

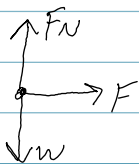
Circular Motion

- 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?

$r = 1.5\text{m}$ (a) $T = \frac{1}{f} = \frac{1}{65} = 0.01538\text{min.}$ (b) $F_c = \frac{mv^2}{r}$
 $f = 65\text{rpm}$ $\frac{\times 60}{0.923\text{s}}$ $F_c = \frac{60(10.21)^2}{1.5} = \boxed{4,169.76\text{N}}$
 $v = ?$

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

$$\boxed{v = 10.21\text{m/s}}$$



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

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

- 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?

$r = 4.5\text{m}$ (a) $a_c = \frac{v^2}{r} = \frac{11.62^2}{4.5}$ (b)
 $v = 11.62\text{m/s}$

$$a_c = 30.005\text{m/s}^2$$

$$30/10 = \boxed{3\text{g's}}$$

① $\sum F_y = 0 = W + F_f$
 $0 = -600 + F_f$ $F_f = 600\text{N}$

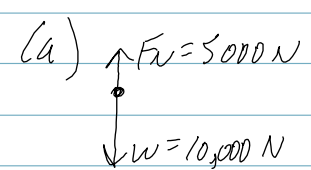
② $F_N = F_c = \frac{mv^2}{r} = \frac{60(11.62)^2}{4.5}$

$$F_c = F_N = 1800.325\text{N}$$

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

3) A 1000 kg rollercoaster is moving along the track. (a) How fast must it be moving for the passengers to feel $\frac{1}{2}$ 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?

$m = 1000 \text{ kg}$
 $F_N = 5000 \text{ N}$
 $w = 10,000 \text{ N}$
 $r = 14 \text{ m}$

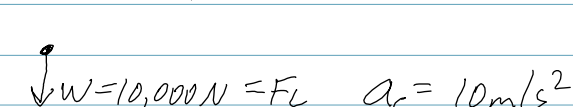
(a) 

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

$5000 = \frac{1000 v^2}{14}$ $v = 8.37 \text{ m/s}$

(1) ~~W + F_N~~

$\Sigma F_y = w + F_N$
 $\Sigma F_y = -10,000 + 5000$
 $\Sigma F_y = F_c = -5000 \text{ N}$

(b) 

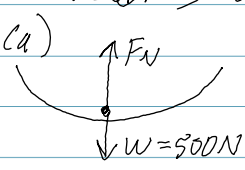
$w = 10,000 \text{ N} = F_c$ $a_c = 10 \text{ m/s}^2$

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

$10 = \frac{v^2}{14}$ $v = 10.95 \text{ m/s}$

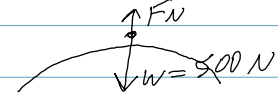
4) A 50 kg guy riding on a 12 kg bike is moving at 5 m/s. (a) What is the normal force acting on the guy when he is at the bottom of a dip in the road that has a radius of 18 m? (b) What is the normal force acting on the bike when he is at the top of a hill that has a radius of 18 m?

$m_g = 50 \text{ kg}$
 $m_b = 12 \text{ kg}$
 $v = 5 \text{ m/s}$
 $r = 18 \text{ m}$

(a) 

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

$F_c = 69.44 \text{ N}$

(b) 

$F_c = \frac{62(5)^2}{18} = 86.11 \text{ N}$

$\Sigma F_y = w + F_N$

-620

$-86.11 = -500 + F_N$

(2) $\Sigma F_y = F_c = w + F_N$

$+69.44 = -500 + F_N$

$F_N = 569.44 \text{ N}$

$F_N = 533.89 \text{ N}$