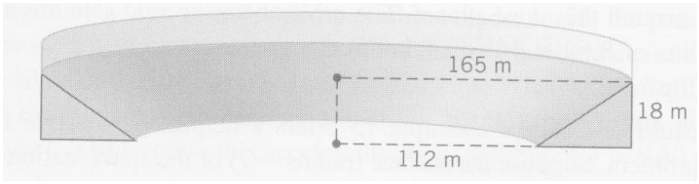
AP Physics 1
3.2 – More on Circular Motion
Assessment

Name: _____ Period: _____

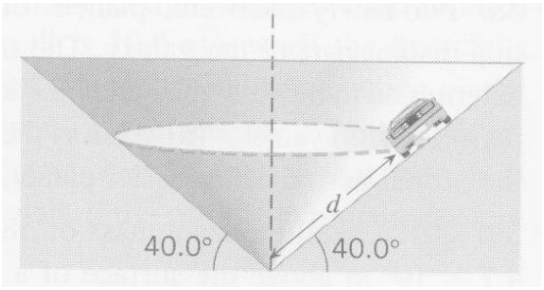
1) A woman is riding a Jet Ski at a speed of 26 m/s and notices a seawall straight ahead. The farthest she can lean the craft in order to make a turn is 22^o. This situation is like that of a car on a curve that is banked at an angle of 22^o. If she tries to make the turn without slowing down, what is the minimum distance from the seawall that she can be making her turn and still avoid a crash?

2) On a banked race track, the smallest circular path on which cars can move has a radius of 112 m, while the largest has a radius of 165 m, as shown below. The height of the outer wall is 18 m. Find the smallest and largest speed at which cars can move on this track without relying on friction.



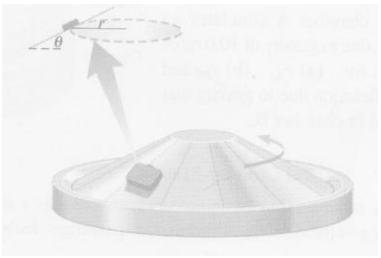
3) Two curves on a highway have the same radii. However, one is unbanked and the other is banked at an angle θ. A car can safely travel along the unbanked curve at a maximum speed of v_o under conditions when the coefficient of static friction is $\mu_s = 0.81$. The banked curve is frictionless, and the car can negotiate it at the same maximum speed v_o. Find the angle θ of the banked curve.

4) A stunt race track has the shape of an inverted cone, as shown. On this surface the cars can race in circles that are parallel to the ground. For a speed of 34.0 m/s, at what value of the distance d should a driver locate his car if he wishes to stay on a circular path without depending on friction?



5) A roller coaster at an amusement park has a dip that bottoms out in a vertical circle of radius r. A passenger feels the seat of the car pushing upward on her with a force equal to twice her weight as she goes through the dip. If the radius r = 20 m, how fast is the roller coaster travelling at the bottom of the dip?

6) A baggage carousel at an airport is shown below. Your suitcase has not slid all the way down the slope and is going around at a constant speed on a circle (r = 11.0 m) as the carousel turns. The coefficient of static friction between the suitcase and the carousel is 0.760, and the angle θ is 36.0°. How long does it take for your suitcase to go around once?



7) A special electronic sensor is embedded in the seat of a car that takes riders around a circular loop-the-loop (vertical) ride at an amusement park. The sensor measures the magnitude of the normal force that the seat exerts on the rider. The radius of the loop-the-loop is 21 m. Sitting on the seat before the ride starts, a rider is level and stationary, and the electronic sensor reads 770 N. At the top of the loop, the rider is upside-down and moving, and the sensor reads 350 N. What is the speed of the rider at the top of the loop?

8) Pilots of high-performance fighter planes can be subjected to large centripetal accelerations during high-speed turns. Because of these accelerations, the pilots are subjected to forces that can be much greater than their body weight, leading to an accumulation of blood in the abdomen and legs. As a result, the brain becomes starved for blood, and the pilot can lose consciousness ("black out"). The pilots wear anti-G suits to help keep blood from draining out of the brain. To appreciate the forces that a fighter pilot must endure, consider the magnitude F_N of the normal force that the pilot's seat exerts on him at the bottom of a dive. The magnitude of the pilot's weight is W. The plane is traveling at 230 m/s on a vertical circle of radius 690 m. Determine the ratio F_N/W. For comparison, note that blackout can occur for values of F_N/W as small as 2 for pilots not wearing an anti-G suit.

9) A 0.20 kg ball on a stick is whirled on a vertical circle at a constant speed. When the ball is at the three o'clock position, the tension in the stick is 16 N. Find the tensions in the stick when the ball is at the twelve o'clock and at the six o'clock positions.

10) In an automatic clothes dryer, a hollow cylinder moves the clothes on a vertical circle of radius r = 0.32 m. It is designed so that the clothes tumble as they dry. This means that when a piece of clothing reaches an angle of θ above the horizontal, it loses contact with the wall of the cylinder and falls. How many revolutions per second should the cylinder make in order that the clothes lose contact with the wall when θ = 70.0°?