

```

> with(VectorCalculus):
> n := <-sin(theta), cos(theta)>
n := -sin(theta)e_x + (cos(theta))e_y
(1)

> ee := <cos(theta), sin(theta)>
ee := (cos(theta))e_x + (sin(theta))e_y
(2)

> gg := -g·n
gg := (g sin(theta))e_x - g cos(theta)e_y
(3)

> RR := R·n
RR := -R sin(theta)e_x + (R cos(theta))e_y
(4)

> aaM := aM·ee
aaM := (aM cos(theta))e_x + (aM sin(theta))e_y
(5)

> am := aaM + <w, 0>
am := (aM cos(theta) + w)e_x + (aM sin(theta))e_y
(6)

> NN := <0, N>
NN := (N)e_y
(7)

> eq1 := m·am - NN - m·gg
eq1 := (m (aM cos(theta) + w) - m g sin(theta))e_x + (m aM sin(theta) - N + m g cos(theta))e_y
(8)

> eq2 := M·aaM + NN - RR - M·gg
eq2 := (MaM cos(theta) + R sin(theta) - Mg sin(theta))e_x + (MaM sin(theta) + N - R cos(theta)
+ Mg cos(theta))e_y
(9)

> x1 := m (aM cos(theta) + w) - m g sin(theta)
x1 := m (aM cos(theta) + w) - m g sin(theta)
(10)

> x2 := m aM sin(theta) - N + m g cos(theta)
x2 := m aM sin(theta) - N + m g cos(theta)
(11)

> x3 := MaM cos(theta) + R sin(theta) - Mg sin(theta)
x3 := MaM cos(theta) + R sin(theta) - Mg sin(theta)
(12)

> x4 := MaM sin(theta) + N - R cos(theta) + Mg cos(theta)
x4 := MaM sin(theta) + N - R cos(theta) + Mg cos(theta)
(13)

> solve({x1 = 0, x2 = 0, x3 = 0, x4 = 0}, [w, aM, R, N])
[[w =  $\frac{g \sin(\theta) (\cos(\theta)^2 m + M \cos(\theta)^2 + m \sin(\theta)^2 + M \sin(\theta)^2)}{M \cos(\theta)^2 + m \sin(\theta)^2 + M \sin(\theta)^2}$ , aM =
 $\frac{\sin(\theta) m g \cos(\theta)}{M \cos(\theta)^2 + m \sin(\theta)^2 + M \sin(\theta)^2}$ , R
]
(14)

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$$\begin{aligned}
&= \frac{Mg (\cos(\theta)^2 m + M\cos(\theta)^2 + m\sin(\theta)^2 + M\sin(\theta)^2)}{M\cos(\theta)^2 + m\sin(\theta)^2 + M\sin(\theta)^2}, N \\
&= \frac{m g \cos(\theta) M (\cos(\theta)^2 + \sin(\theta)^2)}{M\cos(\theta)^2 + m\sin(\theta)^2 + M\sin(\theta)^2} \\
> &\text{simplify} \left(-\frac{\sin(\theta) m g \cos(\theta)}{M\cos(\theta)^2 + m\sin(\theta)^2 + M\sin(\theta)^2}, \text{trig} \right) \\
&\quad - \frac{m g \sin(\theta) \cos(\theta)}{m + M - \cos(\theta)^2 m}
\end{aligned} \tag{15}$$