Maxwell’s wheel essay

Experiment 9: Maxwell’s Wheel Introduction: The second lab performed on 2/1/12 involved two investigations concerning Maxwell’s wheel. Maxwell’s wheel is an apparatus that consists of a large disk with a long axle. The disk then bound to a support hanging from above with strings attached to each end of the axle. Maxwell’s wheel is considered to be an important apparatus to investigate physical phenomenon’s because it its ability to combine straight line motion and rotation of a rigid body.

The two investigations performed during the lab included investigation 1; an investigation into the moment of inertia of Maxwell’s wheel and investigation 2; an investigation into the dynamics of Maxwell’s wheel. Data & Analysis Investigation 1 In order to calculate the moment of inertia of Maxwell’s wheel the moments of inertia of the disk and the axle had to be added to each other. In order to perform this task various quantities and qualitative data were calculated and collected. The mass of Maxwell’s wheel was recorded to be 0. 738 kilograms.

In order obtain the volume of Maxwell’s wheel the volume of the disk and the axel had to be calculated separately and then added together. The volume of the rod was calculated as equal to 2 * 3. 14 * r^2 * d, where r is the radius of the rod was measured to be . 065 cm. The final calculation for volume of the rod was: = 3. 14 * (0. 0065^2) * 0. 192 = 2. 54717E-05 cm^3 The volume of the disk was calculated as equal to 3. 14 * r^2 * d, where r is the radius of the disk was measured to be . 065 cm. The final calculation for volume of the disk was: = 3. 14 * (0. 11^2) * 0. 006 = 0. 000227964 cm^3

The sum of the two volumes gave total volume for the apparatus the calculation for which is give below: . 000227964 cm^3 + 2. 54717E-05 cm^3 = 0. 000253436 cm^3 Using this calculated volume of the wheel and weighed mass of the wheel, density was calculated: Ro = 0. 738 / 0. 000253436 = 2911. 981454 kg/m^2, which came close to a given density of 2700 kg/m^2. Once density had been calculated it was possible to calculate mass of the disk: M(disk) = density (2700 kg/m^2) * volume of disk (0. 000253426 m^2) = 0. 615503 kg The next step in investigation 1 was to calculate the moment of inertia.

The moment of inertia was calculated by utilizing equation 9. 8, Inertia = ? M(disk) * R^2 = 0. 5 * 0. 615503 * 0. 11^2 = 0. 003723792 Investigation 2 As part of investigation 2 the downward motion of Maxwell’s was analyzed. To do this axels wheel was wound N times and then released while the group was recording the time it took for the wheel to unwind itself. The data collected during these time trials is given below: | T^2 | Time (seconds) | Rotations | Y (Meters) | | 8. 41 | 2. 9 | 8 | 0. 2656 | | 7. 29 | 2. 7 | 6 | 0. 24492 | | 6. 25 | 2. 5 | 4 | 0. 16328 | The first step in investigation 2 was to calculate the downward acceleration of Maxwell’s wheel, and this task was completed utilizing equation 9. 6, A = g / 1 + (I / Mr^2) = 9. 8/(1+0. 003723792 /(0. 738*0. 0065^2)) = 0. 0813 m/s^2 The calculation above is the theoretical downward acceleration calculated using quantitative data the group collected.

The next part of investigation 2 was to calculate the actual downward acceleration experienced by the wheel using data collected during the time trials. In order to do this it was necessary to calculate the distance traveled by the wheel, signified by Y in the table above. To calculate Y in the table above, equation 9. 10 was utilized: Y (m) = 2 * 3. 14 * r (radius) * N (number of rotations) Once Y, the distance traveled by the wheel in meters, had been calculated, the first column of the table above was calculated by squaring the time it took for the wheel to unwind itself.

This was an important step because in order to graphically calculate downward acceleration it was necessary to have t^2 to compare to the distance traveled in meters The graph below illustrates the quantitative results of Y (meters) vs T^2, with a calculated acceleration of 0. 0756 m/s^2 [pic] Conclusion In investigation 1 data was collected to determine the moment of inertia allowing for the calculation of theoretical downward acceleration for the wheel apparatus set up by the group. In investigation 2, through the process of conducting time trials an actual value for the downward acceleration of the wheel apparatus was calculated.

The respective calculations downward acceleration in investigation 1 and investigation 2 were 0. 0813 m/s^2 and 0. 0756 m/s^2. These two calculation were close enough together for the group to determine that the expected downward acceleration calculated from data collected in investigation 1 was observed through trials in investigation 2. The difference between the two calculated values for downward acceleration was determined to be the error between a real life experiments and theoretically calculated results. Two major factors can also be attributed to the error in the investigation.

The first factor is existence of two holes in disk. These holes were calculated in the volume of the disk as if they did not exist resulting a volume that was higher and in actuality. This factor also affected the calculation of density and mass of the disk. The second factor accounting for error was the existence of friction. While the wheel apparatus constructed by the group minimized friction it did not completely eliminate the force of friction and this was not factored into the initial calculation of downward acceleration.