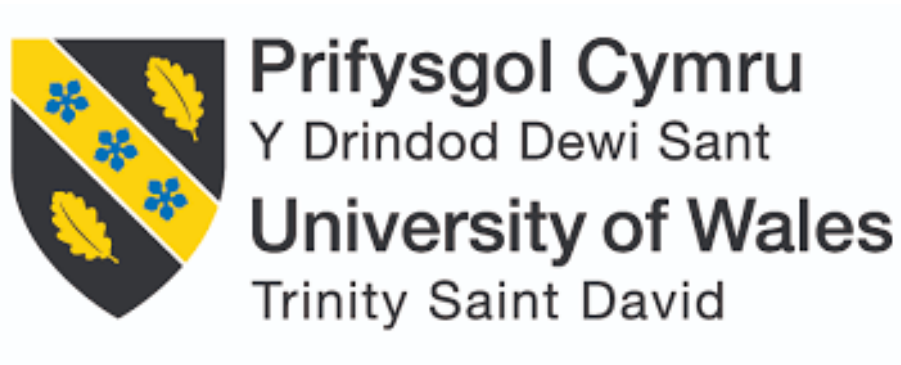


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## Energy Within a Flywheel

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## Introduction

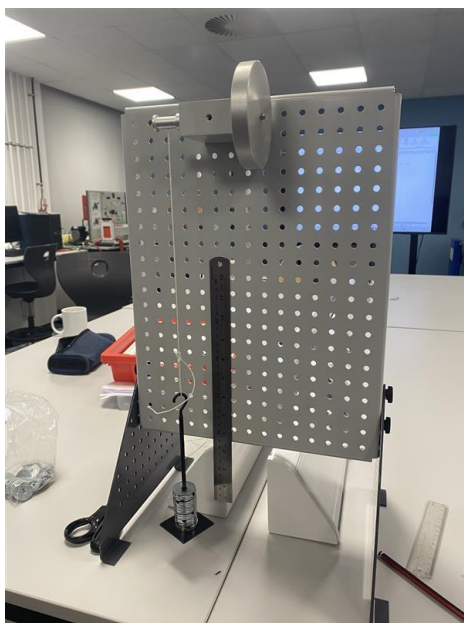
This is a report on an experiment made to prove the theory of energy within a flywheel. The experiment investigates the correlation of mass, with potential energy, speed and time. The general theory going into the procedure was that the object would fall vertically and accelerate more quickly in less time, the greater the mass became.

## Experimental Procedure

In setting up the experiment the Flywheel and Weight Hanger were fitted, and using a magnetic ruler it was made so the bottom of the Weight Hanger (object) would fall vertically a distance just under 290mm.

The object was raised to be level with the 0mm mark on the ruler, with the starting mass of 0.1kg. A stopwatch was used to measure how many seconds it took for the object to fall from its starting position (0mm) to 280mm and back to 0mm. This was repeated 3 times and the average time and distance travelled was calculated and used.

This exercise was reiterated with a 0.1kg increase in weight until the object reached its final mass of 0.5kg. Calculations for falling time, acceleration and velocity were made including PE and PE loss.



## Results

Raw data collected in the lab.

| Mass                 | Initial PE | Tt   | h2    | mg    | PE loss adjustec | Tf      | Acceleration     | v       | $\omega$ | Torque  | $\alpha$           | KE      |
|----------------------|------------|------|-------|-------|------------------|---------|------------------|---------|----------|---------|--------------------|---------|
| Kg                   | J          | s    | m     | N     | J                | s       | m/s <sup>2</sup> | m/s     | rad/s    | Nm      | rad/s <sup>2</sup> | J       |
| 0                    | 0          | 0    | 0     | 0     | 0                | 0       | 0                | 0       | 0        | 0       | 0                  | 0       |
| 0.1                  | 0.275      | 4.16 | 0.237 | 0.981 | 0.022845725      | 2.253   | 0.1103231        | 0.24856 | 38.2778  | 0.0063  | 16.9728            | 0.29785 |
| 0.2                  | 0.549      | 2.9  | 0.251 | 1.962 | 0.030002712      | 1.52919 | 0.2394777        | 0.36621 | 56.3957  | 0.01244 | 36.8427            | 0.579   |
| 0.3                  | 0.824      | 2.46 | 0.253 | 2.943 | 0.041743114      | 1.29231 | 0.3353175        | 0.43333 | 66.7332  | 0.01848 | 51.5873            | 0.86574 |
| 0.4                  | 1.099      | 2.17 | 0.25  | 3.924 | 0.062191698      | 1.14642 | 0.4260928        | 0.48848 | 75.2256  | 0.0244  | 65.5527            | 1.16119 |
| 0.5                  | 1.373      | 1.99 | 0.24  | 4.905 | 0.105646154      | 1.07154 | 0.4877222        | 0.52261 | 80.4822  | 0.0303  | 75.0342            | 1.47865 |
| h1 (m)               | 0.28       |      |       |       |                  |         |                  |         |          |         |                    |         |
| g(m/s <sup>2</sup> ) | 9.81       |      |       |       |                  |         |                  |         |          |         |                    |         |
| c(m)                 | 0.0408     |      |       |       |                  |         |                  |         |          |         |                    |         |
| r(m)                 | 0.0065     |      |       |       |                  |         |                  |         |          |         |                    |         |
| I(kgm <sup>2</sup> ) | 0.0005     |      |       |       |                  |         |                  |         |          |         |                    |         |

Figure 1: Data table displaying the calculations made after and during the experiment.

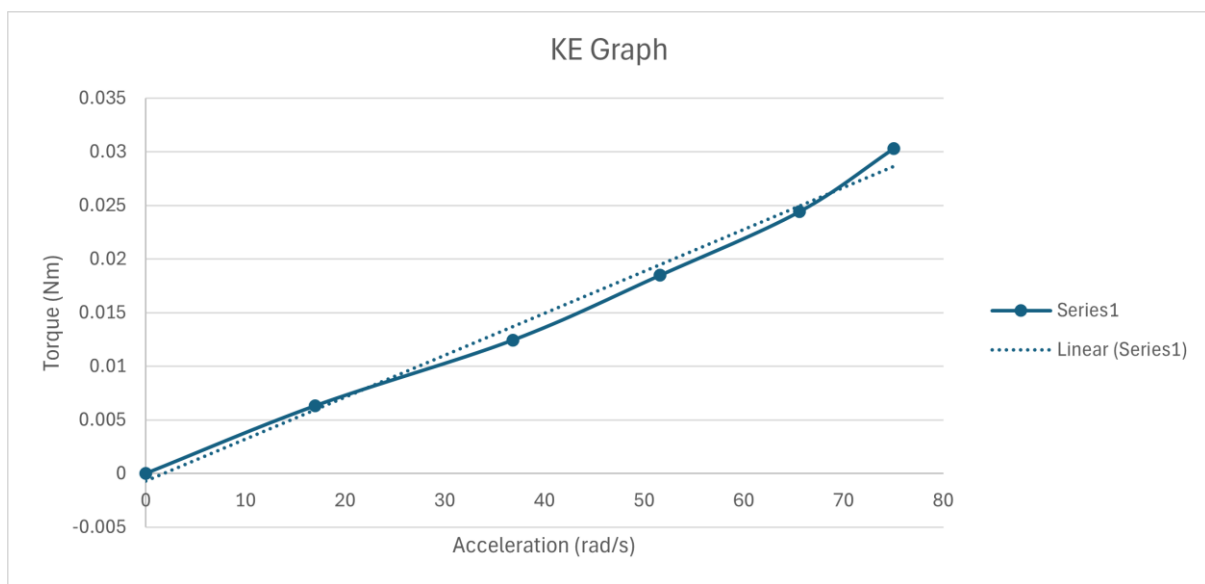


Figure 2: A graph showing the change in Kinetic Energy throughout the experiment.

## Analysis

Figure 1 presents all of the experiments data; the graph shows the acceleration in relation to the amount of torque being produced. There is a steady deceleration for most of the experiment, but once we reach 0.025Nm there is a notably sharp change in deceleration.

## Conclusion

It is concluded that the general theories of how energy acts within a flywheel are correct. The greater mass becomes the speed, acceleration and the time taken of the object to travel

vertically increased along with it. As expected, the amount of energy transferred through each iteration of the experiment increases uniformly when the mass and speed of the object grows.

## Evaluation

Overall, the experiment went smoothly with little resistance. The group achieved our desired results effectively and when there was a potential mistake, there was no hesitation in bringing it up. The mass of the object was increased by adding small individual weights of 0.01kg and this required someone to be a “counter” and ensure the weight was correct. The mass of the object was questioned twice, and the group took steps to ensure that the mass was correct. The team took turns in the different roles required for each running of the experiment, the roles of timing, measuring the distance, and adding the weight were rotated to each member of the group. Everybody each had their own calculations, and we all came together to examine each other’s work to assess our results and conclude the experiment.

## Further Work

To improve the experiment regarding efficiency and accuracy, it would be optimal to employ the use of laser technology and sensors to more accurately determine the distance that the object has travelled, and the time taken. Another potential addition would be to install an automated system to raise the object to the correct height after every running of the experiment. This would ensure that the object is always at the correct height without the margins of human error.