

Centripetal Force

Solve the following problems

1. (Serway, p. 238, #1) A 2.10 m rope attaches a tire to an overhanging tree limb. A girl swinging on the tire has a tangential speed of 2.50 m/s. If the magnitude of the centripetal force is 88.0 N, what is the girl's mass?
2. A bicyclist is riding at a tangential speed of 13.2 m/s around a circular track. The magnitude of the centripetal force is 377 N, and the combined mass of the bicycle and rider is 86.5 kg. What is the track's radius?
3. A dog sits 1.50 m from the center of a merry-go-round and revolves at a tangential speed of 1.80 m/s. If the dog's mass is 18.5 kg, what is the magnitude of the centripetal force on the dog?
4. A 905 kg car travels around a circular track with a circumference of 3.25 km. If the magnitude of the centripetal force is 2140 N, what is the car's tangential speed?
5. Jessica is riding on a merry-go-round on an outer horse that sits at a distance of 8.0 m from the center of the ride. Jessica's sister, Julie, is on an inner horse located 6.0 m from the ride's center. The merry-go-round turns around once every 40.0 sec.
 - a. Explain which girl is moving with the greatest linear speed.
 - b. What is the centripetal acceleration of Julie and her horse?
 - c. If Julie's mass is 50 kg, calculate the centripetal force acting on her during the ride.

12. Explain how the concept of critical velocity could be used in the design of an amusement park ride.
13. Why do many physicists call centrifugal force a “fictitious” force?
14. A 25 kg child moves with a speed of 1.93 m/s when sitting 12.5 m from the center of a merry-go-round. Calculate:
- The centripetal acceleration
 - The centripetal force
15. Determine the maximum speed that can be reached by a 19.61 N steel ball tied to the end of a thin thread. The ball is being whirled in a circle of 2 m radius by an astronaut in space. The thread has a breaking strength of 16 N.
16. The Earth orbits the sun at a distance of 1.5×10^{11} m.
- What is the velocity of the Earth? ($v=d/t!!$)
 - What is the centripetal acceleration of the earth in its orbit?
 - What is the centripetal force and what provides it?

17. A 13500 N car traveling at 50 km/h rounds a curve of radius 200 m. Find:
- The centripetal acceleration of the car
 - The centripetal force
 - The minimum coefficient of friction between the tires and the road so that the car can round the curves safely
 - On a rainy day, the coefficient of friction is 0.05. What is the maximum safe speed of the car under these conditions?
18. A looping rollercoaster ride at an amusement park has a radius of curvature of 7.5 m. At what minimum speed must the coaster be traveling at the top of the curve so the passengers will not fall out?
19. A physics student is twirling a 50 g rubber stopper attached to a 0.95 m length of cord at a uniform speed in a vertical circle. If its speed is 3.5 m/s, what is the tension in the cord at:
- The bottom of the circle
 - The top of the circle
20. A pilot pulls her jet out of a dive by swinging up in an arc of radius 3.8 km at a speed of 450 m/s.
- What is the plane's centripetal acceleration?
 - How many g's does the pilot experience?