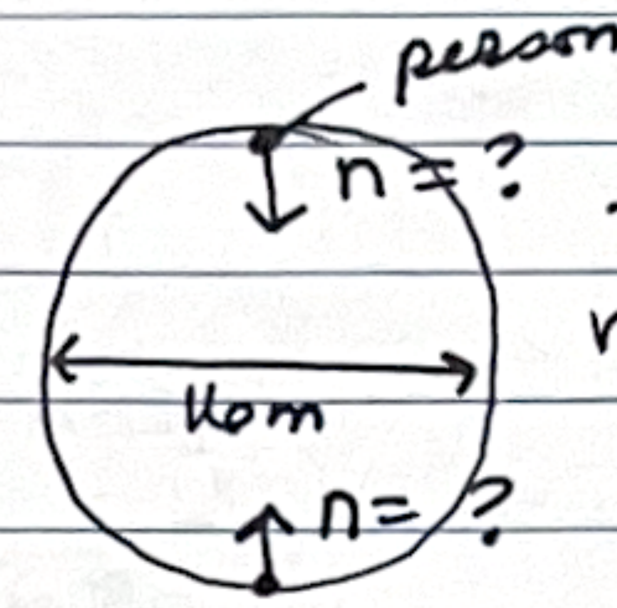
Ch8 p. 201 #51

(a)

Sketch + translate



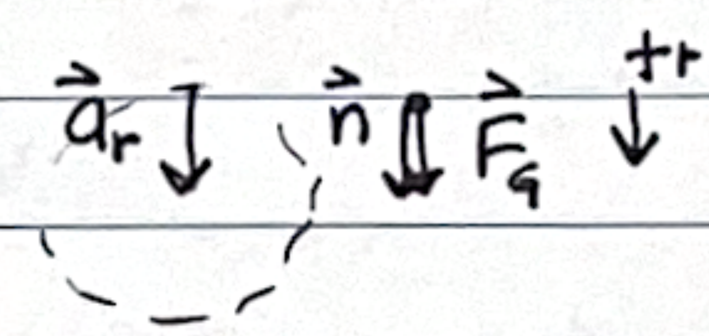
$T = 4.5\,s$

$m = 55\,kg$

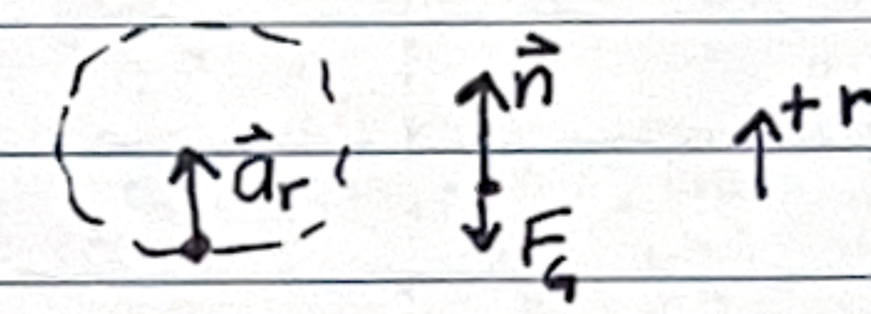
Simplify + Diagram

- model the person as a particle
- model the process as uniform circular motion

at top



at bottom



$(n > F_G)$

Represent Mathematically

at top

$$\Sigma F_r = ma_r$$

$$n + F_G = m\left(\frac{v^2}{r}\right)$$

$$n + mg = m\left(\frac{v^2}{r}\right)$$

$$n = \frac{mv^2}{r} - mg$$

→ I need to know v! $v = \frac{2\pi r}{T}$

$$= \frac{2\pi(8m)}{4.5s}$$

$$= 11.2\,m/s$$

at bottom

$$\Sigma F_r = ma_r$$

$$n - F_G = m\left(\frac{v^2}{r}\right)$$

$$n = mg + m\left(\frac{v^2}{r}\right)$$

$$n = (55kg)(9.8\tfrac{N}{kg}) + \frac{(55kg)(11.2\,m/s)^2}{8m}$$

$$n = 539 + 862.4$$

$n =$ **1401 N, upward**

Solve:

$$n = \frac{(55kg)(11.2\,m/s)^2}{(8.0m)} - (55kg)(9.8\tfrac{N}{kg})$$

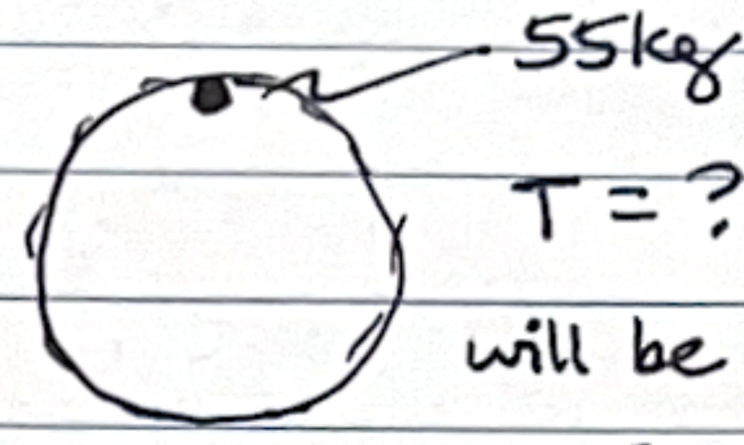
$$n = 862.4 - 539$$

$n =$ **323 N, downward**

#51, continued

Sketch + translate

b) Find Longest period for riders not to fall off at the top.



$T = ?$

will be slowest speed

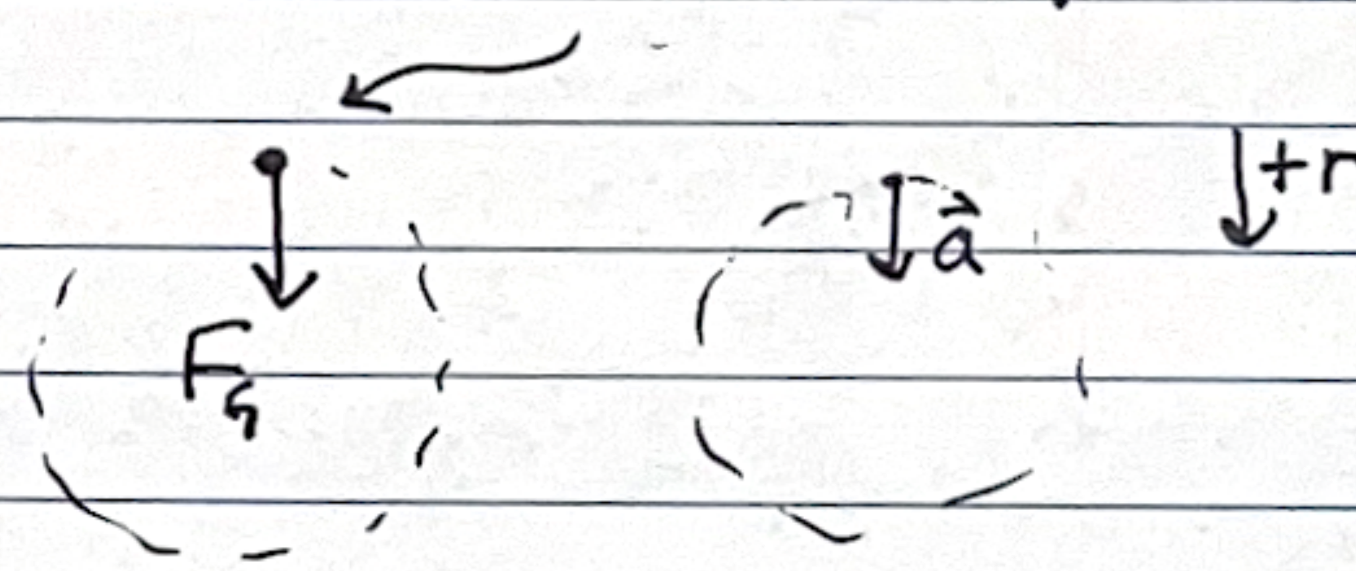
$V = \frac{2\pi r}{T}$

Simplify + Diagram

- person modeled as particle
- motion modeled as uniform circular motion

n ⇅ F_G is the general FBD

As v gets smaller, a_r gets smaller, and ΣF_r gets smaller, and so n gets smaller. The smallest n can be is 0, so this will be the forces when it is at its slowest speed:



Represent mathematically

$$\Sigma F_r = ma_r$$

$$F_G = m\left(\frac{v^2}{r}\right)$$

$$mg = \frac{mv^2}{r}$$

$$\sqrt{gr} = v$$

Solve:

$$\sqrt{(9.8\,N/kg)(8.0\,m)} = v$$

$$8.9\,m/s = v$$

Now I need to know the period at this speed:

$$V = \frac{2\pi r}{T}$$

$$T = \frac{2\pi r}{v}$$

$$= \frac{2\pi(8\,m)}{8.9\,m/s}$$

$$= \boxed{5.6s}$$