A torsional pendulum consists of a long, stiff shaft fixed that is fixed at one end on attached to a large disk on the other. When said disk is rotated by a small angle and then released, the shaft will begin to rotate in a periodic fashion, the amplitude and frequency of which are highly reliant upon the moment of inertia and weight of the disk, as described in Equations (1-2), where *D*, *t*, *G*, *l*, and *ρ* are the respective diameter, thickness, shaft shear modulus, length, and density of the disc.

(1,2)

Based on these parameters, the equation of motion associated with the rotation of the shaft can be described by Equation (3), where *kr* is the rotational spring constant of the shaft, as described in Equation (4).

(3,4)

Based on these equations, the natural frequency and normal frequency can be described by Equations (5-6). Each of these correspond to the undamped frequency of oscillation of the shaft, so if one wants to find the damped frequency of oscillation, Equation (7) can be used, where the damping ratio, *ς*, is defined by Equation (8), where the logarithmic decrement, *δ*, is defined by Equation (9). The u values listed in Equation (9) correspond to amplitudes of oscillation at two separate points (i and i+j). Experimentally, these points can be considered at amplitudes of 90⁰ and 45⁰ respectively.

(5-9)

With all of these values in mind, the behavior of the shaft, disk system when disturbed from equilibrium can be properly predicted and assessed.