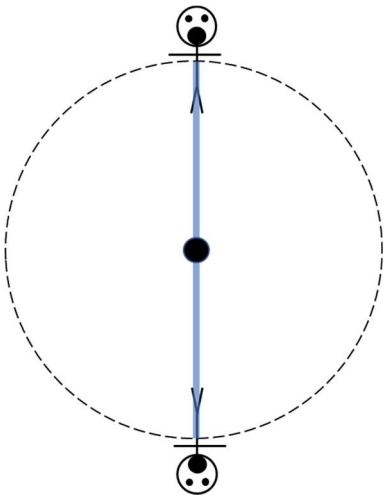
Assessment #8 121 Schwartz

1. Your 50 kg friend is considering a new ride at the amusement park, kind of like a Ferris wheel that takes you in a circular path high in the sky except in *this* ride, you are tied at your waist onto a rotating bar and are inverted at the bottom as shown. The bar can either pull or push on your body. The ride is 10 m across and maintains a constant speed of 10 m/s where the people are.
   a) At which position (top or bottom) would the force the bar puts on your friend's body be the greatest or is this force always the same? Please fully explain your reasoning.
   b) Find the force the bar puts on your friend in the position it pushes/pulls the hardest.



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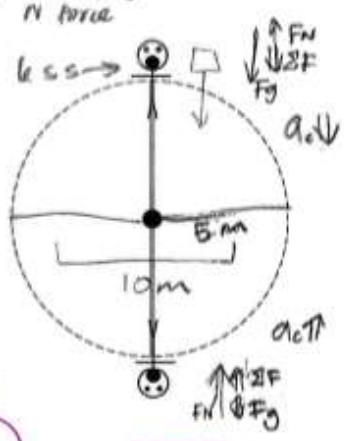
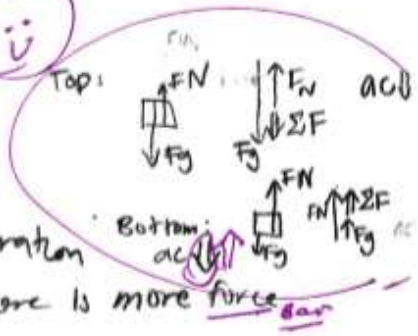
Weight = weakness
N force



I am using dynamics lens to solve this problem because forces cause centripetal acceleration



a.) Force is greatest at the bottom because when objects have centripetal acceleration, they have force and acceleration radially inward At the bottom there is more force acting upward against gravity to accelerate inward

b.) $a_c = \uparrow$ at bottom

$a_c = \frac{v^2}{R} = \frac{100\ m^2/s^2}{5\ m}$ $a_c = 20\ m/s^2$

$a_c = \frac{v^2}{R} = \frac{\Sigma F}{m} = F_N - F_g$

Forces cause centripetal acceleration

$1000N = F_N - 500N$ $\Sigma F = m a_c$

$F_N = 1500N$ $\Sigma F = 50kg \cdot 20 m/s^2$

$\Sigma F = 1000N$

A+

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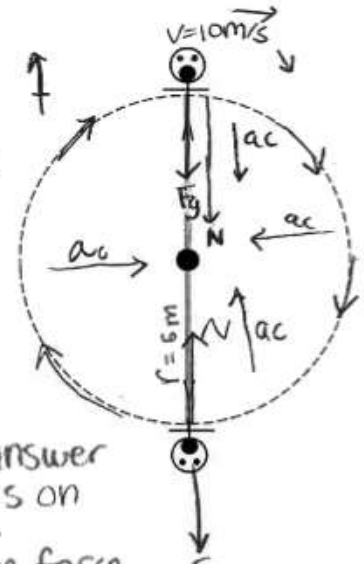


a lense: I am going to use a Dynamics lense to answer this question because we are looking at forces on the body at the top vs. bottom of the ride.

$\Sigma F = F_g + F_N$

Top: $\Sigma F = F_{N_T} + F_{g_T} = ma_c$

$F_N = ma_c - F_{g_T}$

Bottom: $\Sigma F = F_{N_B} - F_{g_B} = ma_c$

$F_{N_B} = ma_c + F_g$

At the bottom the force on my friend will be greater than at the top because The Normal force the bar puts on him/her is going to be the (mass · centripetal acceleration + the force of gravity) meaning they will feel "heavier" at the bottom due to the added Normal force on him/her

b) I will also use a dynamics lense for the same reasons I said ↑

$F_{bar\ @\ Bottom} = F_{N_B} = ma_c + F_g$

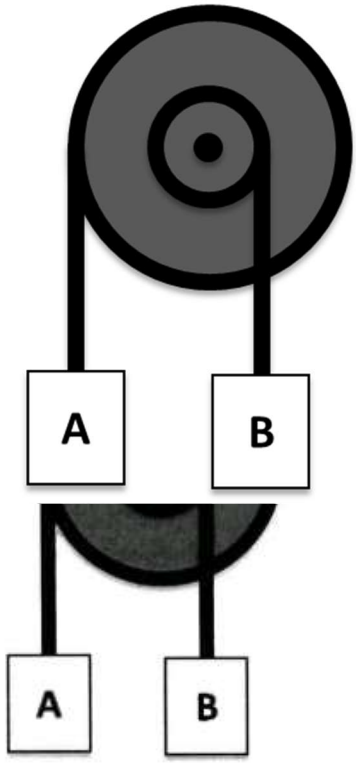
$a_c = \frac{v^2}{r} = \frac{(10 m/s^2)}{5m} = 20 m/s^2$

$F_{bar} = 50kg(20 m/s^2) + 50kg(10 m/s^2)$

$= 1500 N$

A+

2. Two identical masses, A and B, hang from strings wrapped around the outer edge and inner pulley of a freely rotating flywheel as show. The pulley is connected to the flywheel and they rotate as a single body. The flywheel/pulley is released from rest. Which string A or B has a greater tension, or are they the same tension? Please fully explain your answer.



I will use a rotational dynamics lens since two torques at different radii are applying perp. force on the flywheel, causing it to accelerate.

$$\vec{\tau} = I\alpha = \frac{1}{2}mr^2 \cdot \alpha$$

$$\tau = F_{\perp} r$$

Because $\tau_{mass\ A}$ has a greater radius than $\tau_{mass\ B}$, it will be greater in magnitude and therefore accelerate downward, pulling the wheel with it. This will cause mass B to accelerate upward, which means the net forces are upward. Since the only upward force is the string tension, we can conclude that string B has greater tension. Mass A accelerating downward due to gravity means its tension is far less. If the string on mass A had greater tension then it would accelerate upwards while mass B accelerated downward, which is incorrect due to the ratio of their torques.