In[37]:=
```
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]
   };
Column[Simplify@eq, Frame → All]
```

Out[38]=

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

Solve the system

Solve for x0''[t]

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

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

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

Out[23]=

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

Solve for θ''[t]

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

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

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

Out[25]=

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

Solve for f1[t]

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

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

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

Out[28]=

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

Solve for Fn2[t]

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

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

In[39]:=
```
SetDirectory[NotebookDirectory[]]
Export["Explicitly solving for Matlab.pdf", EvaluationNotebook[]]
```

Out[39]=
```
/home/eric/Documents/School/QEA2/Module 3/QEA-BB8/v2
```