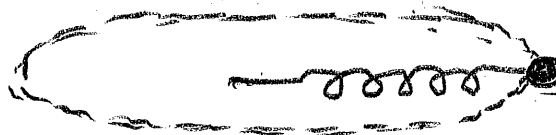


Week 5-Problems

5-1 A particle is moving clockwise on a circle of radius 2m in the xy – plane. It makes 30 revs per minute and its position is $r = 2m \hat{x}$ at $t = 0$. What is (i) its period, (ii) angular velocity, and (iii) its position, velocity and acceleration vectors at $t = 1.5$ seconds (support your answers with appropriate diagrams.)

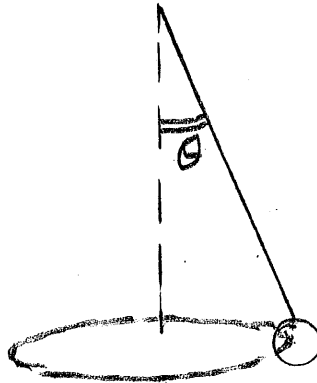
5-2 How do the answers to problem 1 change if the motion is counter-clockwise?

5-3 As shown, you are rotating the 1kg mass in a horizontal circle of radius 0.5m at 15 rpm. Will the spring stretch or squeeze? Why? What will be the change in its length if the spring constant is 10^3 N/m?



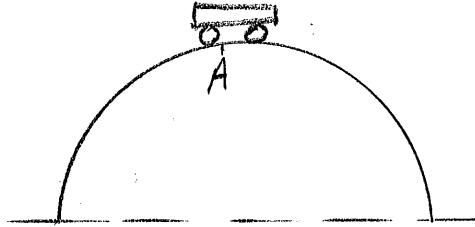
5-4 You are driving on a curve of radius 10m on a level, rough road. If the coefficient of friction is 0.3, what is the maximum velocity at which you can travel without skidding? Why?

5-5 In a conical pendulum, the mass performs uniform circular motion, as shown. If the radius of the circle is 0.25m and it makes 20 revs per minute. What is the angle θ that the string makes with the vertical?

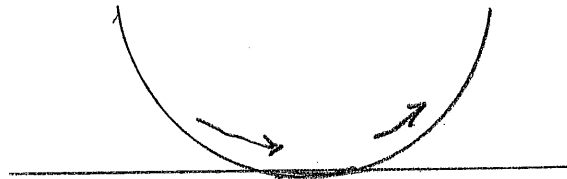


5-6 By what factor would you increase the angular velocity of the Earth so that people located at the equator become "weightless"? Why?

5-7 You are driving over a semi-circular hill of radius 20m.
What is the maximum velocity that you can have
without losing contact at the apex (A)? Why?

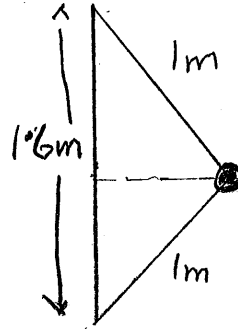


5-8 At the speed derived in Problem 7, what would be the apparent weight of a 100kg passenger when the car is at the bottom of a valley of radius of curvature 20m?



5-9 You want to drive at a speed of 60mph on a frictionless banked curve. If the radius of the curve is 300m, what must be the banking angle?

5-10 A block of mass 0.5kg is attached to a vertical rotating 1.6m spindle by two strings each 1m long. If the periods of rotation is 1.2s, what is the tension in the strings?



5-11 In a centrifuge the viscous force available is 10^{-10} N. If you want a precipitate particle of mass $1 \mu\text{ gm}$ moving at a radius of 0.5m to separate out, what must be the least number of revolutions per sec? In uniform circular motion.

5-12 The centripetal force can be provided by any of the known force (tension, friction, etc). How much work do these forces do on the mass as it goes half way around the circle?