```
In[1]:= eq1 = (2 r''[t] == r[t] th'[t]^2 - g / 2 th[t]^2)
```

$$\text{Out[1]= } 2\,r''[t] == -\frac{1}{2}\,g\,th[t]^2 + r[t]\,th'[t]^2$$

```
In[2]:= eq2 = (r[t] th''[t] + 2 r'[t] th'[t] == -g th[t])
```

$$\text{Out[2]= } 2\,r'[t]\,th'[t] + r[t]\,th''[t] == -g\,th[t]$$

```
In[3]:= DSolve[{eq1, eq2, r[0] == 1, r'[0] == 0, th[0] == eps, th'[0] == 0}, {r[t], th[t]}, t]
```

$$\text{Out[3]= } \text{DSolve}\left[\left\{2\,r''[t] == -\frac{1}{2}\,g\,th[t]^2 + r[t]\,th'[t]^2,\ 2\,r'[t]\,th'[t] + r[t]\,th''[t] == -g\,th[t],\right.\right.$$
$$\left.\left. r[0] == 1,\ r'[0] == 0,\ th[0] == eps,\ th'[0] == 0\right\},\ \{r[t], th[t]\},\ t\right]$$

```
In[4]:= g = 10
```

```
Out[4]= 10
```

```
In[5]:= l = 1
```

```
Out[5]= 1
```

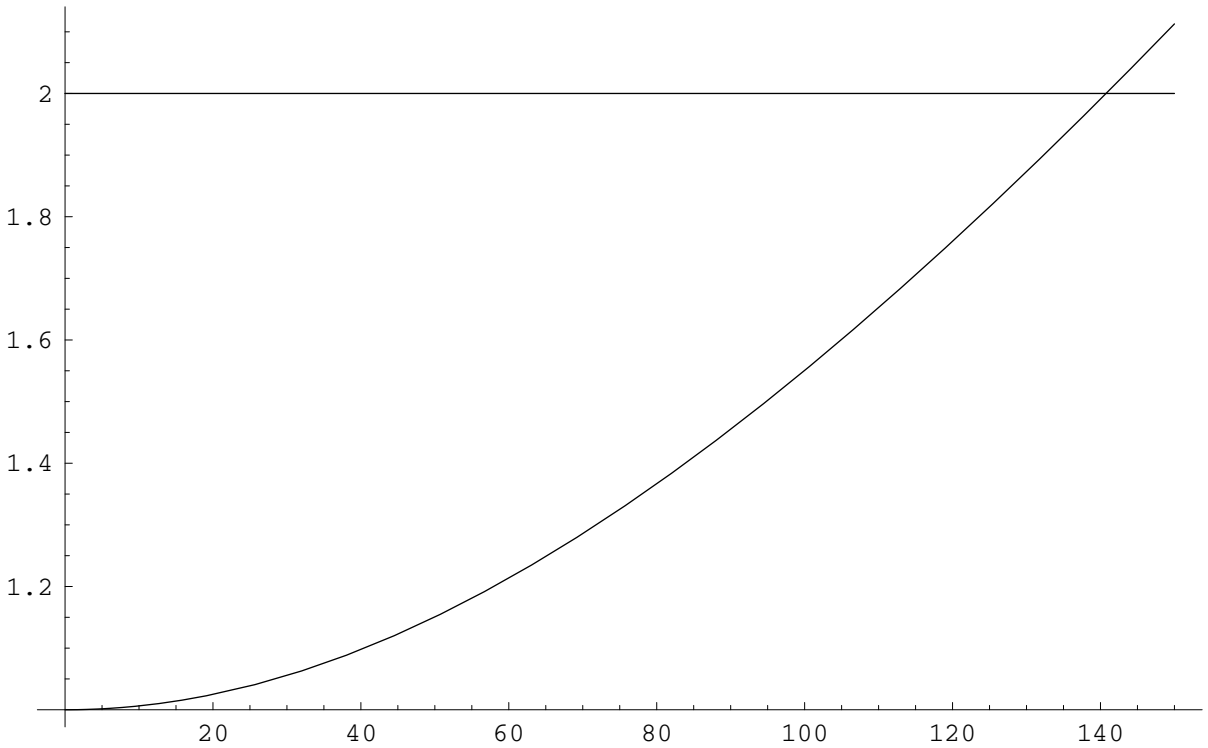
```
In[6]:= eps = .01
```

```
Out[6]= 0.01
```

```
In[7]:= NDSolve[{2 r''[t] == -1/2 g th[t]^2 + r[t] th'[t]^2, 2 r'[t] th'[t] + r[t] th''[t] == -g th[t],
          r[0] == 1, r'[0] == 0, th[0] == eps, th'[0] == 0}, {r, th}, {t, 0, 200},
         MaxSteps -> 10000]
```

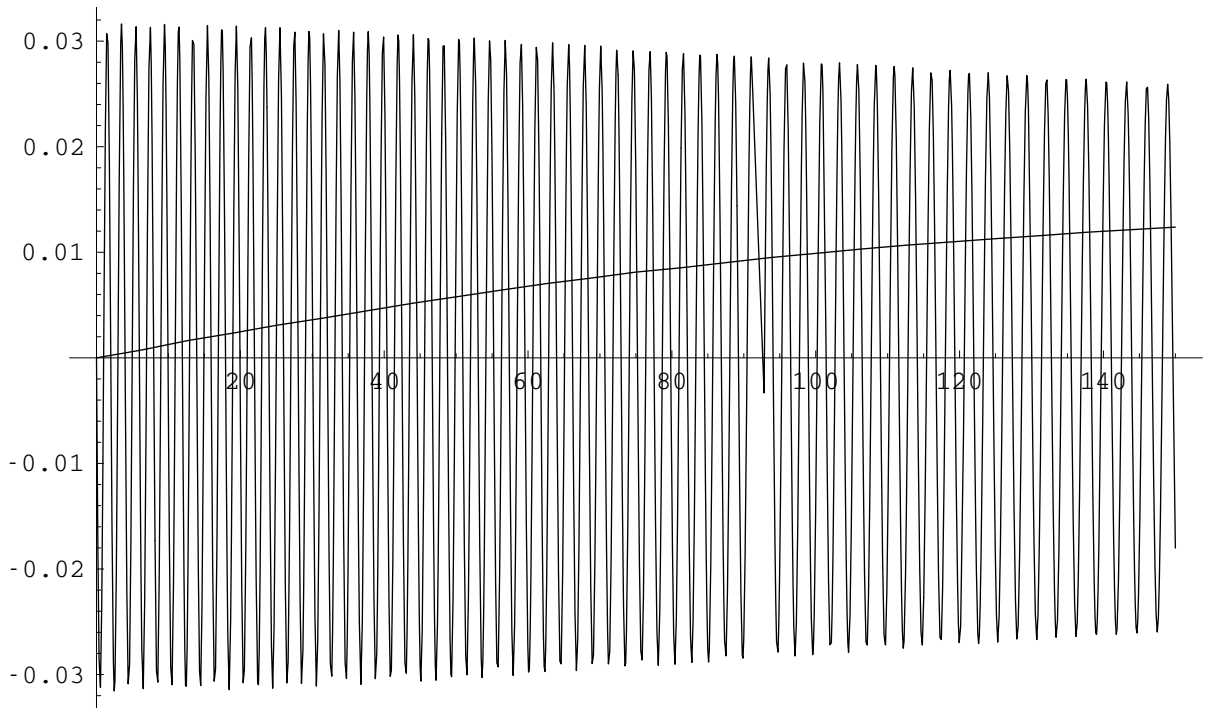
```
Out[7]= {{r → InterpolatingFunction[{{0., 200.}}, <>],
           th → InterpolatingFunction[{{0., 200.}}, <>]}}
```

```
In[8]:= Plot[{Evaluate[{r[t]} /. %[[1]]], 2}, {t, 0, 150}]
```




```
Out[8]= - Graphics -
```

```
In[9]:= Plot[{Evaluate[{th'[t] r[t]} /. %%[[1]]], Evaluate[{r'[t]} /. %%[[1]]]}, {t, 0, 150}]
```




```
Out[9]= - Graphics -
```

```
In[10]:= T = 2 Sqrt[2 l / g] / eps NIntegrate[1 / (y^3 Sqrt[1 - y]), {y, 1 / Sqrt[2], 1}]
```

```
Out[10]= 140.39
```