

Centripetal Force

In this experiment we treat a mass hanging on a centripetal force rotor apparatus as an unknown quantity, and determine its value by measuring the inward/axial force that acts on it while it is spinning. This is a centripetal force – it causes a centripetal acceleration that keeps the mass moving in a circle in the horizontal plane.

Practice spinning the rotor until you acquire the knack of keeping the speed (and hence the radius of the circle described by the hanging mass) constant for many rotations. Then determine the time required for one rotation at the set radius by counting and timing many rotations. From the period and the radius, compute the centripetal acceleration.

The centripetal force acting on the mass when it is rotating is provided by the stretched spring. The magnitude of this force can be determined by stopping the rotation, pulling the mass out to the radial position it occupied during rotation, and measuring the force required to hold it in equilibrium in that position. This outward pull must equal the centripetal force produced by the stretched spring during rotation. Use this method to determine the centripetal force, which was acting on the mass while it was rotating.

Use the measured centripetal force and the computed centripetal acceleration to determine the mass of the bob. Estimate uncertainties in the measurements contributing to this determination, and compute the uncertainty in the value of the mass. One way to compute this uncertainty is to determine or estimate the maximum and minimum values of each of your measured quantities and use these to determine the upper and lower limits to your mass measurement.

Finally, use one of the balances provided to measure the mass directly. Compare with your computed value.