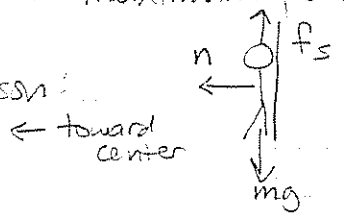
Physics 20B Assignment 7

1. Ch 6 - 55

a) looking for maximum period to keep person from falling

FBD of person:



y direction: $\Sigma F_y = ma_y$

$f_s - mg = ma_y$

radial direction: $\Sigma F_c = ma_c$

$n = m\frac{v^2}{R}$

as v decreases, n decreases,

and $f_{s,max} = \mu_s n$ decreases

∴ if $\mu_s n < mg$, person will slip

so since

$n = m\frac{v^2}{R}$, if $\frac{\mu_s m v^2}{R} < mg$, person will slip

In terms of the period T, $T = \frac{2\pi R}{v} \Rightarrow v = \frac{2\pi R}{T}$

so $\frac{\mu_s}{R}\left(\frac{2\pi R}{T}\right)^2 < g$

$\Rightarrow \frac{4\pi^2 \mu_s R}{T^2} < g \Rightarrow T > \sqrt{\frac{4\pi^2 \mu_s R}{g}}$ as advertised (independent of mass)

b) for $R = 4.00\ m$, $\mu_s = 0.400$,

$T = \sqrt{\frac{4\pi^2 (0.4)(4m)}{9.8\ m/s^2}} = 2.539\ s/rev$

$\#\ \text{revolutions/min} = \frac{1}{2.539\ s/rev} \cdot 60\ s/min = 23.6\ rev/min$

c) if v increases, n increases, so $f_{s,max}$ is larger — but f_s is still just as large as it needs to be to balance mg, so $f_s + mg$ stay the same

the person goes around faster, but still doesn't move vertically

d) if r decreases, n decreases, so $f_{s,max}$ is smaller — which means f_s can no longer balance mg, and the person slips down