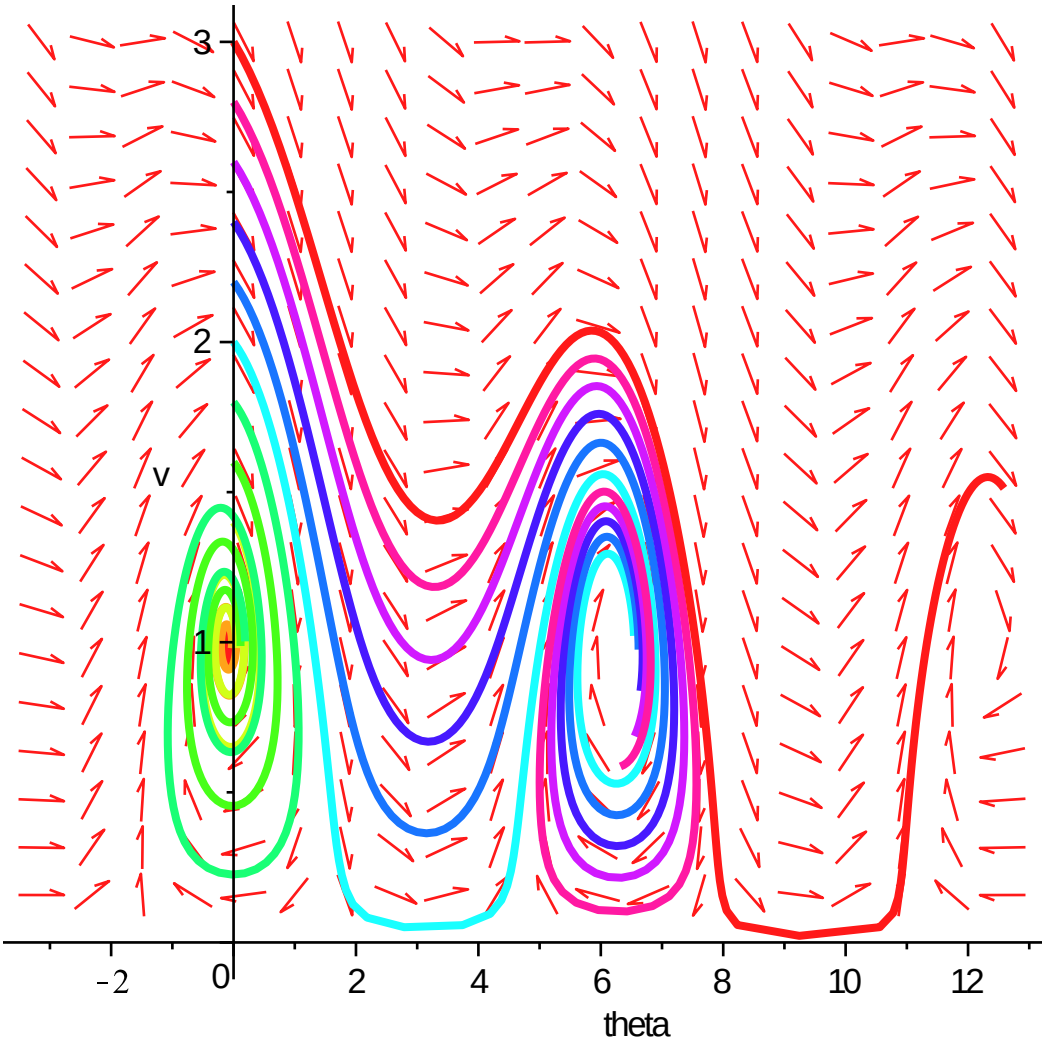
```
> with(DEtools):
> phug:=[ D(theta)(t) = v(t) - cos(theta(t))/v(t),
          D(v)(t)     = -sin(theta(t)) -R*v(t)^2];
```

$$phug := \left[D(\theta)(t) = v(t) - \frac{\cos(\theta(t))}{v(t)}, D(v)(t) = -\sin(\theta(t)) - R\,v(t)^2 \right] \quad (1)$$

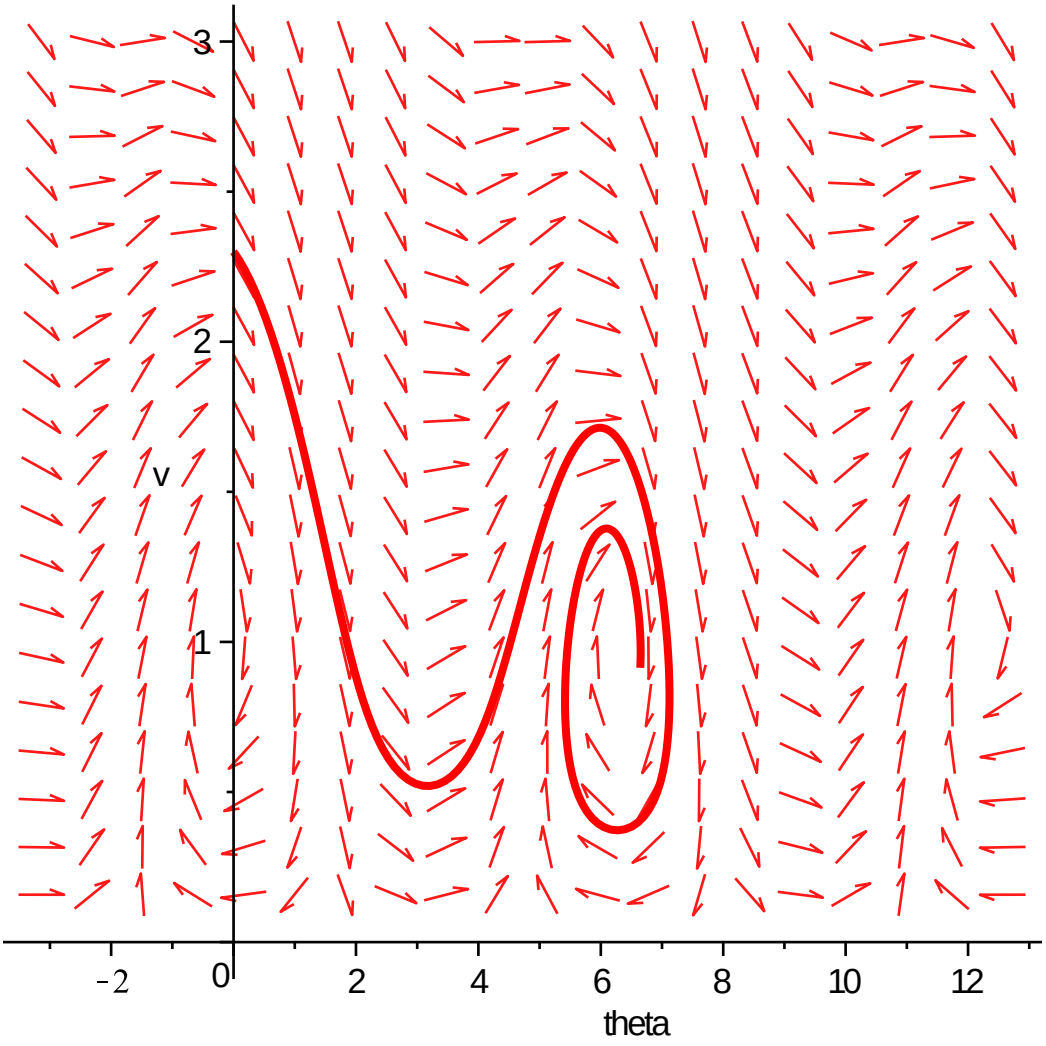
```
> R:=.1;
  DEplot( phug, [theta(t), v(t)], t=0..10,
    theta=-Pi..4*Pi, v=0..3,
    [seq([theta(0)=0, v(0)=i],i=1..3,0.2)],
    linecolor=[seq(COLOR(HUE,i),i=0..1,.1)], stepsize=0.05);
```

$$R := 0.1$$




```
> R:=.1;
  DEplot( phug, [theta(t), v(t)], t=0..10,
    theta=-Pi..4*Pi, v=0..3,
    [[theta(0)=0, v(0)=2.3]],
    linecolor=red, stepsize=0.05);
```

$$R := 0.1$$



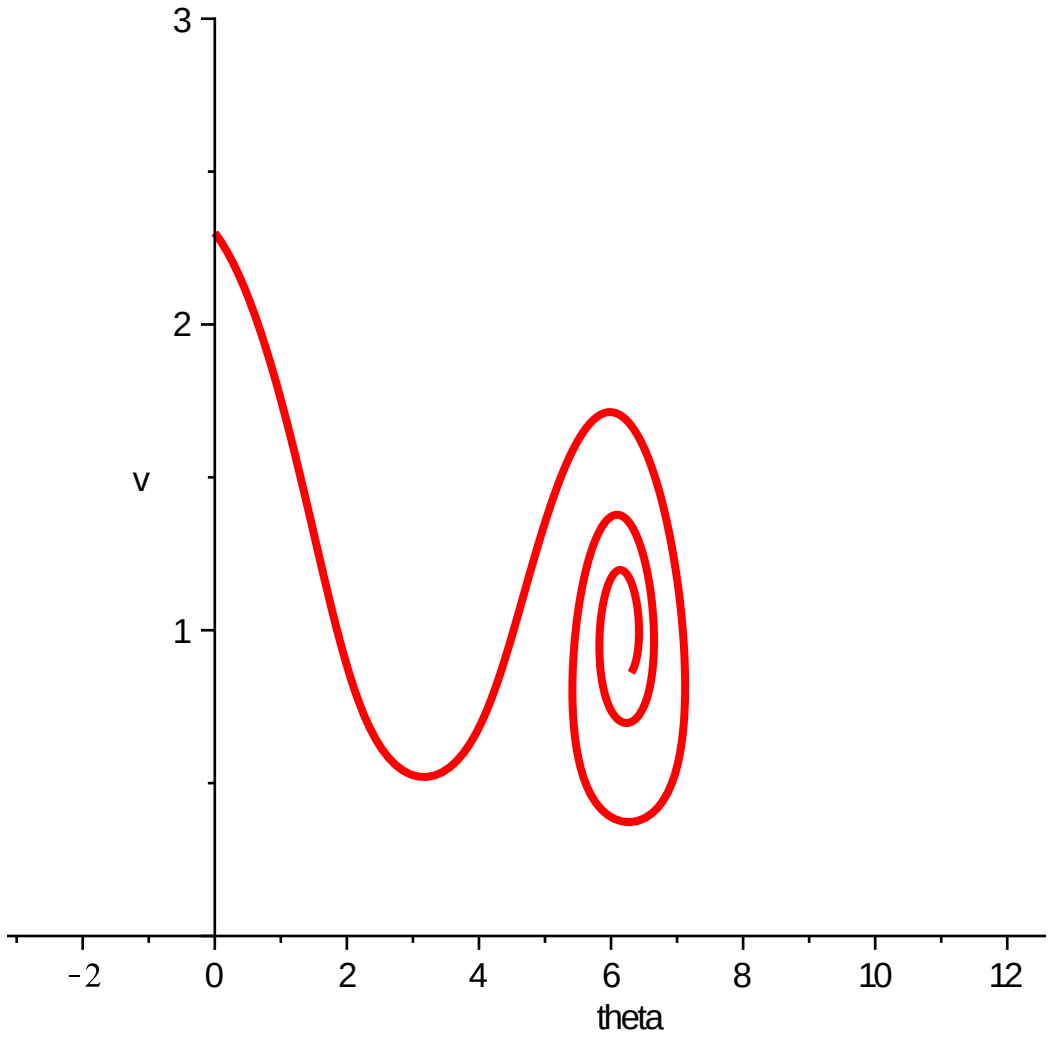

```
> R:='R';
  xphug:=[ D(theta)(t) = v(t) - cos(theta(t))/v(t),
           D(v)(t)     = -sin(theta(t)) -R*v(t)^2,
           D(x)(t)     = v(t)*cos(theta(t)),
           D(y)(t)     = v(t)*sin(theta(t))];
```

$$R := R$$

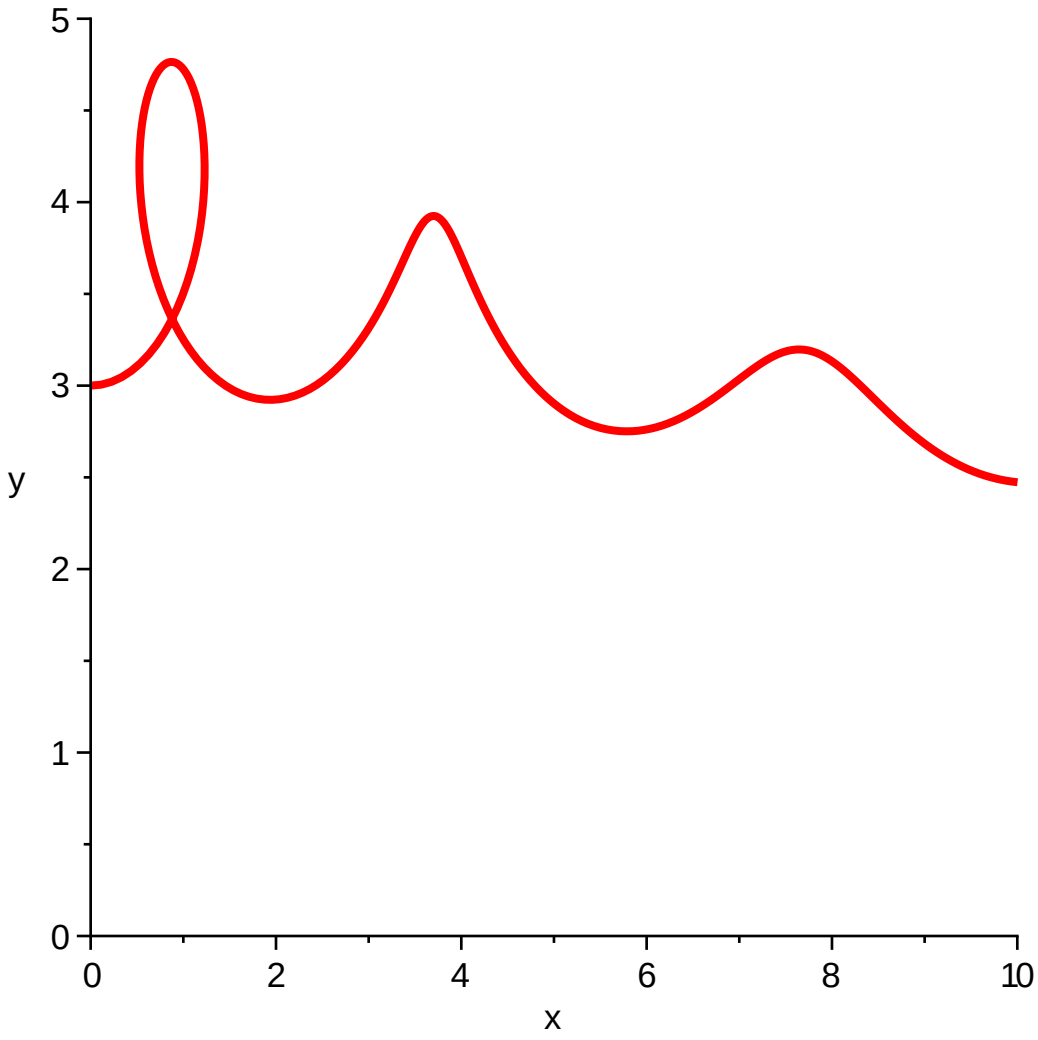
$$xphug := \left[D(\theta)(t) = v(t) - \frac{\cos(\theta(t))}{v(t)}, D(v)(t) = -\sin(\theta(t)) - R\,v(t)^2, D(x)(t) = v(t)\cos(\theta(t)), D(y)(t) = v(t)\sin(\theta(t)) \right] \quad \textbf{(2)}$$

```
> R:=.1;
  DEplot( xphug, [theta(t), v(t), x(t), y(t)], t=0..15,
    theta=-Pi..4*Pi, v=0..3, x=0..10, y=0..5,
    [[theta(0)=0, v(0)=2.3, x(0)=0, y(0)=3]],
    linecolor=red, stepsize=0.05, scene=[theta,v]);
```

$$R := 0.1$$

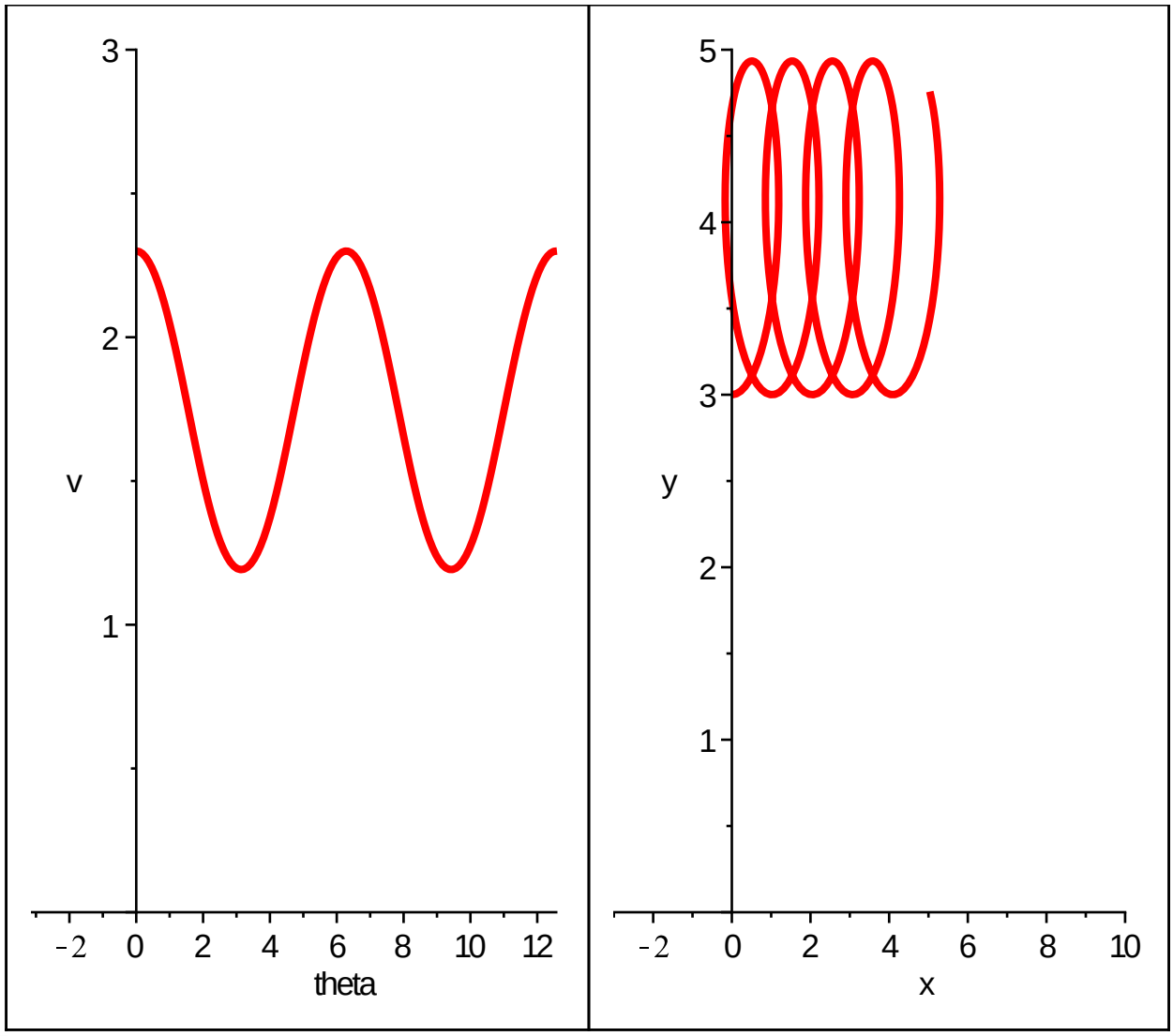



```
> DEplot( xphug, [theta(t), v(t), x(t), y(t)], t=0..15,
    theta=-Pi..4*Pi, v=0..3, x=0..10, y=0..5,
    [[theta(0)=0, v(0)=2.3, x(0)=0, y(0)=3]],
    linecolor=red, stepsize=0.05, scene=[x,y]);
```



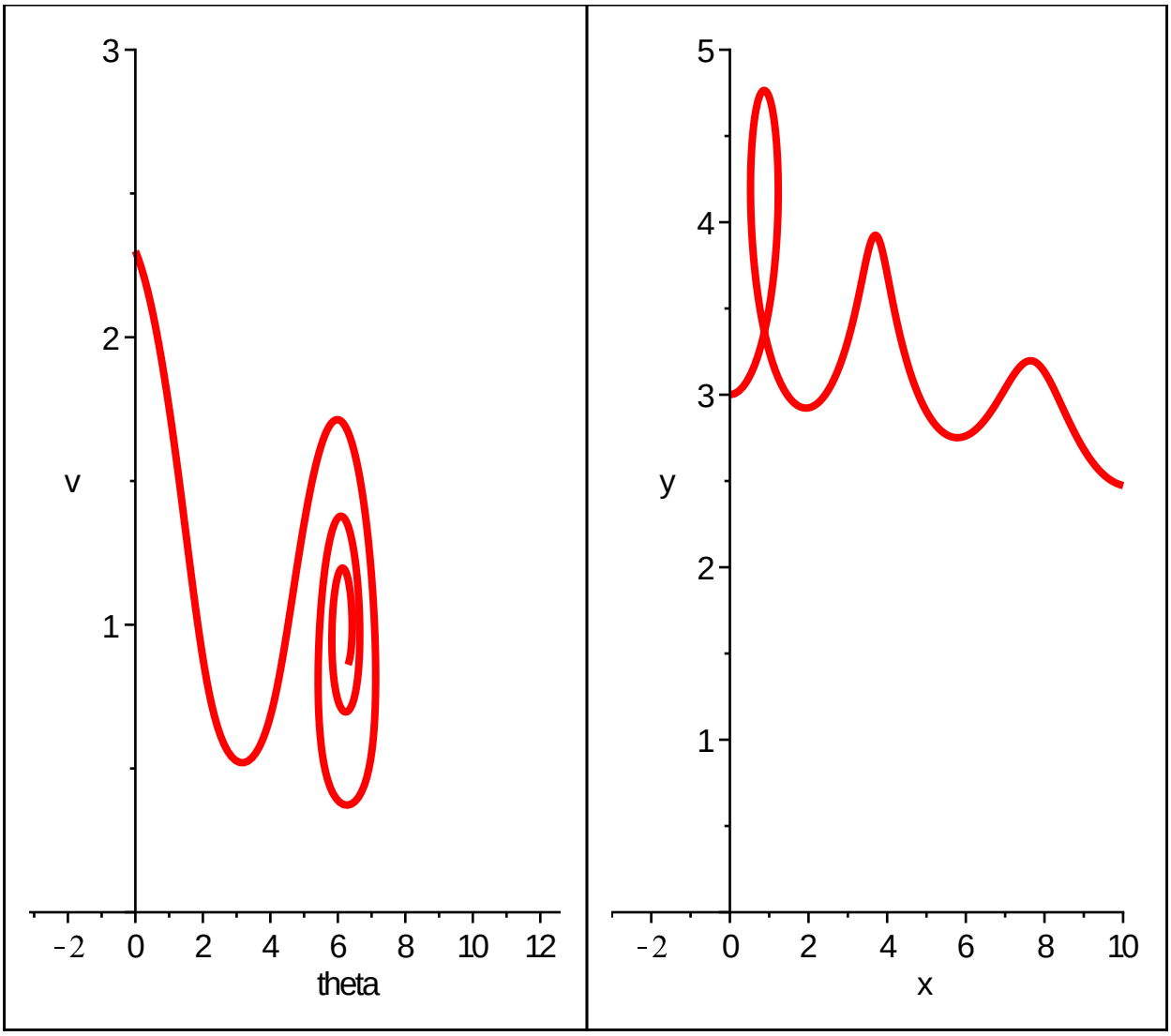

```
> with(plots):
> R:=0;
  display( array( [
  DEplot( xphug, [theta(t), v(t), x(t), y(t)], t=0..15,
    theta=-Pi..4*Pi, v=0..3, x=0..10, y=0..5,
    [[theta(0)=0, v(0)=2.3, x(0)=0, y(0)=3]],
    linecolor=red, stepsize=0.05, scene=[theta,v]),
  DEplot( xphug, [theta(t), v(t), x(t), y(t)], t=0..15,
    theta=-Pi..4*Pi, v=0..3, x=-3..10, y=0..5,
    [[theta(0)=0, v(0)=2.3, x(0)=0, y(0)=3]],
    linecolor=red, stepsize=0.05, scene=[x,y])]));
```

$$R := 0$$



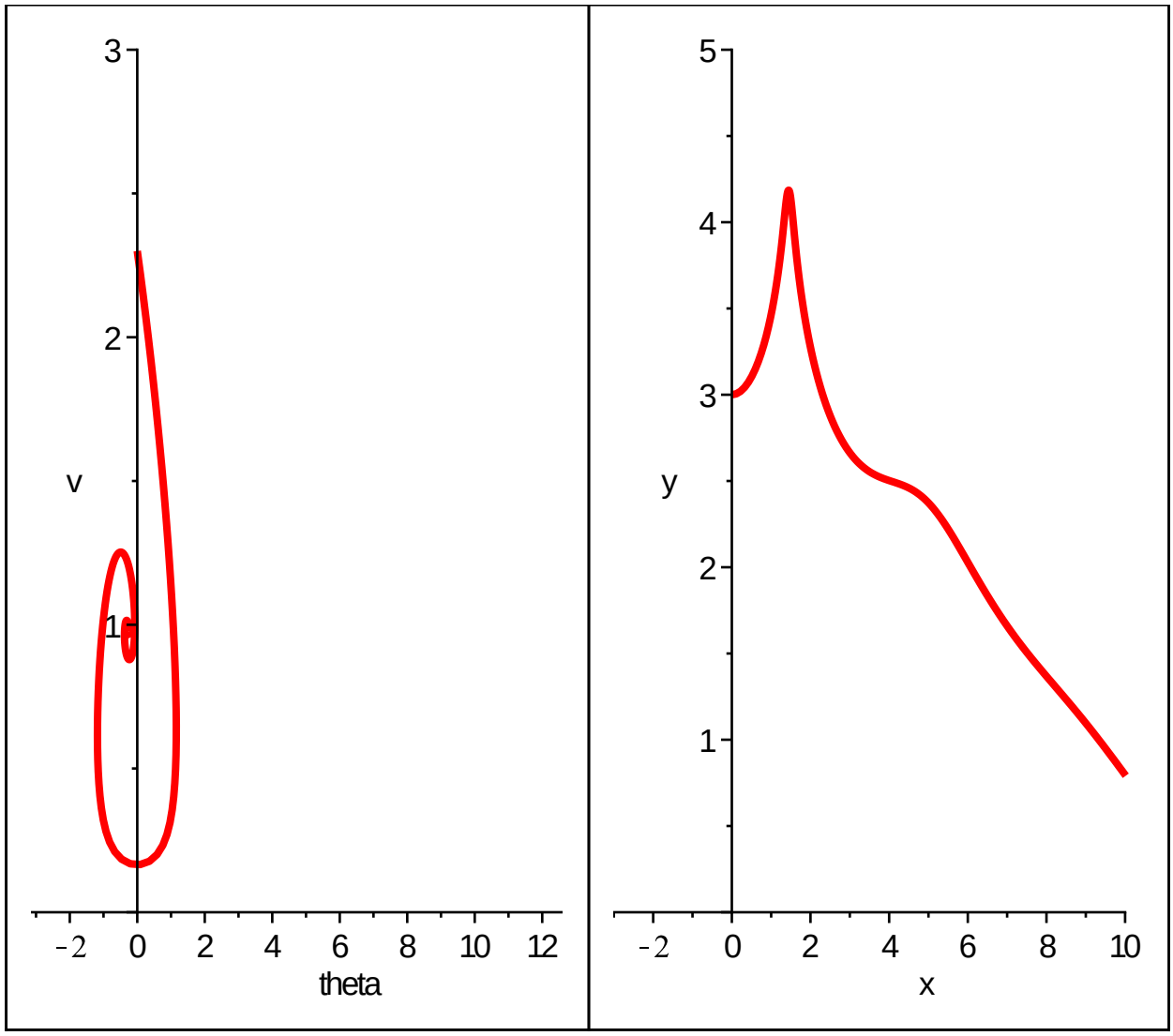

```
> sameoldsameold:=[theta(t), v(t), x(t), y(t)], t=0..15,
    theta=-Pi..4*Pi, v=0..3, x=-3..10, y=0..5,
    [[theta(0)=0, v(0)=2.3, x(0)=0, y(0)=3]],
    linecolor=red, stepsize=0.05:
> R:=0.1;
  display( array( [
  DEplot( xphug, sameoldsameold, scene=[theta,v]),
  DEplot( xphug, sameoldsameold, scene=[x,y])]));
```

$$R := 0.1$$



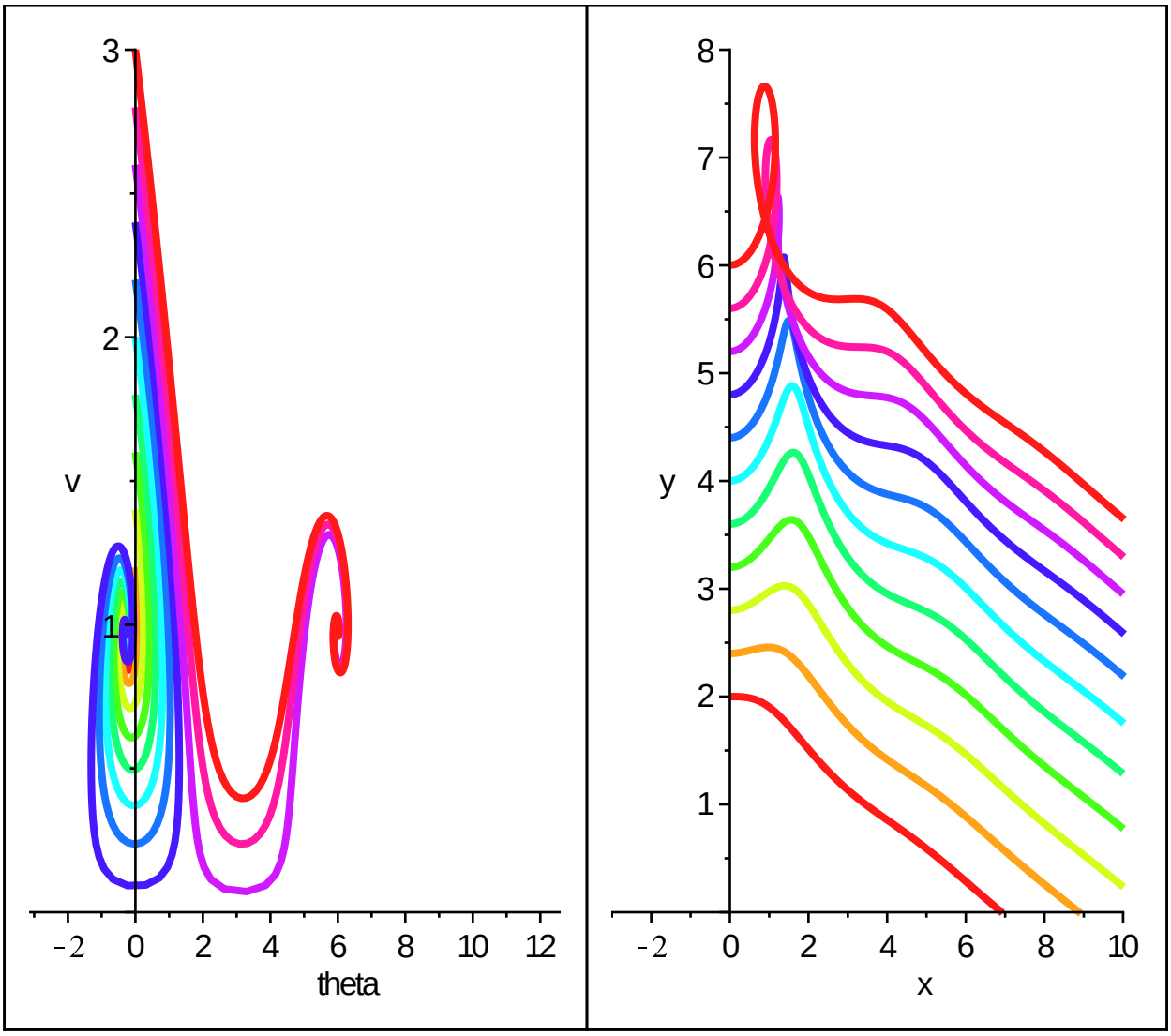

```
> R:=0.3;
  display( array( [
  DEplot( xphug, sameoldsameold, scene=[theta,v]),
  DEplot( xphug, sameoldsameold, scene=[x,y])]));
```

$$R := 0.3$$



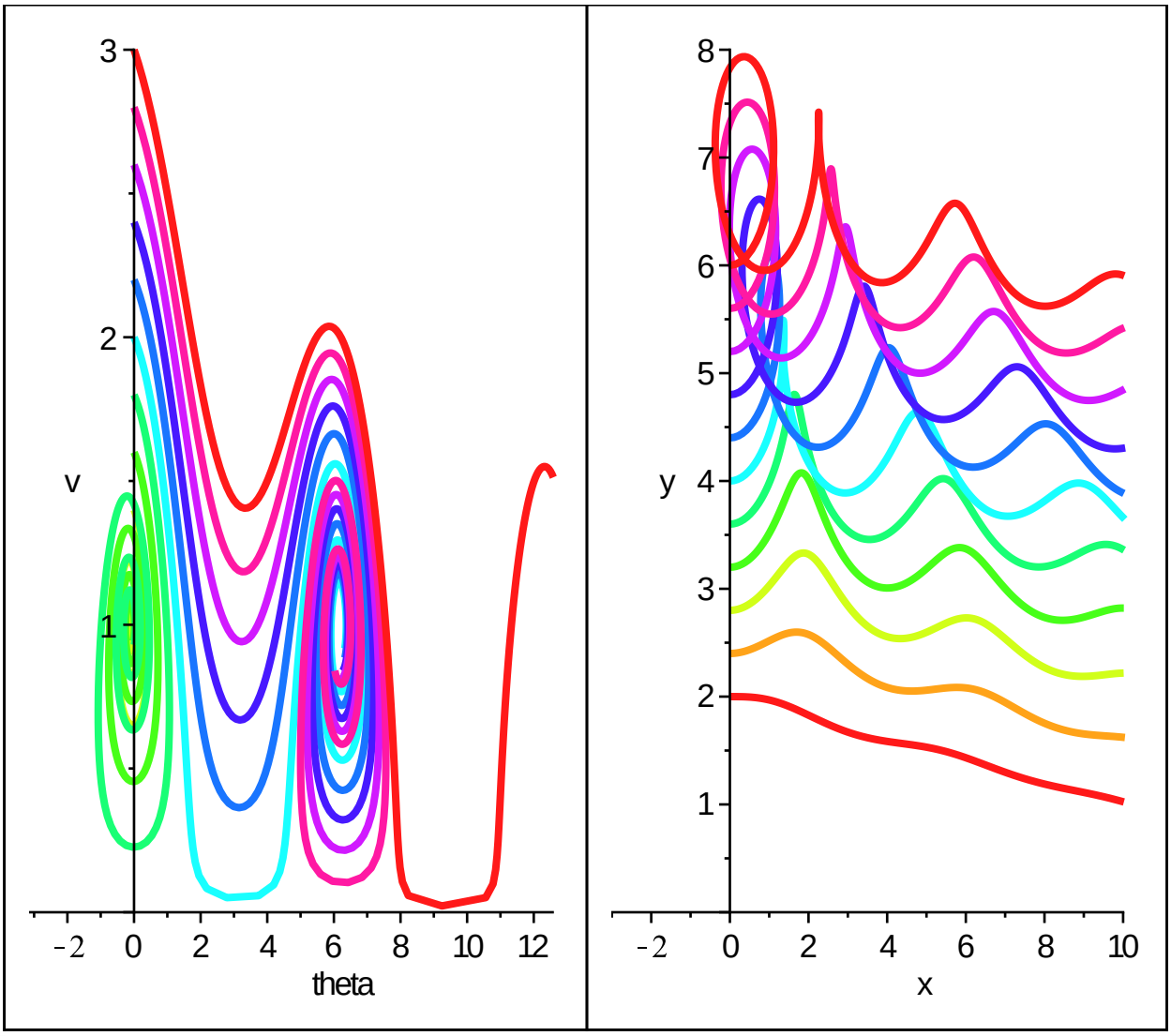

```
> different:=[theta(t), v(t), x(t), y(t)], t=0..15,
   theta=-Pi..4*Pi, v=0..3, x=-3..10, y=0..8,
    [seq([theta(0)=0, v(0)=i, x(0)=0, y(0)=2*i],i=1..3,0.2)],
   linecolor=[seq(COLOR(HUE,i),i=0..1,.1)], stepsize=0.05:
> R:=0.3;
  display( array( [
  DEplot( xphug, different, scene=[theta,v]),
  DEplot( xphug, different, scene=[x,y])]));
```

$$R := 0.3$$




```
> R:=.1;
  display( array( [
  DEplot( xphug, different, scene=[theta,v]),
  DEplot( xphug, different, scene=[x,y])]));
```

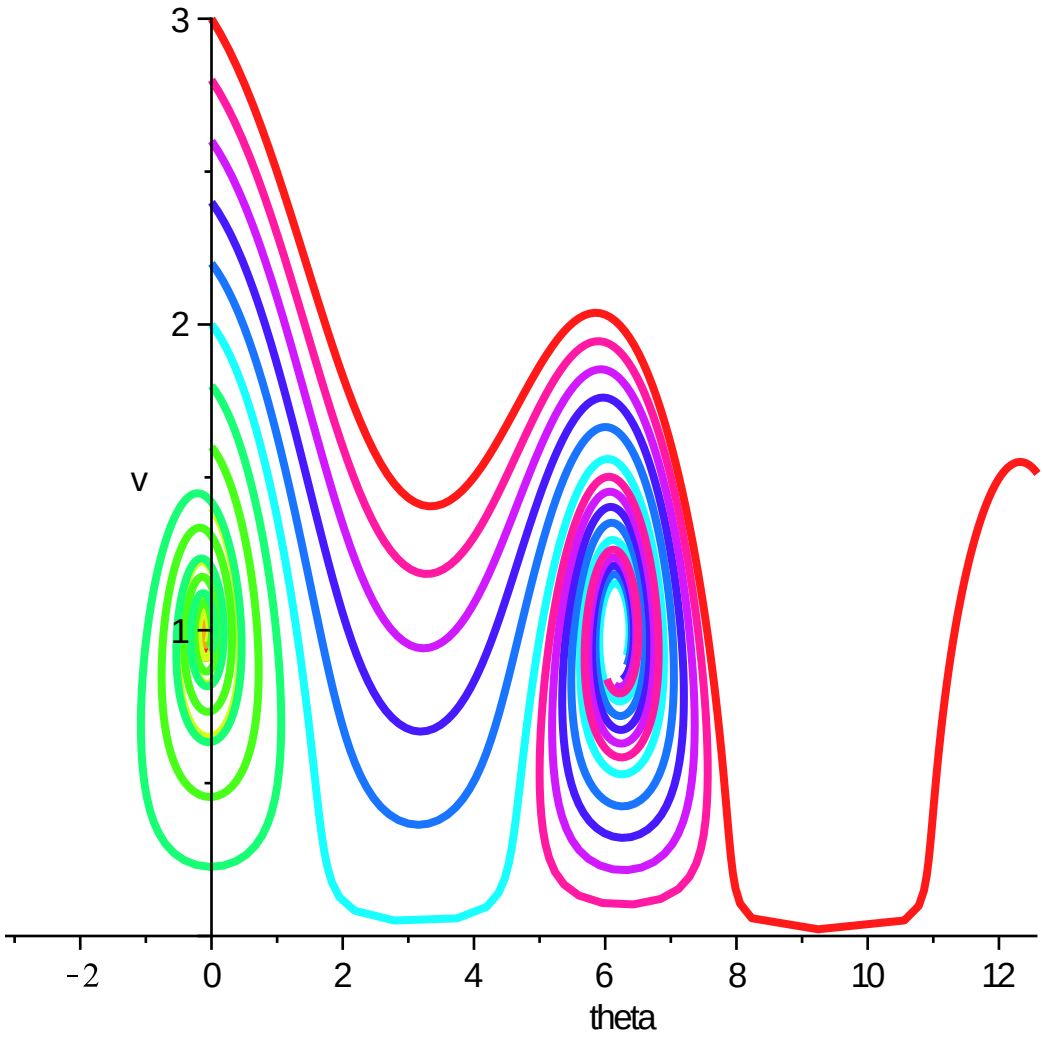
$$R := 0.1$$



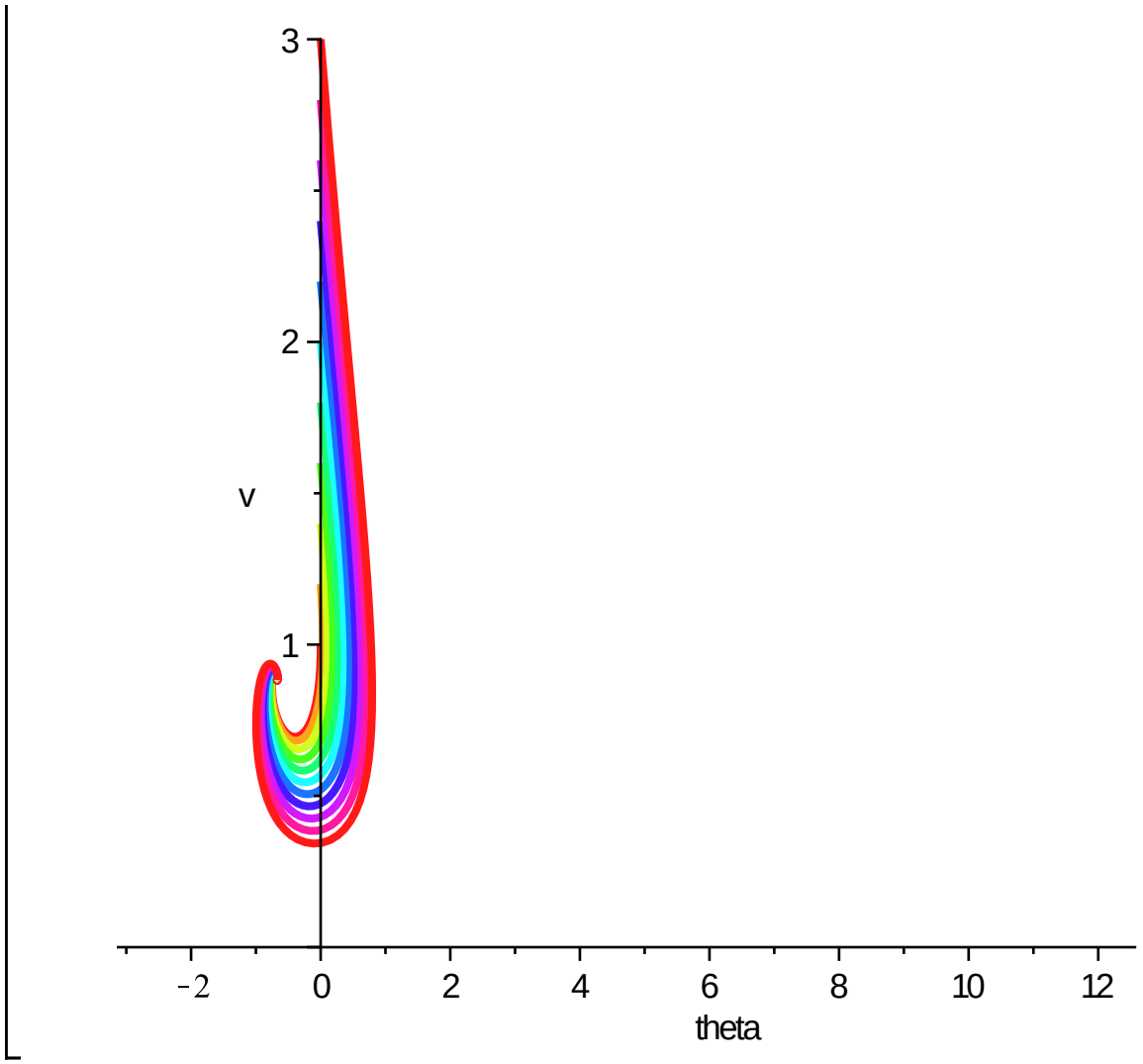

```
> R:='R';
```

$$R := R \tag{3}$$

```
> makepic:=proc(drag)
    global R;
    R:=drag;
    DEplot( xphug, different, scene=[theta,v]);
  end:
>
  makepic(0.1);
```




```
> display( [seq(makepic(r),r=0..1,.2)], insequence=true);
```


3
2
v
1
-2
0
2
4
6
8
10
12
theta