In[1]:=
```
eq = {
  m (x0''[t] + R (θ''[t] Cos[θ[t]] - θ'[t]^2 Sin[θ[t]])) ==
   -f2[t] Cos[θ[t]] + Fn2[t] Sin[θ[t]],
  m R (-θ''[t] Sin[θ[t]] - θ'[t]^2 Cos[θ[t]]) == f2[t] Sin[θ[t]] + Fn2[t] Cos[θ[t]] - m g,
  f2[t] - f1[t] == x0''[t]/R^2 i,
  f1[t] + f2[t] Cos[θ[t]] + Fn2[t] Sin[θ[t]] == m x0''[t]
 }
```

Out[1]=
$$\left\{m\left(x0''[t]+R\left(-\text{Sin}[\theta[t]]\,\theta'[t]^2+\text{Cos}[\theta[t]]\,\theta''[t]\right)\right)==-\text{Cos}[\theta[t]]\,f2[t]+Fn2[t]\,\text{Sin}[\theta[t]],\ m\,R\left(-\text{Cos}[\theta[t]]\,\theta'[t]^2-\text{Sin}[\theta[t]]\,\theta''[t]\right)==-g\,m+\text{Cos}[\theta[t]]\,Fn2[t]+f2[t]\,\text{Sin}[\theta[t]],\ -f1[t]+f2[t]==\frac{i\,x0''[t]}{R^2},\ f1[t]+\text{Cos}[\theta[t]]\,f2[t]+Fn2[t]\,\text{Sin}[\theta[t]]==m\,x0''[t]\right\}$$

Solve the system

Solve for x0”[t]

In[33]:=
```
x0ppsol = First@Simplify@Solve[eq[[3]], x0''[t]]
```

Out[33]=
$$\left\{x0''[t]\to-\frac{R^2\left(f1[t]-f2[t]\right)}{i}\right\}$$

In[23]:=
```
Column[eqs2 = Simplify[eq /. x0ppsol], Frame → All]
```

Out[23]=

$\text{Cos}[\theta[t]]\,f2[t]==Fn2[t]\,\text{Sin}[\theta[t]]+\frac{m\,R\left(R\,f1[t]-R\,f2[t]+i\,\text{Sin}[\theta[t]]\,\theta'[t]^2-i\,\text{Cos}[\theta[t]]\,\theta''[t]\right)}{i}$
$g\,m==\text{Cos}[\theta[t]]\,Fn2[t]+f2[t]\,\text{Sin}[\theta[t]]+m\,R\,\text{Cos}[\theta[t]]\,\theta'[t]^2+m\,R\,\text{Sin}[\theta[t]]\,\theta''[t]$
True
$f1[t]+\frac{m\,R^2\left(f1[t]-f2[t]\right)}{i}+\text{Cos}[\theta[t]]\,f2[t]+Fn2[t]\,\text{Sin}[\theta[t]]==0$

Solve for θ”[t]

In[32]:=
```
θppsol = First@Simplify@Solve[eqs2[[1]], θ''[t]]
```

Out[32]=
$$\left\{\theta''[t]\to\frac{m\,R^2\,f1[t]\,\text{Sec}[\theta[t]]-f2[t]\left(i+m\,R^2\,\text{Sec}[\theta[t]]\right)+i\,\text{Tan}[\theta[t]]\left(Fn2[t]+m\,R\,\theta'[t]^2\right)}{i\,m\,R}\right\}$$

In[25]:=
```
Column[eqs3 = Simplify[eqs2 /. θppsol], Frame → All]
```

Out[25]=

True
$g\,m==\frac{\text{Sec}[\theta[t]]\left(i\,Fn2[t]+m\,R\left(R\,f1[t]\,\text{Sin}[\theta[t]]-R\,f2[t]\,\text{Sin}[\theta[t]]+i\,\theta'[t]^2\right)\right)}{i}$
True
$f1[t]+\frac{m\,R^2\left(f1[t]-f2[t]\right)}{i}+\text{Cos}[\theta[t]]\,f2[t]+Fn2[t]\,\text{Sin}[\theta[t]]==0$

Solve for f1[t]

In[31]:=
```
f1sol = First@Simplify@Solve[eqs2[[4]], f1[t]]
```

Out[31]=
$$\left\{f1[t] \to \frac{m\,R^2\,f2[t] - i\,\text{Cos}[\theta[t]]\,f2[t] - i\,Fn2[t]\,\text{Sin}[\theta[t]]}{i + m\,R^2}\right\}$$

In[28]:=
```
Column[eqs4 = Simplify[eqs3 /. f1sol], Frame → All]
```

Out[28]=

True
$g\,m == \text{Sec}[\theta[t]]\left(Fn2[t] + \frac{m\,R\,\left(-R\,\left(1+\text{Cos}[\theta[t]]\right)\,f2[t]\,\text{Sin}[\theta[t]] - R\,Fn2[t]\,\text{Sin}[\theta[t]]^2 + \left(i+m\,R^2\right)\,\theta'[t]^2\right)}{i+m\,R^2}\right)$
True
True

Solve for Fn2[t]

In[30]:=
```
Fn2sol = First@Simplify@Solve[eqs4[[2]], Fn2[t]]
```

Out[30]=
$$\left\{Fn2[t] \to \frac{m\left(R^2\,f2[t]\,\left(2\,\text{Sin}[\theta[t]] + \text{Sin}[2\,\theta[t]]\right) + 2\left(i + m\,R^2\right)\left(g\,\text{Cos}[\theta[t]] - R\,\theta'[t]^2\right)\right)}{2\,i + m\,R^2 + m\,R^2\,\text{Cos}[2\,\theta[t]]}\right\}$$

In[35]:=
```
SetDirectory[NotebookDirectory[]]
Export["Explicitly solving for Matlab.pdf", EvaluationNotebook[]]
```

Out[35]=
```
/home/eric/Documents/School/QEA2/Module 3/QEA-BB8/v2
```