Name: KEY

Date:

Section C D F

The Masters School
Mr. Alex Rawson
Physics

Rotational Motion III

1. An airplane is flying in a horizontal circle at a speed of 120 m/s. The 72.0 kg pilot does not want his centripetal acceleration to exceed 8.00 times free-fall acceleration. What is the minimum radius of the circular path? (Your answer should be between 150 – 200 m)

$V_t = 120$ m/s

$a_c = 8 \cdot g = 8(9.81)$

$a_c = 78.48$ m/s^2

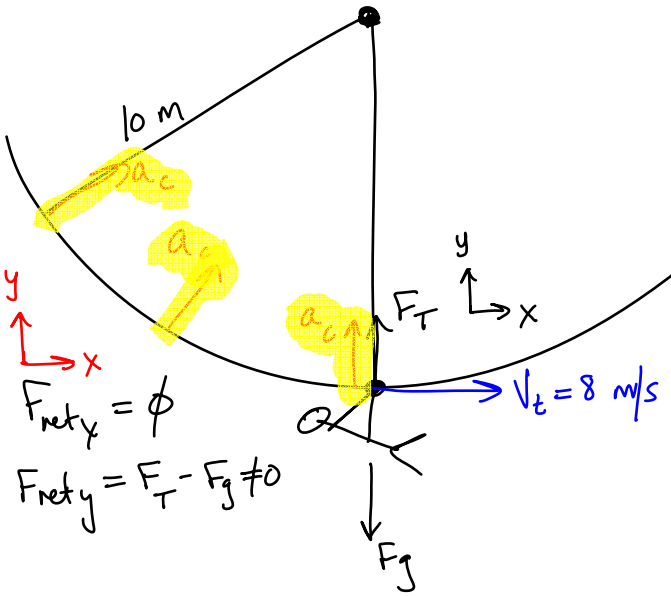
$r = ?$

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

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

$$\boxed{r = 183.49 \text{ m}}$$

2. Tarzan (m = 85 kg) tries to cross a river by swinging from a 10.0 m long vine. His speed at the bottom of the swing, just as he clears the water, is 8.0 m/s. Tarzan doesn't know that the vine has a breaking strength of 1.0 x 10^3 N. Does he make it safely across the river without breaking the vine? Explain your answer through mathematical reasoning. (Your answer should be between 800 – 1400 N)



Centripetal Acceleration, from the position at the bottom of the swing, is straight upwards in the y direction. So $F_{net_y} \neq 0$

$$F_{net_y} = F_T - F_g \neq 0$$

$$F_{net_y} = ma_c$$

$$ma_c = F_T - F_g$$

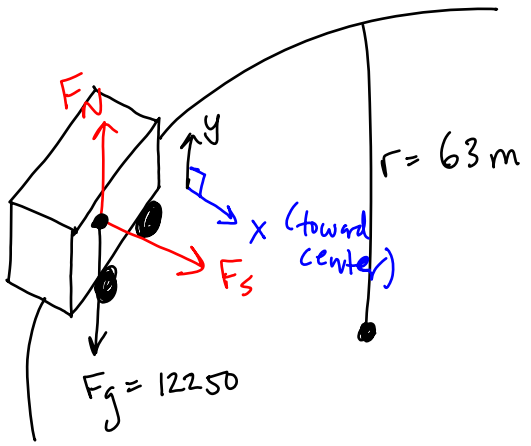
$$F_T = ma_c + F_g$$

$$F_T = m\frac{V_t^2}{r} + mg$$

$$F_T = 85\frac{8^2}{10} + (85)(9.81)$$

$$F_T = 544 + 833.85 = \boxed{1377.85 \text{ N}}$$

3. A 12250 N car attempts to round a 63 m turn traveling at 50 mph, approximately 22.35 m/s.
   a. Find the centripetal acceleration of the car. (Your answer should be between 7 – 10 m/s^2.)



$F_{net\,x} = F_s \neq 0$ b/c accelerating toward center

$F_{net\,y} = F_N - F_g = 0$

$\therefore F_N = F_g = 12250$

$a_c = \frac{v_t^2}{r} = \frac{(22.35)^2}{63} = 7.929\ m/s^2$

   b. Find the force that maintains centripetal acceleration. (Your answer should be between 8 - 10 x 10^3 N)

$F_{net\,x} = F_s \neq 0$

$F_{net\,x} = ma_c$

$F_s = ma_c$

$F_c = ma_c$

$F_c = F_s$

$F_s = ma_c$

$= \left(\frac{12250}{9.81}\right)(7.929)$

$F_s = 9.901 \times 10^3\ N$

Static friction is the force that is keeping the car in circular motion.

   c. Find the minimum coefficient of static friction between the tires and the road that will allow the car to round the curve safely. (Your answer should be between 0.60 - 0.90)

$\mu_s = \frac{F_{s\,max}}{F_N}$

$\mu_s = \frac{9.901 \times 10^3\ N}{12250}$

$\mu_s = .8082$