

```

Exit[]

$Assumptions = t > 0;

er := {Cos[a[t]], Sin[a[t]]}; ea := D[er, t] / D[a[t], t];

rs = {x[t], y[t]}; r = {rs + b * er, rs - b * ea, rs + b / 2 * (ea - er)};

m = {m1, m2, m3}; F[i_] := Fr[i] * er + Fa[i] * ea

T = Sum[m[[i]] / 2 * D[r[[i]], t].D[r[[i]], t], {i, 3}]


$$\left(\frac{1}{2} b (-\cos[a[t]] a'[t] + \sin[a[t]] a'[t]) + x'[t]\right)^2 +$$


$$\left(\frac{1}{2} b (-\cos[a[t]] a'[t] - \sin[a[t]] a'[t]) + y'[t]\right)^2 +$$


$$\frac{1}{2} \left((-b \sin[a[t]] a'[t] + x'[t])^2 + (b \cos[a[t]] a'[t] + y'[t])^2\right) +$$


$$\frac{1}{2} \left((b \cos[a[t]] a'[t] + x'[t])^2 + (b \sin[a[t]] a'[t] + y'[t])^2\right)$$


e1 = Simplify[D[D[T, D[a[t], t]], t] - D[T, a[t]] - Sum[F[i].D[r[[i]], a[t]], {i, 3}]]


$$\frac{1}{2} b (-2 Fa[1] + Fa[3] - 2 Fr[2] + Fr[3] + 6 b a''[t])$$


e2 = Simplify[D[D[T, D[x[t], t]], t] - D[T, x[t]] - Sum[F[i].D[r[[i]], x[t]], {i, 3}]]
- Cos[a[t]] (Fr[1] + Fr[2] + Fr[3]) + (Fa[1] + Fa[2] + Fa[3]) Sin[a[t]] + 4 x''[t]

e3 = Simplify[D[D[T, D[y[t], t]], t] - D[T, y[t]] - Sum[F[i].D[r[[i]], y[t]], {i, 3}]]
- Cos[a[t]] (Fa[1] + Fa[2] + Fa[3]) - (Fr[1] + Fr[2] + Fr[3]) Sin[a[t]] + 4 y''[t]

Simplify[
  {Solve[e1 == 0, D[a[t], {t, 2}]][[1, 1]], Solve[e2 == 0, D[x[t], {t, 2}]][[1, 1]],
  Solve[e3 == 0, D[y[t], {t, 2}]][[1, 1]]} // MatrixForm

$$\left( \begin{array}{l} a''[t] \rightarrow -\frac{-2 Fa[1] + Fa[3] - 2 Fr[2] + Fr[3]}{6 b} \\ x''[t] \rightarrow \frac{1}{4} (\cos[a[t]] (Fr[1] + Fr[2] + Fr[3]) - (Fa[1] + Fa[2] + Fa[3]) \sin[a[t]]) \\ y''[t] \rightarrow \frac{1}{4} (\cos[a[t]] (Fa[1] + Fa[2] + Fa[3]) + (Fr[1] + Fr[2] + Fr[3]) \sin[a[t]]) \end{array} \right)$$


```