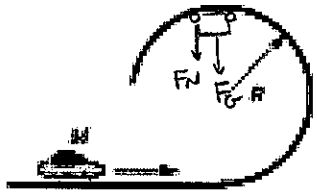
11: Circular Motion

1. What is the minimum acceleration that the car must have at the top of the track if it is to remain in contact with the track? A small car of mass *M* travels along a straight, horizontal track. As suggested in the figure, the track then bends into a vertical circle of radius *R*.



If there is going to be an F_N then required a_c must be greater than what F_G can provide (i.e. $9.8\ m/s^2$)

a) 4.91 m/s^2, downward
b) 4.91 m/s^2, upward
c) 9.81 m/s^2, upward
d) 9.81 m/s^2, downward
e) 19.6 m/s^2, upward

2. The maximum speed around a level curve is 30 km/h. What is the maximum speed around a curve with twice the radius?

a) 42.4 km/h
b) 45 km/h
c) 60.0 km/h
d) 120 km/h

$\Sigma F_c = \frac{mv^2}{r}$

All things equal, 2x the radius would allow for $\sqrt{2}$ x the original speed.

3. A 0.50 kg mass is attached to the end of a 1.0 m string. The system is whirled in a horizontal circular path. The maximum tension the string can withstand is 350 N. What is the maximum speed at which the string breaks?

a) 700 m/s
b) 26 m/s
c) 19 m/s
d) 13 m/s

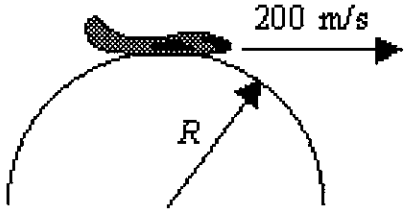
$F_T = \frac{mv^2}{r}$

$350 = \frac{(.5)v^2}{1}$

4. A car goes around a curve of radius r at a constant speed v. What is the direction of the net force on the car.

a) Toward the curve's center → required for circular motion.
b) Away from the curve's center
c) Toward the front of the car
d) Toward the back of the car

A plane is traveling at 200 m/s following the arc of a vertical circle of radius *R*. At the top of its path, the passengers experience "weightlessness." To one significant figure, what is the value of *R*?



All of F_G used to go in a circle

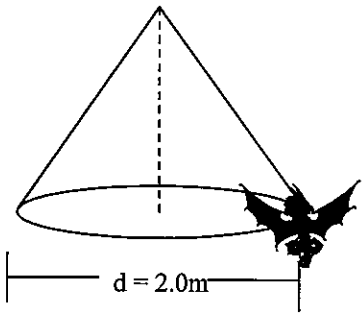
$mg = \frac{mv^2}{r}$

$10 = \frac{(200)^2}{r}$

$r = 4000$ m

a) 200 m
b) 10000 m
c) 2000 m
d) 4000 m
e) 40,000 m

1. A 500 g toy dragon hanging from a string is flying around in a circular path at a constant speed. The diameter of the circular path is 2.0 meters and the dragon makes 10 revolutions in 20 seconds. (10 points)



a) Draw the free body diagram to the right of the figure above. Include all angle measures.

b) What force provides the force needed to move the dragon in a uniform circular path? Be specific.

The horizontal component of tension.

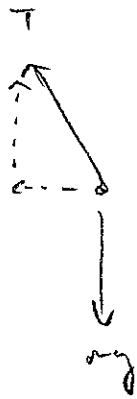
c) Determine the velocity of the dragon.

diameter ÷ 2

$$V = \frac{d}{t} = \frac{2\pi r}{t} = \frac{2(\pi)\left(\frac{2}{2}\right)}{(20/10)} \Rightarrow \boxed{V = 3.14\ m/s}$$

t for 1 rev.

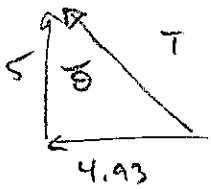
d) Determine the tension in the string and the angle of the string with respect to the vertical axis.



$T_y = mg = (.5)(10) = 5\ N$

Circle

$$T_x = \frac{mv^2}{r} = \frac{(.5)(3.14)^2}{1} = 4.93\ N$$



$$T = \sqrt{5^2 + 4.93^2} = \boxed{7\ N}$$

$$\theta = \tan^{-1}\left(\frac{4.93}{5}\right) = \boxed{44.6^\circ}$$