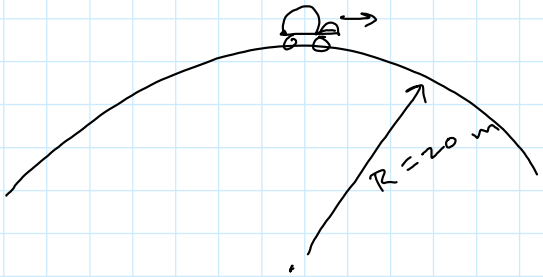
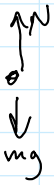
Phy 2A Review 5/5

Friday, May 5, 2017 10:01 AM

Circular motion





$\Sigma F_{radial} = \frac{mv^2}{R}$ ↓+

$mg - N = \frac{mv^2}{R}$

$N = m\left(g - \frac{v^2}{R}\right)$

Find max speed that the car can have and still be in contact with the road

given: $m = 1000$ kg

$R = 20$ m

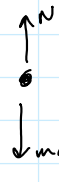
$mg - N = \frac{mv^2}{R}$ from above

at v_{max}: $N \to 0$ (car just loses contact with the road)

$mg - 0 = \frac{m v_{max}^2}{R}$

$g = \frac{v_{max}^2}{R}$

$v_{max} = \sqrt{Rg} = \sqrt{20(9.8)} = 14 \frac{m}{s}$

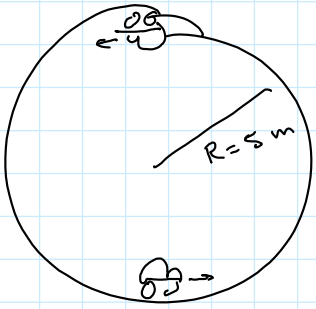


$\Sigma F_{radial} = \frac{mv^2}{R}$ ↑+

$N - mg = \frac{mv^2}{R}$

$N = m\left(g + \frac{v^2}{R}\right)$

Problem: Toy car drives around loop-the-loop



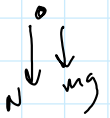
$m_{car} = 1.6$ kg

$R = 5$ m

$v = 12 \frac{m}{s}$ constant

Find the Normal force on the car at the top and the bottom:

Top



$\Sigma F_{radial} = m a_{cp}$ $\downarrow +$

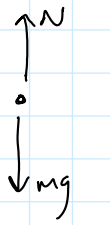
$N + mg = m \frac{v^2}{R}$

$N = m\left(\frac{v^2}{R} + g\right)$

$= 1.6\left(\frac{12^2}{5} + 9.8\right)$

$= 61.8$ N

bottom



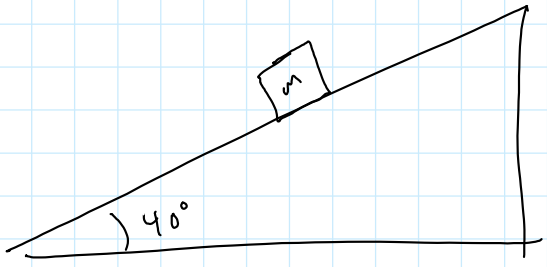
$\Sigma F_{radial} = m a_{cp}$ $\uparrow +$

$N - mg = m \frac{v^2}{R}$

$N = m\left(\frac{v^2}{R} - g\right)$

$= 30.4$ N

Friction



given:

$\theta = 40°$

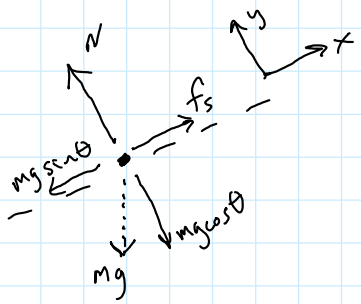
$m = 10$ kg

$\mu_k = 0.2$

$\mu_s = 0.3$

released from rest

Does m slide down incline?



$\Sigma \vec{F} = m\vec{a}$

$\Sigma F_x = ma_x$

$\Sigma F_y = ma_y = 0$

$N - mg\cos\theta = 0$

$N = mg\cos\theta$

find $(f_s)_{max}$ and compare to $mg\sin\theta$

$$(f_s)_{max} = \mu_s N = \mu_s mg\cos\theta$$

$$= (0.3)(10)(9.8)\cos 40^\circ$$

$$= 22.5 \text{ N}$$

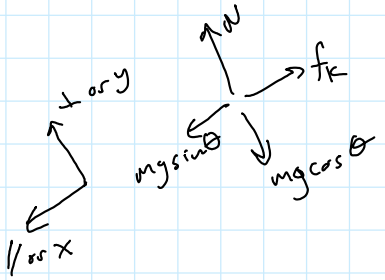
$$mg\sin\theta = (10)(9.8)(\sin 40^\circ)$$

$$= 63.0 \text{ N}$$

It slides down.

Find the acceleration:

sliding → so kinetic friction



$\Sigma F_x = ma_x$ ←+

$mg\sin\theta - f_k = ma$

$mg\sin\theta - \mu_k N = ma$

$mg\sin\theta - \mu_k(mg\cos\theta) = ma$

$g\sin\theta - \mu_k g\cos\theta = a$

$9.8\sin 40^\circ - (0.2)(9.8)\cos 40^\circ = a$

$a = 4.8 \ \frac{m}{s^2}$