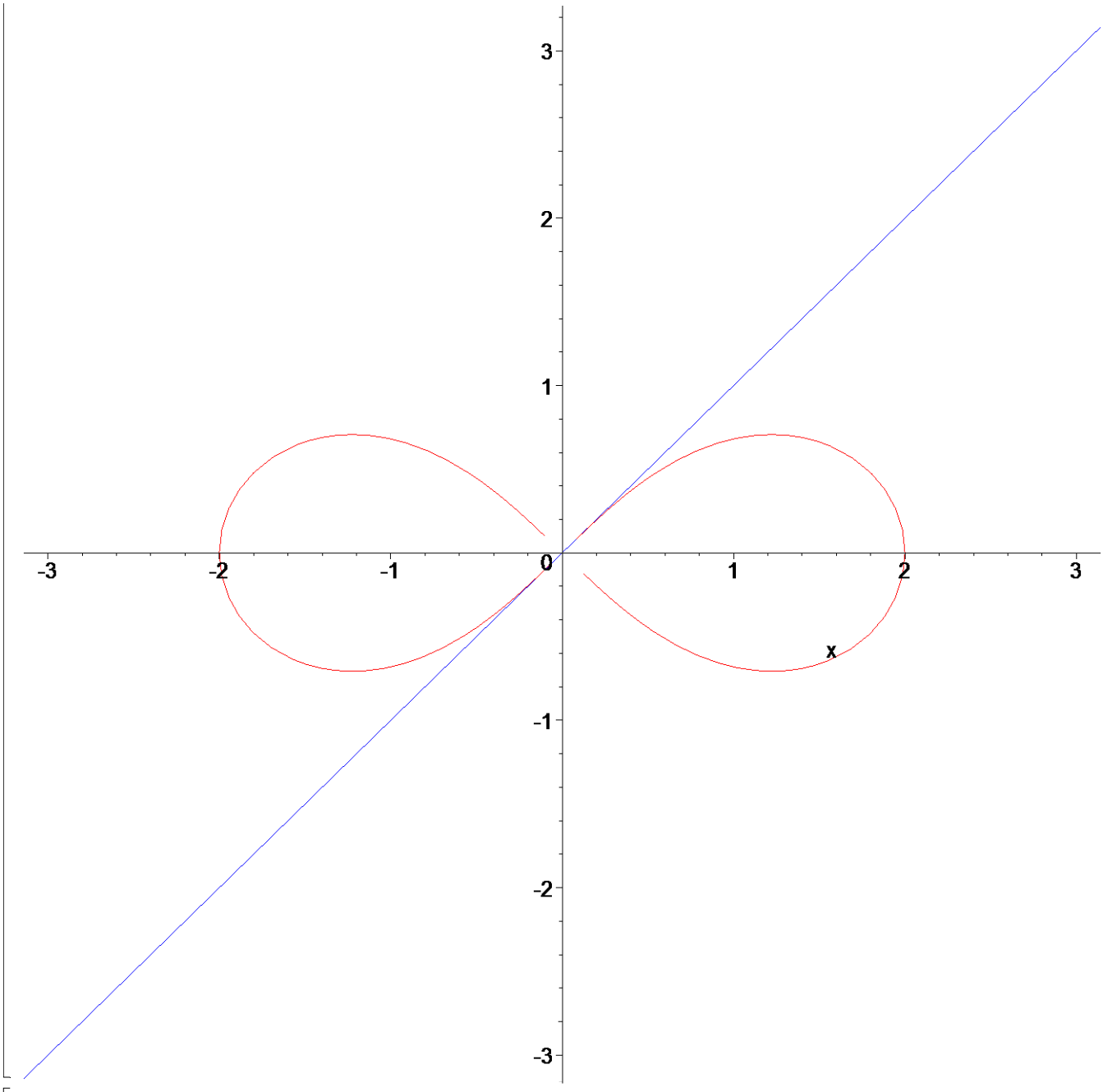
```
> restart:
> with (student):with(plots):

Warning, the name changecoords has been redefined
```

Ex11

```
>
> p1:=
  plot([sqrt(4*cos(2*theta)),theta,theta=0..2*Pi],coords=polar,color
  =red): p2 :=plot(x, x = -Pi..Pi,color=blue): display(p1,p2);
```



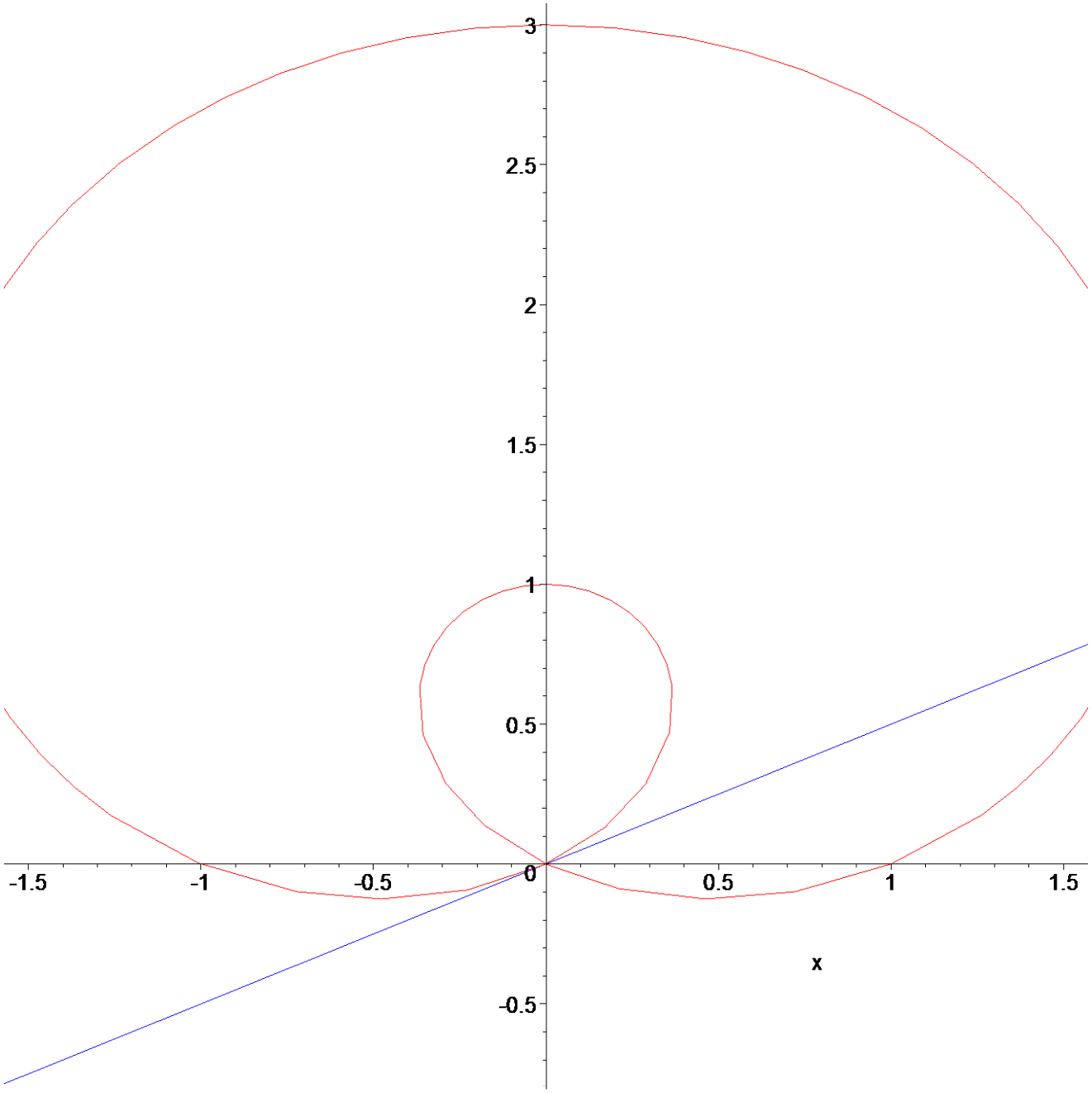
note there are 2 halves which are themselves symmetric so the area in question is 4 x the area of that one part.

```
> 4*Int(1/2*(4*cos(2*theta)),theta=0 ..
  Pi/4)=4*1/2*int((4*cos(2*theta)),theta=0 .. Pi/4);
```

$$4 \int_{0}^{\frac{\pi}{4}} 2 \cos(2\,\theta)\, d\theta = 4$$

Ex21 find area of innner loop

```
> p1 := plot([1 + 2*sin(theta),theta,theta=0..2*Pi],coords=polar):
  p2 :=plot(x/2, x = -Pi/2..Pi/2,color=blue): display(p1,p2);
```




```
>
>
```

note there is 1 inner loop bubble so the area in question is 2 x the area of that one part half that part which obviously has an intersection at Pi/4

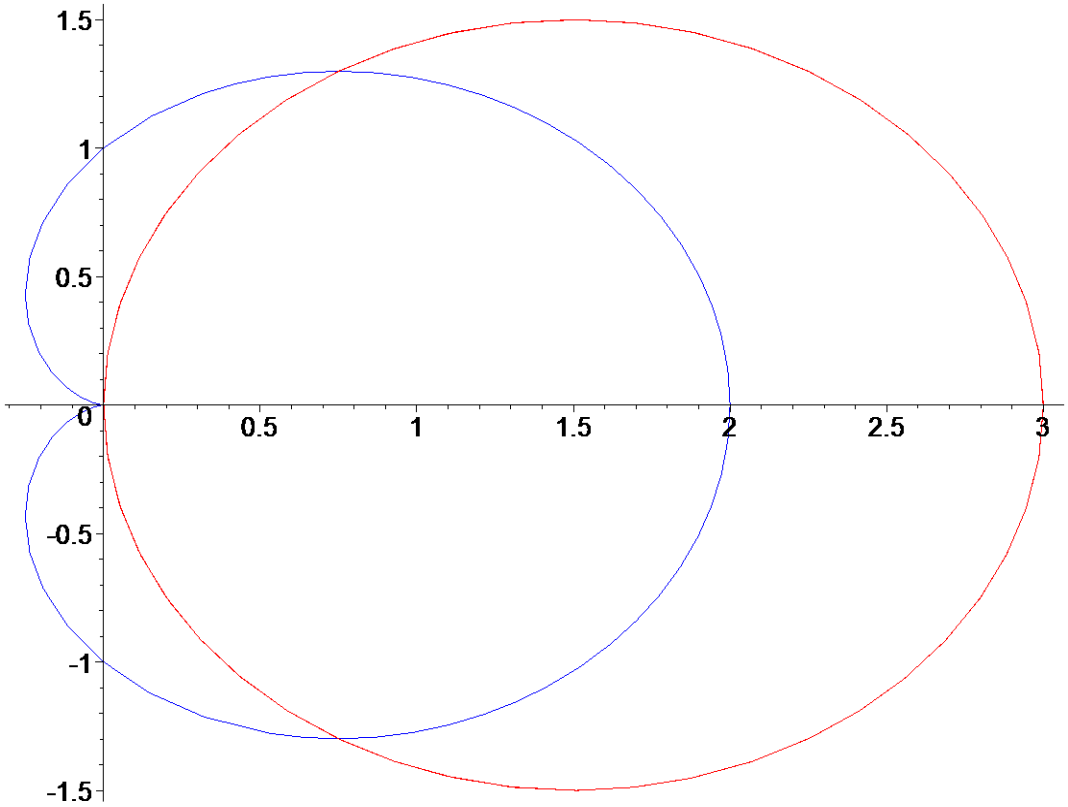
```
> 2*Int(1/2*(1 + 2*sin(theta))^2,theta= 7*Pi/6 ..
  3*Pi/2)=2*int(1/2*(1 + 2*sin(theta))^2,theta= 7*Pi/6 ..
  3*Pi/2);evalf(%);
```

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

$$0.5435164422 = 0.543516442$$

Ex27

```
> p1:=plot([3*cos(theta),theta,theta=0..2*Pi],coords=polar,color=red
  ):
> p2:=plot([
  1+cos(theta),theta,theta=0..2*Pi],coords=polar,color=blue):
>
> display(p1,p2);
```



note we are interested in inside red but outside blue so the area in question is 2 x the area of the top half our first step is to solvethe intersection

```
> eq := 3*cos(theta) -(1+cos(theta));
> solve(eq,theta);
```

$$eq := 2\cos(\theta) - 1$$

$$\frac{\pi}{3}$$

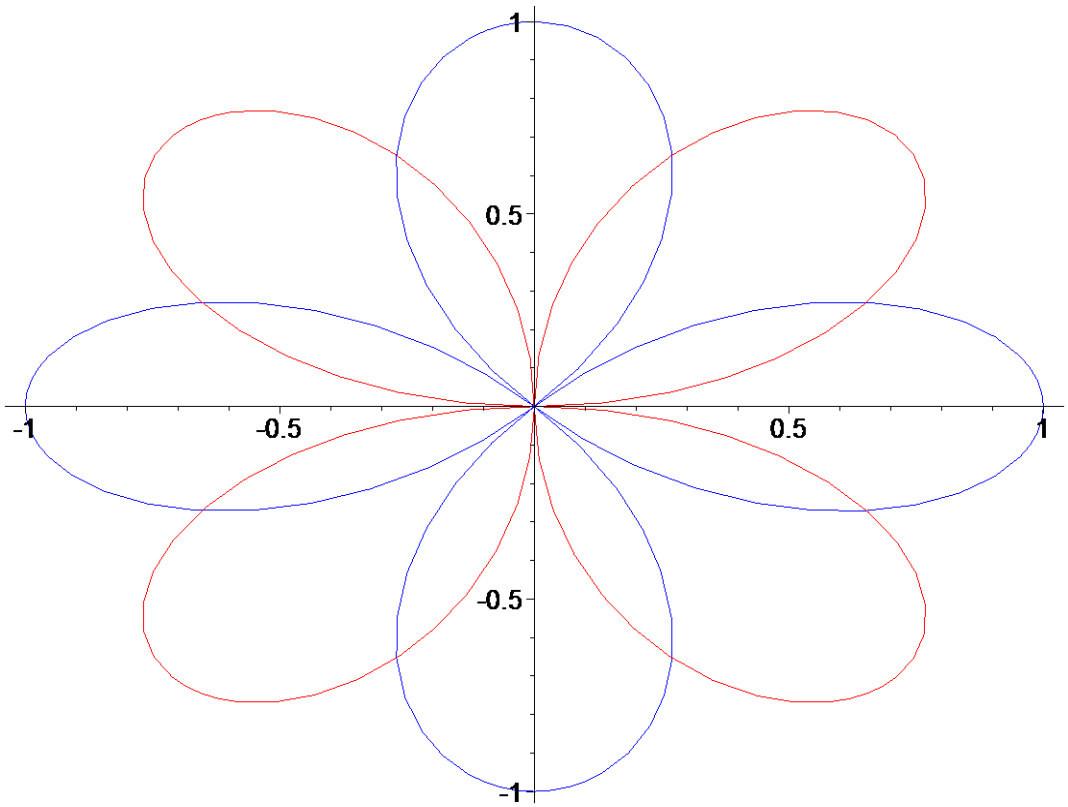
```
> 2 * (Int( 1/2* (3*cos(theta) )^2,theta= 0 .. Pi/3)  - Int( 1/2*
  (1+cos(theta) )^2,theta= 0 .. Pi/3)) =  2*
  int(1/2*((3*cos(theta))^2 -(1+cos(theta))^2),theta= 0 .. Pi/3);
```

$$2\int_0^{\frac{\pi}{3}} \frac{9}{2}\cos(\theta)^2\,d\theta - 2\int_0^{\frac{\pi}{3}} \frac{1}{2}(1+\cos(\theta))^2\,d\theta = \pi$$

```
>
```

Ex31

```
> p1:=plot([sin(2*theta),theta,theta=0..2*Pi],coords=polar,color=red
  ):
> p2:=plot([
  cos(2*theta),theta,theta=0..2*Pi],coords=polar,color=blue):
>
> display(p1,p2);
```



note we are interested in inside both red and bluee so the area in question is sixteen times the partial leaf. our first step is to solve the intersection

```
> eq := cos(2*theta) - sin(2*theta);
```

```
> solve(eq,theta);
```

$$eq := \cos(2\,\theta) - \sin(2\,\theta)$$

$$\frac{\pi}{8}$$

```
> 16 * (Int( 1/2* (sin(2*theta))^2,theta= 0 .. Pi/8) ) =  16 * (int(
  1/2* (sin(2*theta))^2,theta= 0 .. Pi/8) );
```

$$16 \int_{0}^{\frac{\pi}{8}} \frac{1}{2} \sin(2\,\theta)^2 \, d\theta = -1 + \frac{\pi}{2}$$

```
>
>
```