PHYSICS 12 CIRCULAR MOTION WORKSHEET 2

1.   A man swings a 4.0 kg mass in a vertical circle 0.80 m in radius so that it is traveling with a velocity of 5.7 m/s at the lowest point of the circle. Compute the pulling force exerted by the man's hand at this point.

2.   An object is revolving in an orbit in a vertical plane. If the radius of the orbit is 0.20 m, what must be the speed of the object at the top of the orbit for its acceleration there to be equal to **2g**?

3.   The radius of the top of a frictionless roller-coaster track is 15 m and the mass of a cart traveling on it is 150. kg.
        a) Find the critical velocity of the cart at the highest point on the track.
        b) If the actual velocity is <u>one-half</u> the critical velocity, find the normal force exerted by the track against the cart.

4.   a) Neglecting air resistance, how fast must a car travel along a level track in order to *just* become weightless, that is, to go into a circular orbit of radius 6.4×10^6 m around the Earth?
        b) How long would the car take to make a complete trip around the Earth at this speed?

5.   A cord is tied to a pail of water and the pail is swung in a vertical circle of radius 1.2 m. What is the minimum velocity the pail must have at the top of the circle if no water spills out?

6.   A small 3.5 kg mass is tied to the end of a 0.48 m string and made to swing in a conical pendulum at an angle of 26° to the vertical. Calculate:
        a) the radius of the circular path taken;
        b) the period of the pendulum mass;
        c) the tension in the string.

7.   In the previous problem, the string can only handle a maximum tension of 50. N. What minimum period will *just* keep the string from breaking?

8.   A 1.0×10^5 kg train rounds a level curve of radius 200. m at 20.0 m/s.
        a) Determine the centripetal force on the train provided by friction.
        b) What slope would need to be provided on the curved portion of the track so that the weight of the train supplies the centripetal force needed to make the turn successfully, without friction?

9.   A 0.50 kg puck rests on a level air table and is connected by a light thread passing through
        a hole in the table to support a hanging mass of 3.0 kg. A stable orbit is achieved when the puck is sent into a circular path of radius 0.15 m around the hole.
        a) Neglecting friction at the edge of the hole, calculate the period of revolution of the puck in its orbit. (hint: first do a f.b.d. of the hanging mass to find tension **T** in thread)
        b) Suppose that the speed of the puck in its orbit is now doubled, while the radius

remains fixed. What central mass will be needed to achieve a stable orbit?

10.   A 2.5 kg mass is rotated into a conical pendulum where the length of string connected to the mass is 0.68 m and the angle between the string and vertical is 35°. Determine:
a) the tension in the string.   b) the speed of the mass.

11.   The pendulum in the previous question is now spun faster, so that its period is 1.2 s.
Find:
     a) the new tension in the string.
     b) the angle that the string makes with the vertical.

12.   a) An old phonograph turntable revolves at 33.3 rpm. What is the period of revolution of the table in seconds?
     b) A wooden disc rests on the rotating turntable and it is observed that, at small distances from the center, the friction between the disc and the table provides enough centripetal force to keep the disc resting on the table. If the maximum force of friction amounts to 1/4 of the disc's weight,
          i) what is the coefficient of friction between the disc and turntable?
          ii) what is the maximum distance from the center at which the disc can be placed without slipping?

*13.   A mass of 0.10 kg swings in a vertical circle at the end of a 1.0 m cord. If its speed is 2.0 m/s when the cord makes an angle of 30° with the vertical, calculate:
a) the radial (centripetal) and tangential components of its acceleration.
b) the magnitude of the resultant acceleration.
c) the tension in the string.

* - brain crampers

1. 2.0×10^2 N 2. 2.0 m/s 3. a) 12 m/s b) 1.1×10^3 N 4. a) 7.9×10^3 m/s b) 5.1×10^3 s, or about 85 minutes
5. 3.4 m/s 6. a) 0.21 m b) 1.3 s c) 38 N 7. 1.2 s 8. a) 2.0×10^5 N b) 12° 9. a) 0.32 s b) 12 kg
10. a) 30 N b) 1.6 m/s 11. a) 47 N b) 58° 12. a) 1.8 s b) i) 0.25 ii) 0.20 m 13. a) $a_c = 4.0$ m/s^2, $a_t = 4.9$ m/s^2
b) 6.3 m/s^2 c) 1.2 N