① $R - mg\cos\theta = \dfrac{mv^2}{a}$

② $mg(0) + \frac{1}{2}m(4ga) = mg(a - a\cos\theta) + \frac{1}{2}mv^2$

$\Rightarrow mv^2 = 2mga + 2ma\cos\theta$

When $\theta = 60°$, $\cos\theta = \frac{1}{2}$

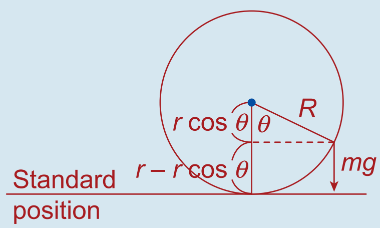
$\Rightarrow mv^2 = 3mga$

Putting these results into equation ① gives

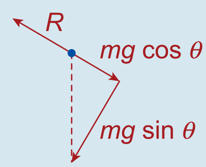
$R - mg\left(\frac{1}{2}\right) = \dfrac{3mga}{a}$

$\Rightarrow R = \dfrac{7mg}{2}$

Q. 4. **Forces**



Resolved



① $R - mg\cos\theta = \dfrac{mv^2}{r}$

② $mg(0) + \frac{1}{2}m\left(\frac{7gr}{2}\right) = mg(r - r\cos\theta) + \frac{1}{2}mv^2$

$\Rightarrow mv^2 = \frac{3}{2}mgr + 2mgr\cos\theta$

Putting this result into equation ① gives

$R - mg\cos\theta = \frac{3}{2}mg + 2mg\cos\theta$

When the marble leaves the sphere, $R = 0$

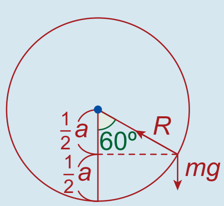
$\therefore\ -mg\cos\theta = \frac{3}{2}mg + 2mg\cos\theta$

$\Rightarrow \cos\theta = -\frac{1}{2}$

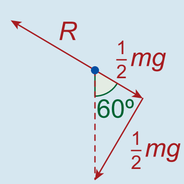
$\Rightarrow \theta = 120°$

It has risen $r - r\cos\theta = r - r\left(-\frac{1}{2}\right) = \frac{3}{2}r$

Q. 5. **Forces**



Resolved



Let v = the speed when $\theta = 60°$

① $R - \frac{1}{2}mg = \dfrac{mv^2}{a}$

② $Mg(0) + \frac{1}{2}mu^2 = mg\left(\frac{1}{2}a\right) + \frac{1}{2}mu^2$

$\Rightarrow mv^2 = mu^2 - mga$

Putting this result into equation ① gives:

$R - \frac{1}{2}mg = \dfrac{mu^2 - mga}{a}$

$\Rightarrow R = \frac{1}{2}mg + \dfrac{mu^2}{a} - mg$

$= \dfrac{mu^2}{a} - \frac{1}{2}mg$

$= m\left(\dfrac{u^2}{a} - \dfrac{g}{2}\right)$