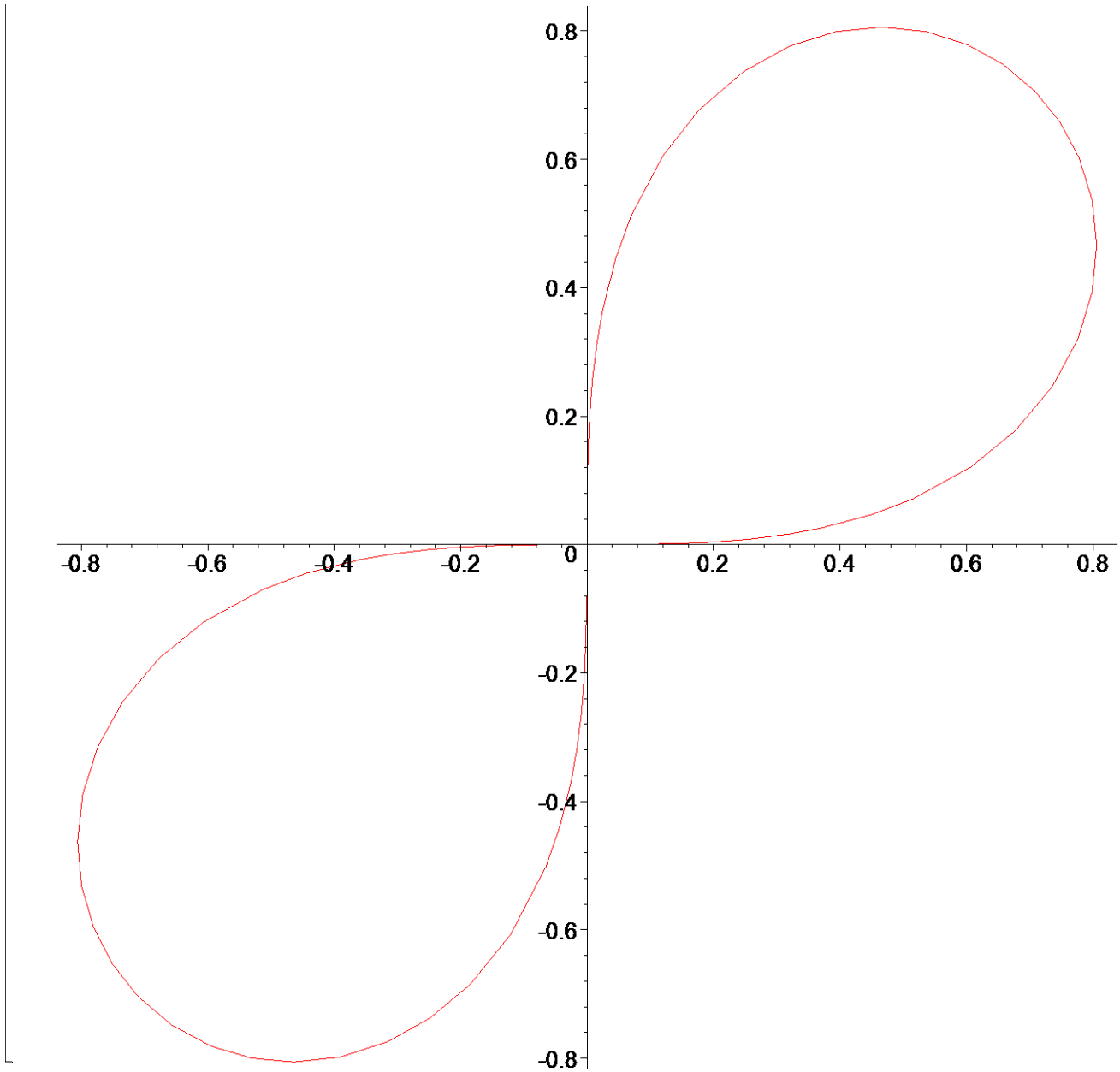
```
> r:= theta  -> sqrt(a * cos(n*theta));plot([r(theta),theta,theta= 0
  ..2*Pi],coords=polar);
```

$$r := \theta \to \sqrt{a \cos(n\,\theta)}$$




```
> r:= theta  -> sqrt(a* sin(n *theta));plot([r(theta),theta,theta= 0
  ..2*Pi],coords=polar);
```

$$r := \theta \to \sqrt{a \sin(n\,\theta)}$$


0.8
0.6
0.4
0.2
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
-0.2
-0.4
-0.6
-0.8

> >