

Acceleration and Force in Uniform Circular Motion

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10-17-2017

Abstract

In this experiment we compared the force of magnitude that was exerted by the spring when we hung weights and the weight hanger to the magnitude of the force exerted by the rotating object with "mass M with a constant velocity and radius r ". This is the force in Uniform circular motion. We took 5 sets of data in which we approximated the frequency of the rotating object and used it to verify that the magnitude of that force was given by the force given equation mv^2/r . I gave my force of magnitude that was exerted by the spring when we hung weights and the weight hanger the name F_1 . I gave my predictive value the name F_2 , which was the comparative value. Our results came into agreement since our discrepancy was lower than the uncertainty. Given that, we can safely verify that magnitude of force F_2 is really given by the equation. As our results showed, we came into agreement with our theory and where well under our total uncertainty which was 0.2.

Theory

When an object is moving in a circle with a constant speed but has acceleration means that velocity is changing. Also, it means that the object is moving in Uniform circular motion. Given that, we know that according to Newtons second law, $F = ma$ we can calculate the magnitude of F if we acknowledge that acceleration can be written as v^2/r since the acceleration is centripetal. Since we are dealing a rotating apparatus, we know that we can express the F in terms of frequency of rotation $v = \omega r = 2\pi fr$. Using this we can calculate the magnitude of the force of the object moving in Uniform circular motion.

$$\vec{a} = v^2/r$$

$$\vec{F} = m\vec{a}$$

$$v = \omega r = 2\pi fr$$

$$\vec{F} = mr(2\pi fr)^2$$

$$\vec{a} = \omega^2 r = (2\pi f)^2 r$$

- Equations are from Lab Note Book

Procedure

- Lab Equipment – *Lab Notebook*
 - Centripetal force apparatus
 - Weight hanger and weights
 - Vernier caliper

1ST

We determined the amount of weight that was required to stretch the spring using a weigh hanger and measured weights. We hanged the weight hanger and continually added weight as we observed that the pointer in the Centripetal force apparatus was aligned with index inside of the apparatus; this mass (**m**) was the amount required to stretch it. Inside the apparatus we had a mass **M** (which was given) that provided us the string to hang our weights.

2ND

Using the Vernier caliper, that was provided, we measured the distance from the line marked in the middle of mass **M** to the line under the index in the center of the apparatus. This provided us the radius of rotation **r** measured in mm.

3rd

We took the rotation assembly and installed it to the Centripetal force apparatus safely. As we assembled everything together, we made sure that our digital display on the apparatus was in RPM.

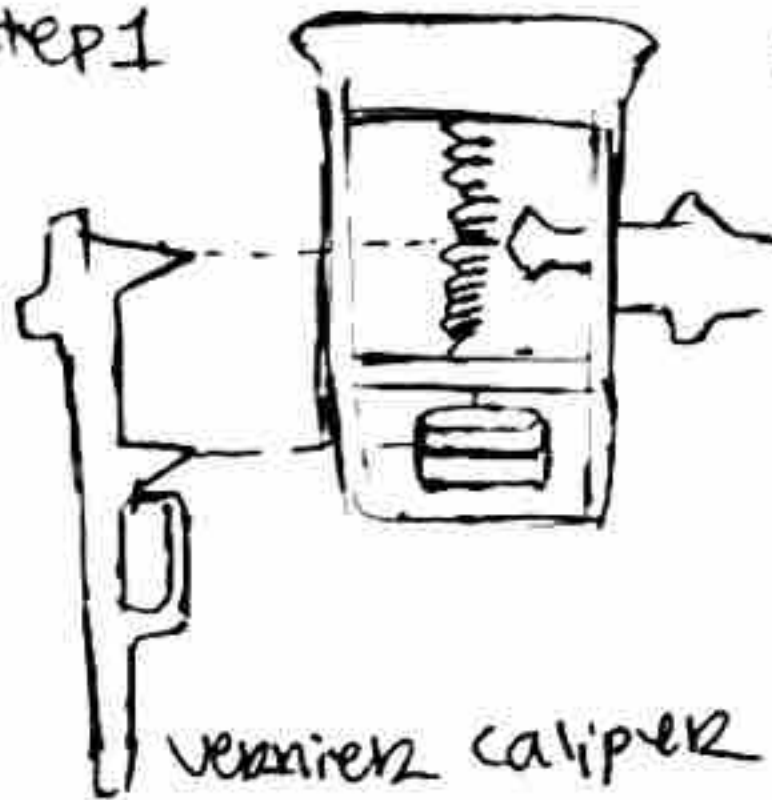
4th

Lastly, we made sure that the apparatus was stable and safe to perform our experiment and began. We powered on the apparatus and gradually increased the speed until we saw indicator point to the upper and lower most position under the index. This gave us the **Highf and Lowf** we needed for the **Avef**. We performed this five times with a different person observing the upper and lower points each time.

Procedure
Rotational assembly



Step 1



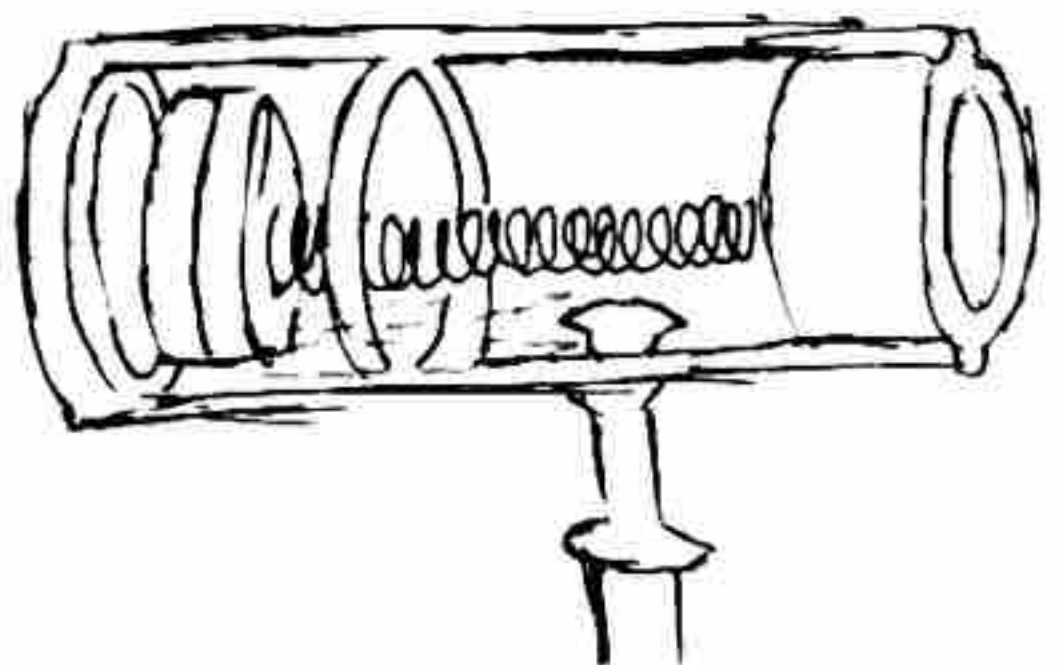
Step 2.

vernier caliper

Step 3



Step 4.



Results come into Agreement since my Discrepancy < Uncertainty. Our discrepancy which I calculated as by subtracting my final F2 (Average of F2) to the F1 (0.003419). Our uncertainty was calculated as Average of DELTA F (0.21122).

Question 1:

The magnitude of acceleration experienced by the hanging mass in part two of the procedure was G (9.8 m/s^2).

The magnitude of acceleration experienced by the rotating mass in part 5 of the procedure is 159.85 m/s^2 . I calculated this by using the equation

$\vec{a} = \omega^2 r = (2\pi f)^2 r$ I used the Best Est of f as my f .

$$(2\pi * 8.4866)^2 * 0.0564$$

Question 2:

The reason why they have the same magnitude of force and have different acceleration is because one is in rotational motion and the other is in linear motion. Given that, the forces are pointing in different directions.

Conclusion

In conclusion, we compared the force of magnitude that was exerted by the spring when we hung weights and the weight hanger which I named F1 ($F1 = (M+m) \times g$), to F2. F2 was the calculated force that was given by ($F2 = (4\pi^2 M r f_{ave}^2)$) of the rotating object with mass M with a constant velocity and radius r . F2 was my predicted value for the given equation.