Circular Motion

1) A merry-go-round that has a radius of 1.5m is spinning around at 65 revolutions per minute. (a) Find the velocity of a rider if they are on the outside edge of the ride? (b) Find the centripetal force acting on the 60kg rider. (c) How many g's is he experiencing?

$r = 1.5m$
$f = 65 rpm$
$v = ?$

(a) $T = \frac{1}{f} = \frac{1}{65} = 0.01538 min.$ $\times 60$ $0.923 s$

$V = \frac{2\pi r}{T} = \frac{2\pi(1.5)}{.923}$

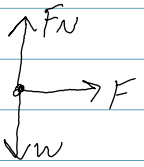
$V = 10.21 m/s$

(b) $F_c = \frac{mv^2}{r}$

$F_c = \frac{60(10.21)^2}{1.5} = 4,169.76 N$

(c) $\frac{4169.76}{600} = 6.95 g's$

$a_c = \frac{10.21^2}{1.5} = 69.496/10 = 6.95 g's$



2) The gravitron ride at the fair has a radius of 4.5m & spins with a speed of 11.62m/s. (a) How many g's is the 60kg rider experiencing? (b) When the floor drops out from the rider, what is the coefficient of friction between the wall and the rider?

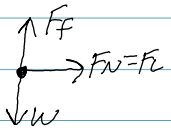
$r = 4.5m$
$v = 11.62 m/s$

(a) $a_c = \frac{v^2}{r} = \frac{11.62^2}{4.5}$

$a_c = 30.005 m/s^2$

$30/10 = 3 g's$

(b)



① $\Sigma F_y = 0 = w + F_f$
$0 = -600 + F_f$ $F_f = 600N$

② $F_N = F_c = \frac{mv^2}{r} = \frac{60(11.62)^2}{4.5}$

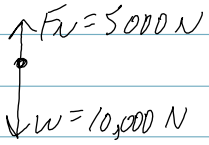
$F_c = F_N = 1800.325N$

③ $F_f = \mu F_N$
$600 = \mu(1800.325)$ $\mu = 0.33$

3) A 1000 kg rollercoaster is moving along the track. (a) How fast must it be moving for the passengers to feel 1/2 their weight while moving over a hill that has a radius of 14m? (b) What is the slowest speed the coaster can go to make it through a loop that has a radius of 12m?

$m = 1000kg$
$F_N = 5000N$
$w = 10,000N$
$r = 14m$

(a)



① ~~[illegible]~~

$\Sigma F_y = w + F_N$

$\Sigma F_y = -10,000 + 5000$

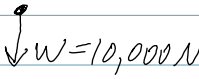
$\Sigma F_y = F_c = -5000N$

② $F_c = \frac{mv^2}{r}$

$5000 = \frac{1000\,v^2}{14}$

$\boxed{v = 8.37 m/s}$

(b)



$a_c = 10 m/s^2$

$a_c = \frac{v^2}{r}$

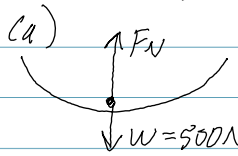
$10 = \frac{v^2}{14}$

$\boxed{v = 10.95 m/s}$

4) A 50kg guy riding on a 12kg bike is moving at 5m/s. (a) What is the normal force acting on the guy when he is at the bottom of a dip in the road that has a radius of 18m? (b) What is the normal force acting on the bike when he is at the top of a hill that has a radius of 18m?

$m_g = 50kg$
$m_b = 12kg$
$v = 5m/s$
$r = 18m$

(a)



① $F_c = \frac{mv^2}{r} = \frac{50(5)^2}{18}$

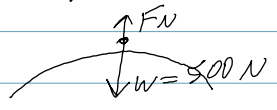
$F_c = 69.44N$

② $\Sigma F_y = F_c = w + F_N$

$+69.44 = -500 + F_N$

$\boxed{F_N = 569.44N}$

(b)



$F_c = \frac{50(5)^2}{18} = 86.11N$

$\Sigma F_y = w + F_N$

-620

$-86.11 = -500 + F_N$

$\boxed{F_N = 533.89N}$