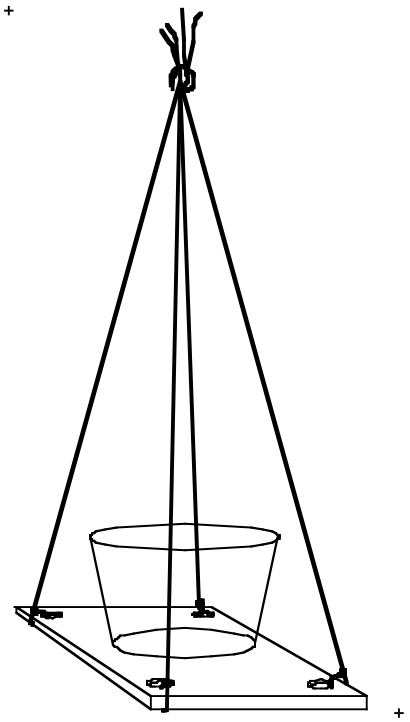
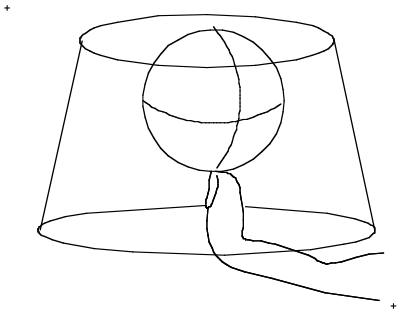
The Swinging Water Cup Demonstration

A simple demonstration that helps students to understand centripetal acceleration in a vertical circle uses a swinging platform with a cup of water on the platform. The platform, empty cup and supporting strings are illustrated on the left below. The platform can be made of heavy cardboard or thin wood. Holes are made in the corners of the platform and the strings; each about 30" long, are passed through these holes and tied securely.

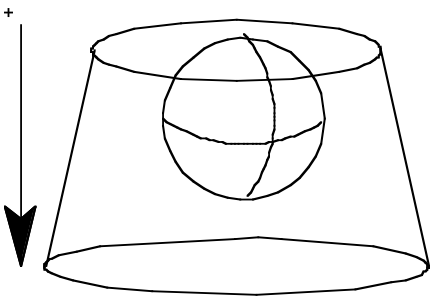


With the cup about half full of water swing the platform while holding the strings at the knot at the top. Large and complicated swings can be accomplished without spilling the water. In fact, with care and sufficient speed, the cup can be swung overhead without spilling the water. A way of explaining why the water does not fall out of the cup when upside down and swung overhead might go as follows:

1. Hold the empty cup upside down with a small ball in it that you hold up with your finger.



2. Ask the class what will happen if you remove your finger? (Obvious!) Do it and the ball falls.
3. Now ask the class how could you keep the ball in the cup without holding it up with your finger? Hopefully they will suggest moving it downward. Insist that they be specific about <u>how</u> you should move it downward? Again, hopefully they will conclude that you must move the cup downward with acceleration equal to or greater than the acceleration of gravity.
4. Finally, when discussing why the water does not fall out of the cup when it is swung overhead, students should realize that at the top of the swing, the centripetal acceleration must be downward and equal to or greater than the acceleration of gravity.



Downward acceleration of cup must be equal to or greater than the acceleration of gravity.

The illustration of the cup on the left shows that the cup must be accelerating downward at equal to, or greater than g. On the right shows the swinging platform in a vertical circle with the platform moving at a speed such that the centripetal acceleration is equal to, or greater than g.