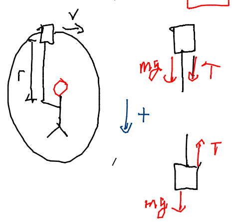
Object moving in a circle at constant speed

then net force must point towards center of circle

$$F_{net} = m\boxed{\frac{v^2}{r}}$$ — centripetal acceleration



$$mg + T = m\frac{v^2}{r}$$
$$T = m\frac{v^2}{r} - mg$$

upward

$$mg - T = -m\frac{v^2}{r}$$
$$T = mg + m\frac{v^2}{r}$$

Tension is greater at bottom

At bottom, $T > mg$

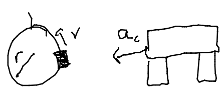
At top, T could "go negative" which means T disappears

If $T \leq 0$, $m\frac{v^2}{r} - mg \leq 0$

$$\frac{v^2}{r} \leq g \rightarrow v \leq \sqrt{rg}$$

Tension disappears at top if $v \leq \sqrt{rg}$

Car going around a circle



Which of these forces causes the centripetal acceleration?

A) W

B) N

$\boxed{\text{C) S}}$

D) K

E) None of these

$$F_{net} = m\frac{v^2}{r} = ma_c$$

$$S = m\frac{v^2}{r},$$

but only exists if

$$S \leq \mu_s N$$

$$\cancel{m}\frac{v^2}{r} \leq \mu_s \cancel{m}g$$

$$v^2 \leq \mu_s r g \rightarrow v \leq \sqrt{\mu_s r g}$$

e.g. rubber on dry concrete

$\mu_k = 0.84$

$r = 0.1\text{ km}$

$$V \leq \sqrt{(0.84)(0.1\times10^3 m)(9.8 m/s^2)}$$

e.g. rubber on dry concrete

$$\mu_k = 0.84$$

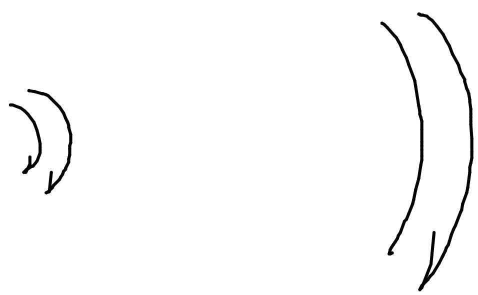
$$r = 0.1\,km$$

$$v \le \sqrt{(0.84)(0.1\times10^3\,m)(9.8\,m/s^2)}$$

$$v \le 30\,m/s \sim 60\,mph$$

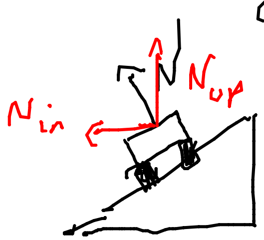
if it rains, μ_s gets smaller

v_{max} goes down



bigger r,
more gentle
curve

another way to prevent skidding



N_{in} now can
contribute to
centripetal force