1. Be able to identify and explain centripetal force in the following scenarios:
   1. Vehicle on a level track (friction)
   2. Something on a string/cable (tension)
   3. Something on a vertical track (normal)
   4. Planets/satellites in orbit (gravity)
2. Be able to write (sentences or math) Keppler’s three laws. Be able to recognize & draw pictures of the first two
3. Solve the following:
   1. A 350kg roller coaster completes a loop with radius 35m at 22m/s2. Find the following values at the top of the loop AND the bottom of the loop: Fg, a, Fn

Bottom:   
Fg=\_\_3430N\_\_

a = \_\_13.83m/s2

Fn= \_\_8270.5N\_

Top:   
Fg=\_\_3430N\_\_

a = \_\_13.83m/s2

Fn= \_\_1410.5N\_

* 1. A 1000kg car drives around a level track with radius 50m at 23m/s2. Find Fg, FN, a, Ff, μ.

Fg=\_9800N\_

Fn= 9800N

a = 10.58m/s2

Ff = 10580N

μ = 1.08

* 1. A motor cross racer and bike (400kg) make a tight turn (r=10m) at 13m/s. Find Fg, FN, a, Ff, μ.

Fg=\_3920N

Fn= 3920N

a = 16.9 m/s2

Ff = 6760N

μ = 1.72

* 1. A roller coaster car (500kg) has a vertical loop (r=17m) that it completes at 14m/s. Find the following values at the top of the loop AND the bottom of the loop: Fg, a, Fn

Bottom:   
Fg=\_\_4900N\_\_

a = \_\_11.53m/s2

Fn= \_10664.7N\_

Top:   
Fg=\_\_4900\_\_

a = \_\_11.53m/s2

Fn= \_\_874.7N\_

Use these values for the following problems: G = 6.67x10-11N\*m2/kg2; MEarth=5.98x1024; REarth=6380km.

1. A 500kg satellite orbits the earth 250km from the surface.

Fg=\_4529.43N\_\_

a (satellite) = \_\_9.06m/s2

v (satellite) = 7785.49m/s\_

1. A 7000kg space ship orbits earth 3000km from the surface.

Fg=\_31680.5N\_\_

a (ship) = 4.53m/s2

v (ship) = 6515.5m/s\_

1. Mars has a mass of 6.21x1023kg and is a distance of 230 million km from the sun (mass 2x1030kg) What is the gravitational force of attraction between the two? What is Mars’ acceleration and velocity relative to the sun?

Fg=\_1.6x1021 N\_

a (Mars) = 0.025 m/s2

v (Mars) = 7582.88m/s\_

1. Mars has an average distance from the sun of 230 million km. Earth has an average distance from the sun of 1.5x1011m. How long does it take Mars to go around the sun (in earth years)  
     
   T=1.9 earth years
2. A satellite orbiting earth at a height of 1000km takes 67.4 days to orbit earth. How far away would a satellite need to be to complete a rotation every 100 days?

R=1300km

1. How long does it take Neptune (4.5x1012m from the sun) to orbit the sun, in earth years? (Earth is 1.5x1011m from the sun)   
     
   T = 164.43 years

T2/R3= T2/R3