```
> restart:
  theta2(t);
  PG2x(t) := r2 * sin(theta2(t));
  PG2y(t) := - r2 * cos(theta2(t));
  VG2x(t) := diff(PG2x(t),t);
  VG2y(t) := diff(PG2y(t),t);
  AG2x(t) := diff(VG2x(t),t);
  AG2y(t) := diff(VG2y(t),t);
```

$$\theta 2(t)$$

$$\mathrm{PG2x}(t) := r2 \sin(\theta 2(t))$$

$$\mathrm{PG2y}(t) := -r2 \cos(\theta 2(t))$$

$$\mathrm{VG2x}(t) := r2 \cos(\theta 2(t)) \left(\frac{\partial}{\partial t} \theta 2(t)\right)$$

$$\mathrm{VG2y}(t) := r2 \sin(\theta 2(t)) \left(\frac{\partial}{\partial t} \theta 2(t)\right)$$

$$\mathrm{AG2x}(t) :=$$

$$-r2 \sin(\theta 2(t)) \left(\frac{\partial}{\partial t} \theta 2(t)\right)^2 + r2 \cos(\theta 2(t)) \left(\frac{\partial^2}{\partial t^2} \theta 2(t)\right)$$

$$\mathrm{AG2y}(t) :=$$

$$r2 \cos(\theta 2(t)) \left(\frac{\partial}{\partial t} \theta 2(t)\right)^2 + r2 \sin(\theta 2(t)) \left(\frac{\partial^2}{\partial t^2} \theta 2(t)\right)$$

```
> eq1:= R12x  = m2 * AG2x(t);
  eq2 := R12y - m2 * g = m2 * AG2y(t);
  eq3 := - R12y*r2*sin(theta2(t)) -
  r2*R12x*cos(theta2(t)) = IG2 *
```

```
diff(diff(theta2(t),t),t);
```

$$eq1 := R12x = m2\left(-r2\sin(\theta2(t))\left(\frac{\partial}{\partial t}\theta2(t)\right)^2 + r2\cos(\theta2(t))\left(\frac{\partial^2}{\partial t^2}\theta2(t)\right)\right)$$

$$eq2 := R12y - m2\,g = m2\left(r2\cos(\theta2(t))\left(\frac{\partial}{\partial t}\theta2(t)\right)^2 + r2\sin(\theta2(t))\left(\frac{\partial^2}{\partial t^2}\theta2(t)\right)\right)$$

$$eq3 := -R12y\,r2\sin(\theta2(t)) - r2\,R12x\cos(\theta2(t)) = IG2\left(\frac{\partial^2}{\partial t^2}\theta2(t)\right)$$

```
> sostituzioni := {diff(theta2(t),t$2)=
  (t2_i2 - 2*t2_i1 +
  t2_i)/(delta_t^2),diff(theta2(t),t)=
  (t2_i1 - t2_i)/delta_t, theta2(t) = theta2
  };
  equaz1 := subs(sostituzioni,eq1);
  equaz2 := subs(sostituzioni,eq2);
  equaz3 := subs(sostituzioni,eq3);
```

$$sostituzioni := \{\frac{\partial^2}{\partial t^2}\theta2(t) = \frac{t2\_i2 - 2\,t2\_i1 + t2\_i}{delta\_t^2},\ \frac{\partial}{\partial t}\theta2(t) = \frac{t2\_i1 - t2\_i}{delta\_t},\ \theta2(t) = \theta2\}$$

$$equaz1 := R12x = m2\left(-\frac{r2\sin(\theta2)\,(t2\_i1 - t2\_i)^2}{delta\_t^2}\right.$$

$$+\frac{r2\cos(\theta 2)\,(t2\_i2-2\,t2\_i1+t2\_i)}{delta\_t^2}\Bigg)$$

$$equaz2 := R12y - m2\,g = m2\left(\frac{r2\cos(\theta 2)\,(t2\_i1-t2\_i)^2}{delta\_t^2}\right.$$

$$\left.+\frac{r2\sin(\theta 2)\,(t2\_i2-2\,t2\_i1+t2\_i)}{delta\_t^2}\right)$$

$$equaz3 := -R12y\,r2\sin(\theta 2) - r2\,R12x\cos(\theta 2) = \frac{IG2\,(t2\_i2-2\,t2\_i1+t2\_i)}{delta\_t^2}$$

```
> sistema := {equaz1,equaz2,equaz3}:
  variabili := {R12x,R12y,t2_i2}:
  soluzione:=solve(sistema,variabili);
```

$$soluzione := \{R12x = -m2\,r2\sin(\theta 2)\,(r2^2\,m2\,t2\_i1^2 + t2\_i1^2\,IG2 - 2\,r2^2\,m2\,t2\_i1\,t2\_i - 2\,t2\_i1\,t2\_i\,IG2 + r2^2\,m2\,t2\_i^2 + t2\_i^2\,IG2 + \cos(\theta 2)\,m2\,r2\,g\,delta\_t^2) \,/\, ((r2^2\,m2 + IG2)\,delta\_t^2),\ t2\_i2 = -(m2\,r2\sin(\theta 2)\,g\,delta\_t^2 - 2\,r2^2\,m2\,t2\_i1 + r2^2\,m2\,t2\_i - 2\,IG2\,t2\_i1 + IG2\,t2\_i) \,/\, (r2^2\,m2 + IG2),\ R12y = -m2\,(-g\,delta\_t^2\,r2^2\,m2 - g\,delta\_t^2\,IG2 - r2^3\cos(\theta 2)\,t2\_i1^2\,m2 - r2\cos(\theta 2)\,t2\_i1^2\,IG2 + 2\,r2^3\cos(\theta 2)\,t2\_i1\,t2\_i\,m2 + 2\,r2\cos(\theta 2)\,t2\_i1\,t2\_i\,IG2 - r2^3\cos(\theta 2)\,t2\_i^2\,m2 - r2\cos(\theta 2)\,t2\_i^2\,IG2 + r2^2\sin(\theta 2)^2\,m2\,g\,delta\_t^2) \,/\, ((r2^2\,m2 + IG2)\,delta\_t^2)\}$$

```
> theta2 := t2_i;
  assign(soluzione);
```

$$\theta 2 := t2\_i$$

```
> factor(t2_i2);
```

$$-(m2\ r2\ \sin(t2\_i)\ g\ delta\_t^2 - 2\ r2^2\ m2\ t2\_i1 + r2^2\ m2\ t2\_i - 2\ IG2\ t2\_i1 + IG2\ t2\_i) \Big/ (r2^2\ m2 + IG2)$$

```
> IG2 := 0.15;
  r2 := 0.3;
  l := 0.6;
  m2 := 0.480;
  g := 9.807;
  delta_t := 0.001;
```

$$IG2 := .15$$

$$r2 := .3$$

$$l := .6$$

$$m2 := .480$$

$$g := 9.807$$

$$delta\_t := .001$$

```
> TE2_ini := evalf(135*(Pi/180));
  OM2_ini := evalf(0*(Pi/180));
  TE2_2 := TE2_ini + delta_t * OM2_ini;
  TE2[1] := TE2_ini;
  TE2[2] := TE2_2;
  TE2[3] :=
  eval(t2_i2,{t2_i=TE2_ini,t2_i1=TE2_2,t3_i=
  TE3_ini,t3_i1=TE3_2});
```