Exercise 7.2.23

Here is one way to do the numerics for part (a) of exercise 7.2.3.

```
soln[gamma_, v_] := NDSolve[{theta'[t] == z[t], z'[t] == -6 Sin[theta[t]] - gamma z[t],
    theta[0] == 0, z[0] == v}, {theta, z}, {t, -10, 10}]
```

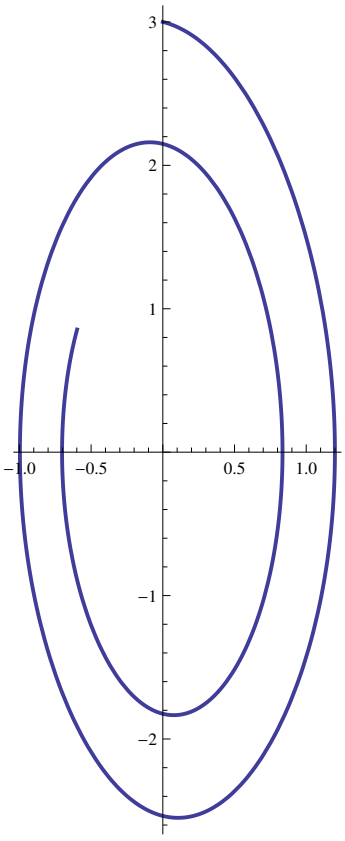
```
first = soln[1 / 4, 3]
```

```
{{theta → InterpolatingFunction[{{-10., 10.}}, <>],
  z → InterpolatingFunction[{{-10., 10.}}, <>]}}
```

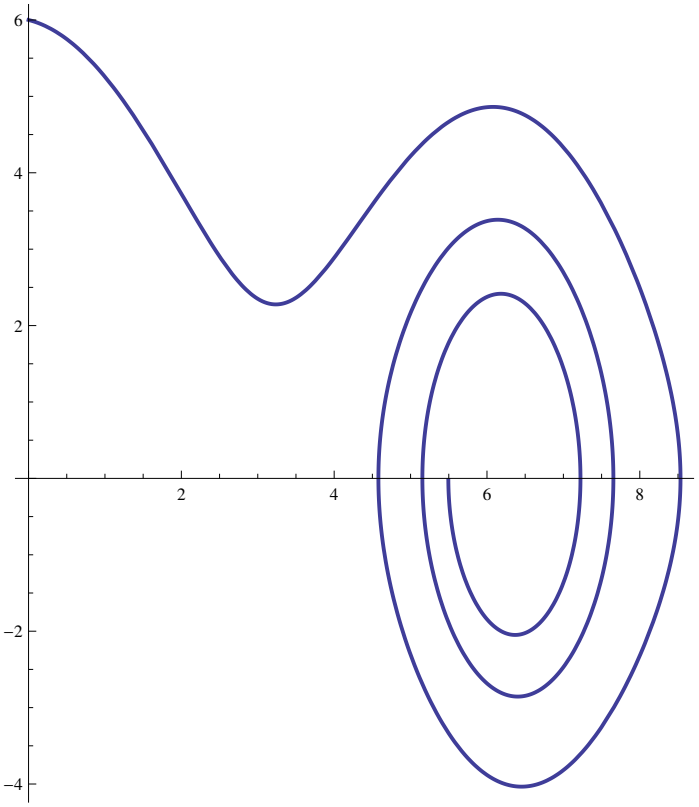
```
second = soln[1 / 4, 6]
```

```
{{theta → InterpolatingFunction[{{-10., 10.}}, <>],
  z → InterpolatingFunction[{{-10., 10.}}, <>]}}
```

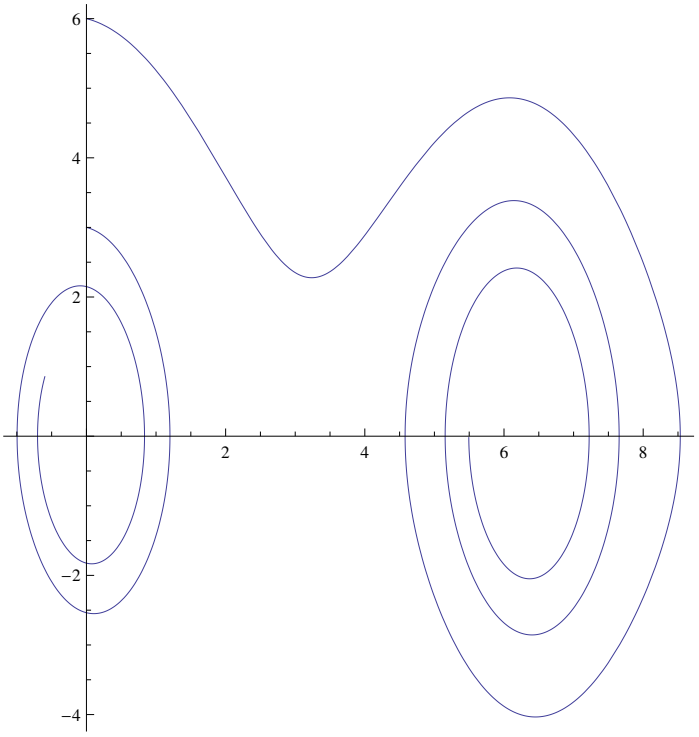
```
a = ParametricPlot[{theta[t], z[t]} /. first, {t, 0, 5}, PlotStyle → Thick]
```



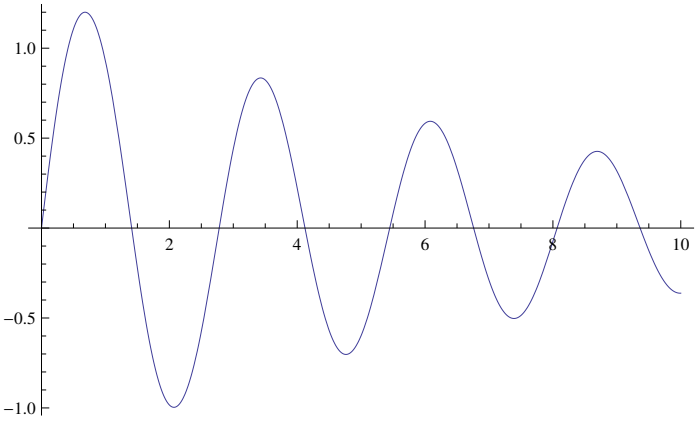
```
b = ParametricPlot[{theta[t], z[t]} /. second, {t, 0, 10}, PlotStyle → Thick]
```



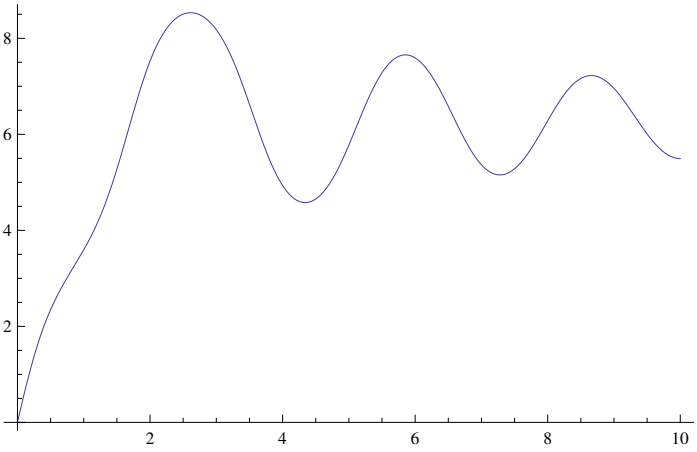

```
Show[a, b, PlotRange → All]
```



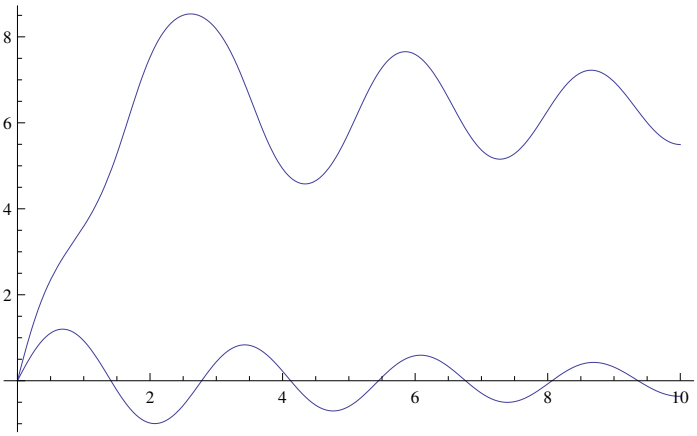
```
c = Plot[theta[t] /. first, {t, 0, 10}]
```



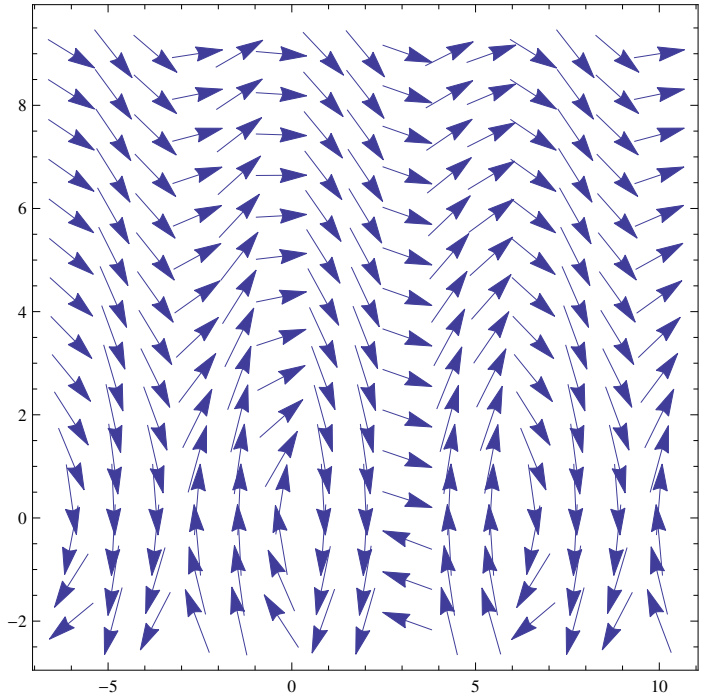

```
d = Plot[theta[t] /. second, {t, 0, 10}]
```




```
Show[c, d, PlotRange → All]
```



```
e =
 VectorPlot[{y, -6 Sin[x] - y / 4} / Norm[{y, -6 Sin[x] - y / 4}], {x, -6, 10}, {y, -2, 9}]
```




```
Show[a, b, e, PlotRange → All]
```