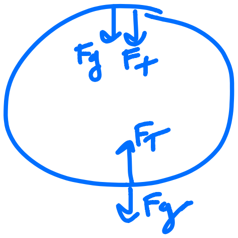

Worksheet 4.2

1. A ball on the end of a string is cleverly revolved at a uniform rate in a vertical circle of radius 85.0 cm. If its speed is 4.15 m/s and its mass is 0.300 kg, calculate the tension in the string when the ball is (a) at the top of its path, and (b) at the bottom of its path.

a). $F_c = F_g + F_T$
$\frac{mv^2}{r} = mg + F_T$
$\frac{.3(4.15)^2}{.85} = .3(10) + F_T$
$F_T = 3N$

b). $F_c = F_T - F_g$
$\frac{.3(4.15)^2}{.85} = F_T - 3$
$F_T = 9N$

2. A discus thrower spins their discus (2 kg) in a horizontal circle with a radius 1 meter. The normal force applied from the thrower's finger tips keeps the disc in circular motion. If the discus with a speed of 2 m/s, what normal force do the thrower's fingers exert on the disc? What normal force does the disc exert on the fingers?

$F_c = F_N$
$\frac{(2)2^2}{1} = 8N$ for both (3rd Law)

3. A bucket with a mass of 4 kg is swung around in a vertical circle with a rope that is 1.2 meters long. What is the speed of the bucket at the top of the circle if the tension in the rope at the same point is 8 N?

@ top, $F_c = F_g + F_T$
$\frac{(4)(v^2)}{1.2} = 40 + 8$ $v = 3.79 m/s$

4. Revolution at Six Flags Magic Mountain has a loop with a height of 27 meters (assume a circular loop). The ride travels at 25 m/s at the bottom of the loop. If the loaded cart has a mass of 2000 kg, what is the normal applied to the ride from the track at the bottom?

d $r = 27m/2$
F_N?
@ bottom, $F_c = F_N - F_g$
$\frac{2000(25)^2}{13.5} = F_N - 20000$ $F_N = 112592.6 N$

5. A 50 kg teenager is riding on the Gravitron (radius 6 m), which spins its riders around in circles so the stick to the walls. The coefficient of static friction between the teenager and the wall is 0.4. How fast must the Gravitron spin in order to allow the teenager to stick to the wall with their feet off of the ground?

We need $F_{fs} \geq F_g$, but F_{fs} depends on the F_N.

$F_c = F_N$
$\frac{(50)v^2}{6} = F_N$

$F_{fs} = (.4)\left(\frac{50v^2}{6}\right)$
$F_g = 500N$

so... $.4\left(\frac{50v^2}{6}\right) \geq 500$
$v = 12.2 m/s$

6. A child on a merry-go-round is moving with a speed of 1.35 m/s when 1.20 m from the center of the merry-go-round. Calculate (a) the centripetal acceleration of the child, and (b) the centripetal force exerted on the child (mass = 25.0 kg).

$a_c = \frac{1.35^2}{1.2} = 1.5\, m/s^2$ $F_c = \frac{25 \cdot 1.35^2}{1.2} = 37.97\, N$

7. Calculate the centripetal acceleration of the Earth in its orbit around the sun and the net force exerted on the Earth? What exerts this force on the Earth? Assume that the Earth's orbit is a circle of radius 1.50 x 10^{11} m, its mass is $6x10^{24}$ kg and the mass of the sun is $2x10^{30}$kg.

V=
1year=365 days
8760 hrs
525600min
31536000 sec

$v = \frac{2\pi(1.5\times10^{11})}{31536000} = 3\times10^4\, m/s$

$a_c = \frac{(3\times10^4)^2}{1.5\times10^{11}} = .006\, m/s^2$

$F_c = .006\, m/s^2 \times 6\times10^{24} = 3.6\times10^{22}\, N$

The F_g between the sun & earth, it's due to their interaction.

8. A 1000-kg sports car moving at 20 m/s crosses the rounded top of a hill (radius = 100 m). Determine (a) the normal force on the car, (b) the normal force on the 70-kg driver, and (c) the car speed at which the normal force equals zero.

a) $F_c = F_g - F_N$

$\frac{1000 \cdot 20^2}{100} = 10000 - F_N$

$F_N = 6000\, N$

b). $\frac{70 \cdot 20^2}{100} = 700 - F_N$

$F_N = 420\, N$

c) $\frac{1000 v^2}{100} = 10000 - 0$

$v = 31.6\, m/s$