SPH4UI - Uniform Circular Motion : Review Problems

1. Calculate the centripetal force needed to rotate a 2.00 kg mass in a radius of 0.500m at a frequency of 3.00 Hz.
2. Find the centripetal force that is generated if a 1.5 kg mass is being spun at a radius of 2.0m and it takes 0.702s for the mass to go around once.
3. A car of a certain amusement park ride has a mass of 1200 kg including its passengers. It completes one revolution in 5.2s and generates a centripetal force of 6307N. At what radius is the car rotating?
4. In the movie The Hulk, the big green man picks up a tank (mass 2880kg) by the barrel, spins it around at 28m/s at a radius of 4.2 m (centre-to-centre) and throws it away like a projectile. How much centripetal force would this take?
5. What velocity would a 600g mass be moving at if it was rotated at a radius of 80cm by a centripetal force of 18.75N (assume 2 sig figs in your answer)?

Vertical Circular Motion (i.e. loop-de-loops)

6. One of the strings we were using in our centripetal lab would break if a force of 4.10N is applied to it.
    a. If rotated in a horizontal circle at radius 1.00m, what velocity would our 15.4g stopper have to be spinning at to break the string?
    b. What would the velocity be in the above example to break the string, if the stopper was rotated in a vertical circle instead of horizontal circle?
7. The bat at Canada's wonderland has a top speed of 76.0 km/hr and generates a maximum "g" force of 5.20 g's.
    a. Where would the maximum "g" force be experienced?
    b. What is the radius of the loop-de-loop in the track of the Bat roller-coaster (to achieve 5.20g's at 76.0 km/hr)?

Planetary Mechanics

8. A communications satellite is placed in orbit around the earth at an altitude of 3.587×10^7m. (express all of your answers with 2 significant digits).
    a. What is the radius of the satellite's orbit?
    b. The mass of the earth is 5.97×10^{24}kg, use this information to determine the period of the satellite?
    c. The moon has a radius of orbit around the earth of 3.84×10^8m and a period of 2.36×10^6s to orbit the earth once. Use this information and Kepler's third law to find the period of the communications satellite.

9. Rhea is one of the moons of Saturn. The mass of Saturn is 5.67×10^{26}kg. If Rhea takes 3.89×10^5s to orbit Saturn, what is Rhea's radius of orbit around Saturn?

Friction

10. The friction between the road and bike tires is sufficient to provide a centripetal force of 137N. If a bike and rider have a mass of 95kg and are trying to bike around a circle that has a radius of 25m, what is the maximum speed that the cyclist can travel at?

Answers:

1. F_c=355N 2. F_c=240N 3. r=3.6m 4. $F_c = 5.4 \times 10^5$N 5. V=5.0 m/s

6a. v=16.3m/s b. v=16.0m/s 7.a. at the bottom b. r=10.8m

8.a. $r = 4.2 \times 10^7$m b. $T = 8.6 \times 10^4$s (1 day) c. $T = 8.6 \times 10^4$s (1 day)

9. $r = 5.27 \times 10^8$m 10. v=6.0 m/s