INTERNATIONAL BACCALAURATE
EXTENDED ESSAY
(PHYSICS HIGHER LEVEL)

Investigating the amount of skidding of a car when turning around a corner

RESEARCH QUESTION: How does changing the radius of a toy car on a rotating platform affect the distance skidded by the car?

WORD COUNT: 3995

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INTRODUCTION

Driving a car is one of the biggest dreams of mine since I was a child. I always wondered how it feels to control a machine that changes people's lives since it is invented. However the structure of cars are way too complicated then people think. I grew up watching my father drive and that impressed me a lot. When I asked my father to drive with him he said I was young to drive, so I really can't wait for the day that I will be able to drive a car by myself. One day my father bought me a lego car which from then on my interest increased for legos and cars. I also started to watch car races every weekend with my father. However, I know that it is quite important to be careful when driving. To be a good driver I should know the rules and what to do or not. This can be possible by lots of practice. Until the day I can start practicing I decided to research about some concepts of driving. Turns are one of the most indispensable situations when driving a car. If I can't turn correctly, I can crash or cause accidents in the traffic. I thought about this and decided to go deep into the physics behind turning smoothly and not skidding or turning too early. In order to test these, I wanted to investigate how different distances when entering the turn effect the amount of skidding from the road.

In this experiment I will investigate the effect of different radius lengths of a toy car on a rotating platform to compare the distance skidded when the platform rotates. I will rotate the platform with nearly the same speed as possible as I can, as I didn't use any system to rotate it in a constant speed, then the toy car skidded out from the platform to hit the ground. I measured the distance between the center of the rotating platform and the center of the car and deduced relations between the radius and the distance skidded. I then inferred what is important while turning around a corner in real life.

BACKGROUND INFORMATION

Most of the objects are in motion some of them can be in different forms of motion such as uniform linear motion, projectile motion, circular motion, simple harmonic motion and many more. According to Newton's first law of motion the body that is at rest tends to stay at rest and the body moving tends to stay moving as long as there are no external forces acting the body. This desire of bodies to not change the motion status of themselves is called inertia. In these systems if the net force acting on the system is zero then the bodies are in equilibrium position. Recalling to this law if an object is performing a uniform linear motion it moves with constant velocity which means that there is neither a net force acting on the system and the object neither have an acceleration.

CIRCULAR MOTION

Similar to the uniform linear motion the circular motion is the motion of a body when the body follows a circular path with a constant speed. During this motion the body changes its position regularly.

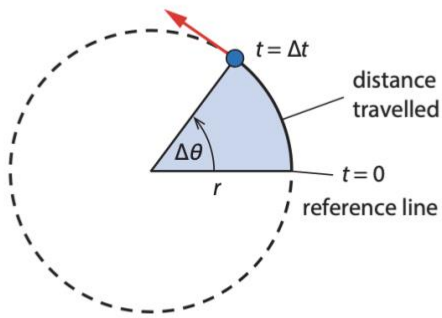


Figure 1: Circular motion of a body and the distance travelled

ANGULAR AND LINEAR SPEED

As the object moves around the circle it changes position of an angle of $\boldsymbol{\Delta\theta}$ in a time Δt. This change of angle with time is defined as the angular speed of the object shown by $\boldsymbol{\omega}$ with a unit $rads^{-1}$.

$$\boldsymbol{angular\ speed = \omega = \frac{\Delta\theta}{\Delta t}}$$

For one complete rotation of the object the change in the angle is 2π and the time taken for the object to complete this one whole revolution is called the period of the object and shown by T. So, we can derive the angular speed also from the following formula.

$$\boldsymbol{\omega = \frac{2\pi}{T}}$$

As seen in the *Figure 3*, the velocity vector of the object is tangent to the circle. In a little certain amount of time Δt the object travels $\boldsymbol{\Delta s = v\Delta t}$ through the circle. The angle change in that same time is $\boldsymbol{\Delta\theta}$. This distance travelled by the object Δs is equal to the arc length of the circle with a radius r where the arc length is calculated with trigonometry and equals to $\boldsymbol{\Delta s = r\Delta\theta}$. So now we have the equity of

$$\boldsymbol{v\Delta t = r\Delta\theta}$$

And we can find the linear speed of the object as

$$\boldsymbol{v = \frac{r\Delta\theta}{t} = r\omega}$$

CENTRIPETAL ACCELERATION

It is important to keep in mind that the linear speed is constant however the velocity keeps changing because the direction changes. As we defined before, this change in velocity results in an acceleration. To find the centripetal acceleration we should first find the difference between two points during the motion. Let this points A and B have velocities v_A and v_B and a difference of $\Delta \boldsymbol{v} = \boldsymbol{v_B} - \boldsymbol{v_A}$. As the velocities of these two points are same from the center of the circle they form a isosceles triangle. Using the previous arc formula we provided, we can find the $\Delta \boldsymbol{v} = \boldsymbol{v} \Delta \boldsymbol{\theta}$. Also, from the formula $\boldsymbol{a} = \frac{\Delta \boldsymbol{v}}{\Delta \boldsymbol{t}}$ we can deduce the centripetal acceleration as

$$\boldsymbol{a} = \frac{\boldsymbol{v} \Delta \boldsymbol{\theta}}{\Delta \boldsymbol{t}}$$

Which gives

$$\boldsymbol{a} = \boldsymbol{v\omega} = \boldsymbol{v} \; \boldsymbol{x} \; \frac{\boldsymbol{v}}{\boldsymbol{r}} = \frac{\boldsymbol{v}^2}{\boldsymbol{r}}$$

This is how the magnitude of the acceleration of the object is calculated and as the Δt in this relation gets really small, the $\boldsymbol{\Delta\theta}$ gets smaller and so does the velocity vector Δv which is in the same direction with the acceleration, it becomes perpendicular to the speed. This states that the acceleration vector is normal to the circle and directed into the center of the circle.

CENTRIPETAL FORCE

If there is an object moving in a circular path there must be a net force acting on the object since the object is accelerating during its motion. As it is found that the acceleration of the object is directed to the center of the circular path the net force on the object should also be directed to the center. This force is called the centripetal force and can be calculated through the relation in the Newton's second law of motion. Newton states that the net force is equal to the mass of the body multiplied by its acceleration which gives us the following equation.

$$F_{net} = m\ x\ a$$

In the case of circular motion the net force is the centripetal force (F_C)

$$F_C = m\ x\ a$$

For acceleration we substitute the relation we found for the centripetal acceleration so the equation is like in below

$$F_C = m\ x\ \frac{v^2}{r}$$

ROTATIONAL DYNAMICS

MOMENT OF INERTIA

Moment of inertia of a body in a rotating axis is defined as the body's tendency to resist the angular acceleration. When a body that is rotating around an axis with the angular velocity ω is considered, if up this body is broken down into small pieces of mass m_i the kinetic energy of the body as a whole would be the sum of all of the kinetic energy of these smaller masses which can be written as

$$KINETIC\ ENERGY = \frac{1}{2}m_1{v_1}^2 + \frac{1}{2}m_2{v_2}^2 + \frac{1}{2}m_3{v_3}^2 + \cdots = \sum \frac{1}{2}m_i{v_i}^2$$

As each divided small pieces are away from the axis in different distances r_i but have the same angular velocity we can deduce that

$$\boldsymbol{KINETIC\ ENERGY} = \frac{1}{2}(\sum \boldsymbol{m_i r_i}^2)\boldsymbol{\omega}^2$$

According to this equation the moment of inertia of the object shown by the letter *I* is

$$\boldsymbol{I} = \sum \boldsymbol{m_i r_i}^2$$

Since it is assumed that the rotating body contains small pieces all of these small pieces have the same distance (*R*) from the axis so

$$\boldsymbol{I} = \sum \boldsymbol{m_i r_i}^2 = \sum \boldsymbol{m_i R}^2 = \boldsymbol{R}^2 \sum \boldsymbol{m_i} = \boldsymbol{MR}^2$$

Where the letter *M* represents the total mass of the body. Every object has a different mass and shape, as a result, it is not always possible to find moment of inertias of all objects however the one that is most used is the moment of inertia of a disc which is $\boldsymbol{I_{Disc}} = \frac{1}{2}\boldsymbol{MR}^2$. We also found that the kinetic energy of a rotating body is

$$\boldsymbol{KINETIC\ ENERGY} = \frac{1}{2}\boldsymbol{I\omega}^2$$

ANGULAR MOMENTUM

Angular momentum is the tendency of the willingness of an object to continue the rotational motion that is has been doing and like we have discussed in the moment of inertia this angular momentum depends on the mass, shape and speed of the objects. Angular momentum shown by the letter L is a vector quantity which can be expressed as the product of the moment of inertia of a body with the angular speed of that body rotating in through an axis.

$$\boldsymbol{L = I\omega}$$

CONSERVATION OF ANGULAR MOMENTUM

In the law of conservation of momentum if the net torque acting on the system is zero then the angular momentum of the system stays constant. As the angular momentum doesn't change if the radius increases the moment of inertia will increase so according to the law of conservation of momentum the angular speed will decrease.

A CAR TURNING AROUND A CORNER

So far, the fundamental of circular motion is discussed and now the application of circular motion into the real life will be analyzed and compared. As mentioned before there is a net force acting on the body when the body is rotating around an axis. In real life when a car comes near a corner it slows down and turns. During this turn there are some forces that act on the car.

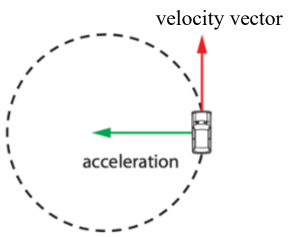


Figure 2: Velocity vector and the acceleration of a car

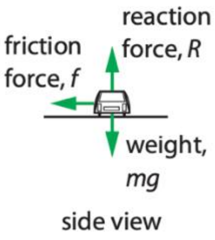


Figure 3: Side view of the car when turning around a corner

As can be seen from the figures above the net force acting on the system is the friction force acting on the car. This friction force acts as the centripetal force on the car and causes it to continue rotating around the axis. The condition to turn a corner safely is the maximum value of friction force should be equal or greater than the instantaneous force of friction. The resulting relation would be like

$$\boldsymbol{f_{f(maximum)} \geq f_f}$$

$$\boldsymbol{\mu mg \geq m\frac{v^2}{r} \Rightarrow \mu gr \geq v^2}$$

$$\boldsymbol{v = \sqrt{\mu gr}}$$

From the equation derived it can be stated that if a car comes with higher velocities around a corner the friction force won't be enough to hold the car in its path and the car will end skidding from the road.

METHODOLOGY

HYPOTHESIS

As I have mentioned in the research question, I will set up an experiment where a toy car will be placed on a rotating platform with different distances from the center and measure and compare their moment of inertias, kinetic energies, and distance of skidding away from the platform. I predict that as the distance from the center increases the moment of inertia will increase and according to the law of conservation of momentum the angular speed decreases therefore the kinetic energy decreases so does the distance skidded.

VARIABLES

INDEPENDENT VARIABLE	DEPENDENT VARIABLE
Radius that the toy car is placed from the center of the rotating platform.	Distance of skidding by the toy car
CONTROLLED VARIABLES	METHOD OF CONTROL
Rotating platform	A same wooden rotating platform will be used in all trials
Angular speed and linear speed	As there are no mechanism to keep the platform rotating with the same speed in this experiment I have spun the rotating platform with the same speed with my hand as possible as I can so that the values would not have a huge difference in the experiment
Car properties	A single metallic toy car with same weight and dimensions will be used in every trial

Table 1: Independent, dependent, and controlled variables of the experiment and method of control of the controlled variables

MATERIALS

- A wooden rotating platform
- A toy car
- Tape measure (±0.01 cm)
- Ruler (±0.01 cm)

- A camera
- A stopwatch (±0.01 s)
- Pencil
- A digital scale to measure the masses of the platform and the toy car (±0.01)

SETTING UP OF THE EXPERIMENT

To make the experiment a mechanism is set up firstly by marking a huge point on the platform.

Image 1: The photo of the rotating platform from the top

Image 2: The photo of the rotating platform from the side view

Here below lies a diagram of the experiment to show how does the mechanism of the toy car and the rotating platform will work in this experiment more clearly.

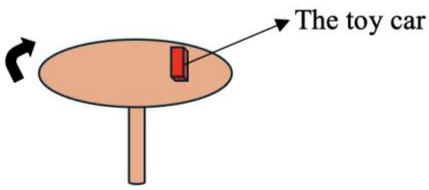


Figure 4: A diagram of the rotating platform and the representation of the toy car

Then all the materials are gathered to start the experiment and the steps are followed that are written in the procedure to start measuring the distances that the toy car has skidded to make the calculations.

Image 3: The photo of all the materials

Image 4: The photo the car and the center of the platform marked by the pencil

Image 5: The photo of the measurement of the distance skidded away from the center

PROCEDURE

1) Mark a point on the rotating platform that is big enough to be seen when it is spinning.
2) Start the stopwatch, while holding it from the handle and spinning, and stop it when the point that is marked completes 10 turns.
3) Then divide the time you recorded to 10 to find the average period of the platform to complete one rotation.
4) Apply the angular speed and linear speed formula to find them for the rotating platform and note them.
5) Measure the masses of the platform and the toy car using the digital scale and note them.
6) If the center is not marked measure the perimeter of the rotating platform with tape measure and mark the points that form the half of the perimeter. Connect them with ruler and draw a linear line. Then measure the length of that line to find the diameter of the platform. Point the half of that line to determine the center of the platform.
7) Place the car 2.5 cm away from the center.
8) Spin the rotating platform as with the same velocity as in the step 2.
9) Measure the distance that the toy car skidded away from the center of the rotating platform by marking the center with a pencil and measuring the distance between the pencil and the car with a tape measure and the time taken for the car to fall in the ground.
10) Do 4 more trials (5 in total) with the same distance.
11) Repeat the experiment 5 more times from step 7 with radii of 5.0, 7.5, 10.0, 12.5, 15.0 cm.

SAFETY, ETHICAL AND ENVIRONMENTAL ISSUES

There aren't any ethical, safety or environmental considerations while making this experiment as it does not include any research or work about humans, and it is not a system that will harm the environment that includes only a rotating platform and a toy car that will fall to the ground with really small speeds which can't hurt anyone or the environment that the experiment is made.

ANALYSIS

In order to make an error propagation values of the distance skidded is calculated throughout and a comparison is made with the real values that are measured.

QUALITATIVE DATA

Toy car placed further away from the center skidded less distance from the center of the rotating platform.

The angular speed decreases as the toy car is placed further from the center of the platform.

The kinetic energy decreases as the toy car is placed further from the center of the platform.

The moment of inertia increases as the toy car is placed further from the center of the platform.

SOME VALUES

Until the distance skidded is measured and given, the values of angular speed and period of the rotating platform, perimeter and diameter of the platform, mass of the platform, mass of the toy car, moment of inertias of the car and the system, rotational kinetic energies and the linear speeds of the toy car while skidding will be measured, found and given in tables to investigate how these values vary with radius and also want to calculate the theoretical values of the distance skidded to compare these theoretical values with the real values that I measured and to do an error propagation.

	Time to complete 10 revolutions (s)± 0.01	Period of one revolution (s)± 0.01	Angular speed of the platform (rads^{-1})± 0.01
Measurement 1	03.37	0.34	18.61
Measurement 2	03.53	0.35	18.02
Measurement 3	03.63	0.36	17.43
Measurement 4	03.21	0.32	19.61
Measurement 5	03.54	0.35	18.04

Table 2: Time for the rotating platform to complete 10 revolutions, period of one revolution and the angular speed of the platform.

Perimeter of the platform (cm)±0.05	Half of the perimeter of the platform(cm)±0.05	Diameter of the platform(cm)±0.05	Radius of the platform(cm)±0.05	Mass of the platform (g)±0.01	Mass of the toy car(g)±0.01
110.02	55.01	35.11	17.55	873.25	57.75

Table 3: Perimeter of the platform, half of the perimeter of the platform, diameter of the platform, radius of the platform, mass of the platform and mass of the toy car

To find the total angular momentum that will be conserved during the experiment, firstly the moment of inertia of the rotating platform and the absolute uncertainty is calculated.

$$\frac{0.01}{0.87}x100+\frac{0.05}{0.18}x100x2\approx\%56.7$$

$$\frac{56.7x0.014}{100}\approx 0.008$$

$$I_p=\frac{1}{2}(0.87)(0.18)^2=0.014\pm 0.008\ kgm^2$$

Then this value is multiplied with the average angular speed of the platform to find the total angular momentum and the absolute uncertainty is calculated

$$\frac{0.01}{18.34}x100+\frac{0.008}{0.014}x100\approx\%57.2$$

$$\frac{57.2x0.26}{100}\approx 0.15$$

$$L=(0.014)(18.34)=0.26\pm 0.15\ kgm^2s^{-1}$$

After that, the moment of inertias, the total moment of inertia of the system (rotating platform and toy car) and the angular speeds of the system will be calculated with the formulas that are provided and explained in the background information section, the values are found by dividing the total angular momentum to the total moment of inertia of the system as it is conserved, which the toy car is in different radii from the center.

	2.50 ± 0.05 cm radius from the center	5.00 ± 0.05 cm radius from the center	7.50 ± 0.05 cm radius from the center	10.00 ± 0.05 cm radius from the center	12.50 ± 0.05 cm radius from the center	15.00 ± 0.05 cm radius from the center
Moment of inertia of the toy car	$1.81 x 10^{-5}$	$7.25 x 10^{-5}$	$16.31 x 10^{-5}$	$29.00 x 10^{-5}$	$45.31 x 10^{-5}$	$65.25 x 10^{-5}$
Total moment of inertia of the system	0.01402	0.01410	0.01416	0.01429	0.01445	0.01465
Angular speed of the car	18.54	18.44	18.36	18.19	17.99	17.75

Table 4: Moment of inertia of the toy car, total moment of inertia of the system and the angular speed of the car varying with different radii

After these values are calculated, the rotational kinetic energy of the toy car in these specific times are calculated as well and the equation is applied to find the linear speeds of the car skidding away from these distances.

$$\frac{1}{2}I\omega^2 = \frac{1}{2}mv^2$$

	2.50 ± 0.05 cm radius from the center	5.00 ± 0.05 cm radius from the center	7.50 ± 0.05 cm radius from the center	10.00 ± 0.05 cm radius from the center	12.50 ± 0.05 cm radius from the center	15.00 ± 0.05 cm radius from the center
Rotational kinetic energy of the toy car (J)	0.0031	0.0123	0.0275	0.0480	0.0733	0.1028
Linear speed while skidding (ms^{-1})	0.328	0.652	0.974	1.286	1.590	1.883

Table 5: Rotational kinetic energy of the toy car and the linear speed of the toy car while skidding varying with different radii

RAW DATA

Here below the table shows the distance skidded away with different radii of 2.50, 5.00, 7.50, 10.00, 12.50 and 15.00 cm after the platform is rotated and the car is placed on it.

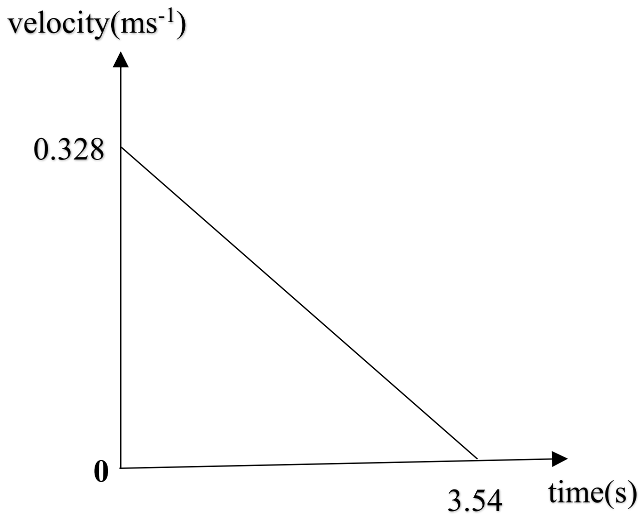
Distance skidded away from the center ± 0.05	2.50 ± 0.05 cm radius from the center	5.00 ± 0.05 cm radius from the center	7.50 ± 0.05 cm radius from the center	10.00 ± 0.05 cm radius from the center	12.50 ± 0.05 cm radius from the center	15.00 ± 0.05 cm radius from the center
Trial 1	64.51	58.34	51.78	49.27	43.76	40.74
Trial 2	59.84	57.62	50.94	45.62	45.47	39.31
Trial 3	47.47	53.41	48.65	46.05	44.90	40.45
Trial 4	68.72	55.30	49.42	46.45	45.13	39.98
Trial 5	47.69	55.27	51.68	45.89	44.34	40.55

Table 6: Distance skidded away from the center varying with different radii

PROCESSED DATA

After the kinetic energies are found for the specific radii, the linear speed of the toy car is calculated in these values of radius to calculate the distance skidded and find the predicted values of these distances to compare these theoretical values with the actual values measured and do an error propagation.

First of all, to calculate the expected distance skidded a velocity-time graph is drawn. In this graph, the slope of this graph will give the value of the acceleration. For the first radius of 2.5 cm the linear speed of the toy car while skidding is 0.328 ms^{-1} and the time taken for the toy car to fall is 3.54 seconds.



Graph 1: Velocity-time graph of the toy car when released from the radius 2.5 cm

The slope therefore the acceleration of the toy car is calculated as

$$\frac{0.328 - 0}{0 - 3.54} \approx -0.09\ ms^{-2}$$

This value is found negative as the toy car is slowing down in the opposite direction of the motion. The value of acceleration will be used to calculate the distance skidded until the toy car stops by the usage of the following formula.

$$v_f{}^2 = v_i{}^2 + 2a\Delta x$$

Where the v_f represents the final speed of the toy car which will be zero and v_i stands for the initial speed of the toy car. Acceleration is shown by the letter a and the distance skidded is represented by Δx. So, the application of the formula will be like in the following and the distance skidded by the toy car is found.

$$0^2 = 0.328^2 - 2(0.09)x$$

$$2(0.09)x = 0.328^2$$

$$\Delta x \approx 58.06\ cm$$

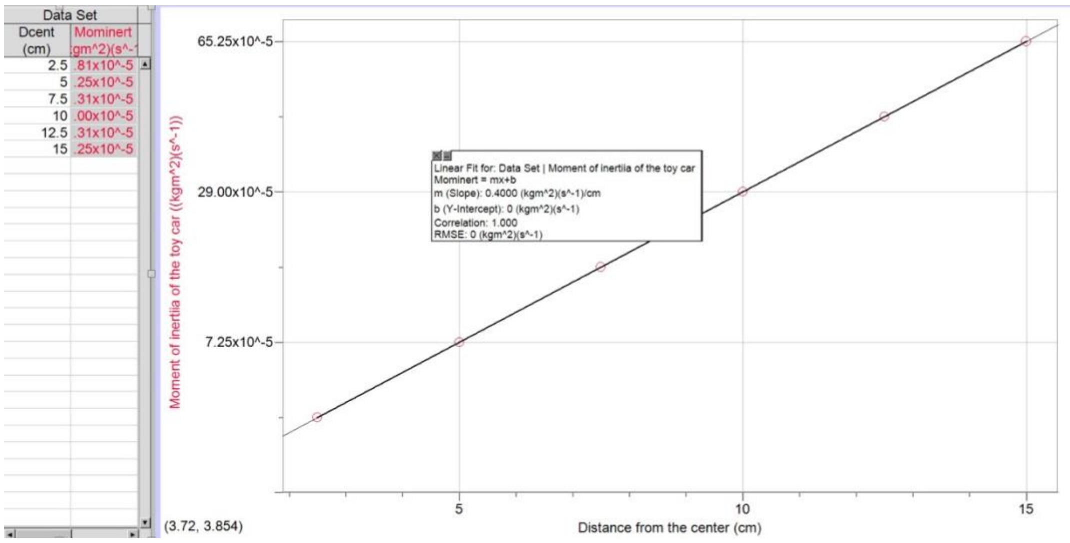
These calculations are done for all of the particular values of radius and the distance skidded is calculated and shown in the following table.

	2.50 ± 0.05 cm radius from the center	5.00 ± 0.05 cm radius from the center	7.50 ± 0.05 cm radius from the center	10.00 ± 0.05 cm radius from the center	12.50 ± 0.05 cm radius from the center	15.00 ± 0.05 cm radius from the center
Distance skidded away from the center ± 0.05	58.06	52.71	46.39	42.68	40.25	37.34

Table 7: Theoretical values of the distance skidded away from the center varying with different radii.

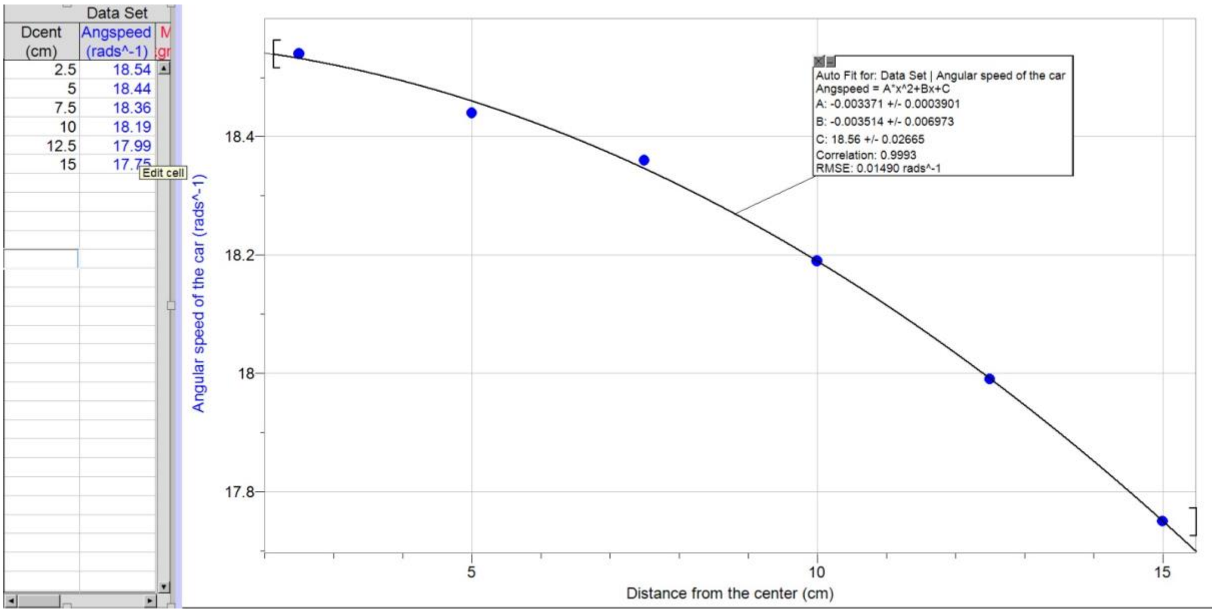
GRAPHS

I have deduced how does the moment of inertias, angular speeds, rotational kinetic energies and the linear speeds while skidding changes with different radii. After these graphs, the main graph (***Graph*** 5) that shows the distance skidded measured against the change of radius of the toy car will be graphed by using the application LoggerPro.



Graph 2: Distance from the center(radius) against moment of inertia of the toy car graph

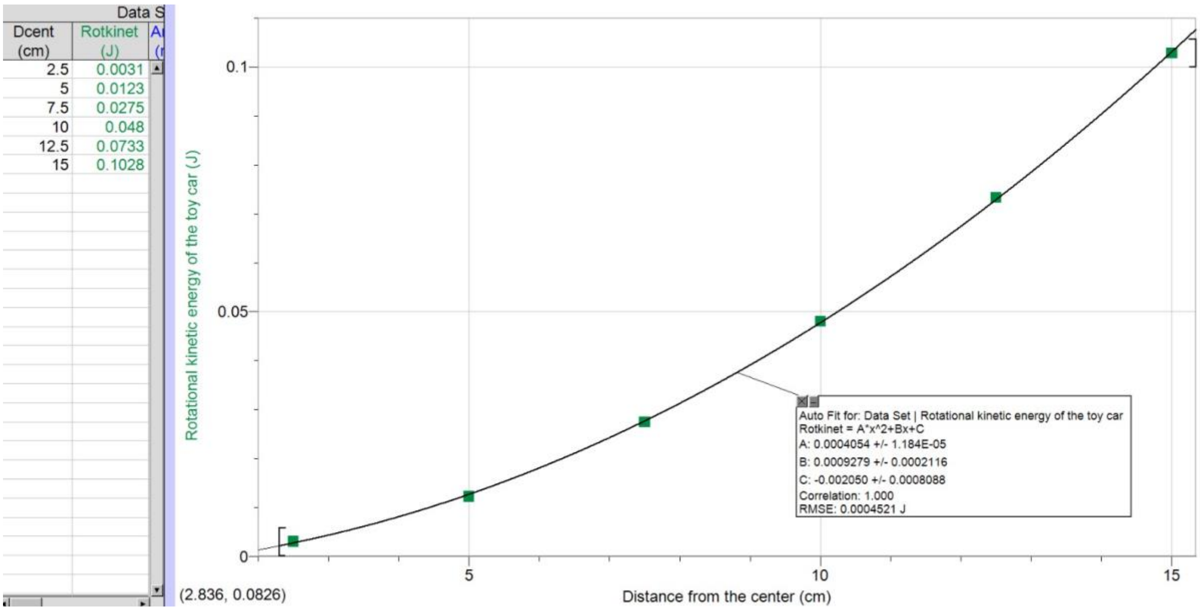
The graph below shows how does the angular speed changes with the distance of the toy car from the center.



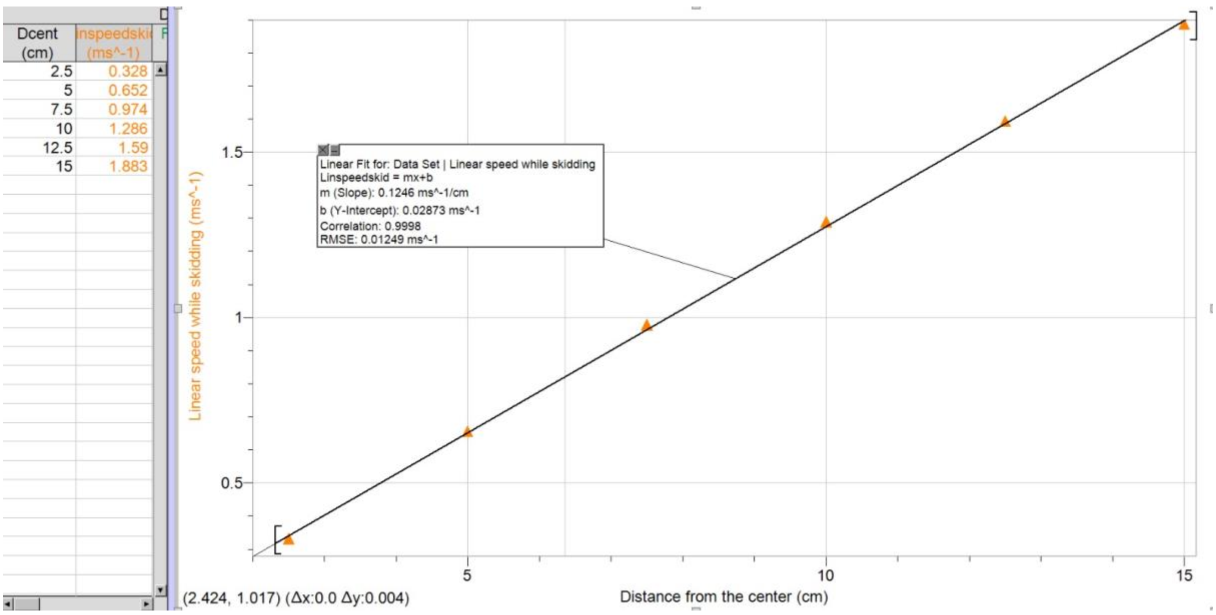
Graph 3: Distance from the center(radius) against angular speed of the toy car graph

By examining the ***Graph 2*** it can be seen that the moment of inertia changes increases directly proportional to the distance away from the center and from the second graph we can deduce that the angular speed changes inversely proportional with the distance. This relation also supports the law of conservation of angular momentum.

The ***Graph 4*** below shows how does the rotational kinetic energy changes with distance.



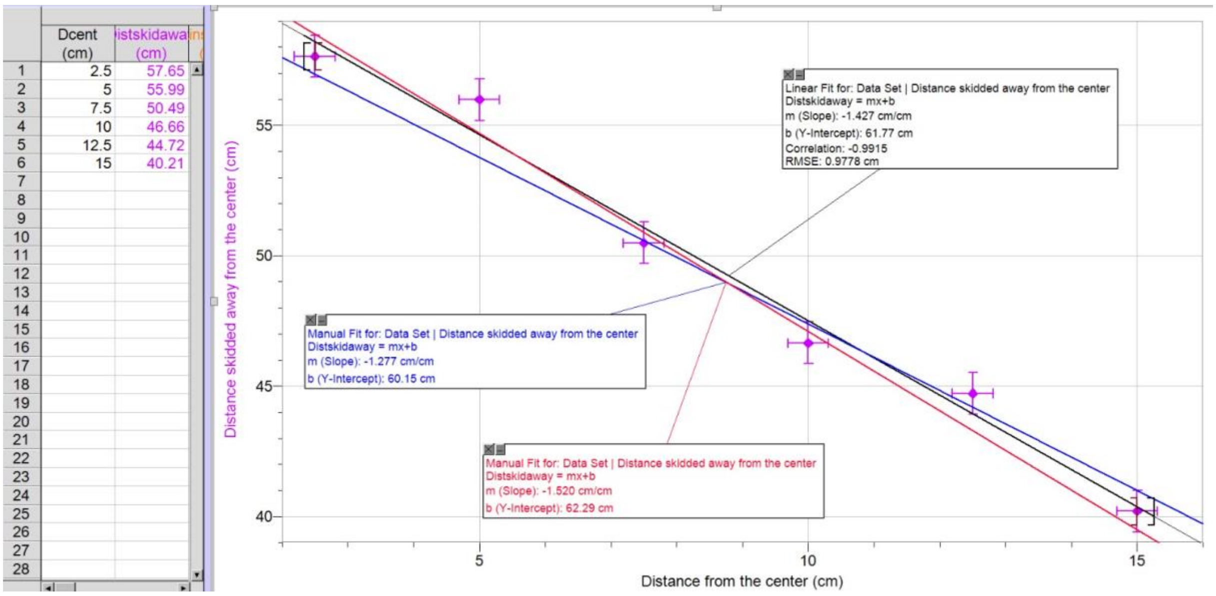
Graph 4: Distance from the center(radius) against rotational kinetic energy of the toy car graph



Graph 5: Distance from the center(radius) against the linear speed of the toy car while skidding graph

The graph above shows the linear speed of the toy car while skidding.

Finally, the graph below suggests that the distance skidded away from the center of the rotating platform decreases as the distance of the toy car from the center increases.



Graph 6: Distance from the center(radius) against distance skidded away from the center of the platform graph and the best fit line, maximum slope and the minimum slope.

After the graph is drawn, the best line, the line with maximum slope and the minimum slope is drawn in this graph and error bars are added to calculate the uncertainty of the slope to find a more precise value. Uncertainty of the slope is calculated by the following formula.

$$uncertainty\ of\ slope = \frac{\text{maximum}\ gradient - minimum\ gradient}{2}$$

For this graph the minimum gradient is equal to -1.520 and the maximum gradient is equal to -1.277. The slope of the best fit line is -1.427. So, the uncertainty in the slope of the best fit line of the graph would be.

$$\frac{-1.277-(-1.520)}{2} \approx 0.122$$

As a result, the slope of the best fit line can be stated as -1.427±0.122.

ERROR PROPAGATION

While doing this experiment I calculated the theoretical values of the distance skidded from the center of the rotating platform of a toy car and measured the real values of the distance skidded. After the required calculations and the measurements are made it is seen that the real values deviate from the expected values of the distance skidded. In order to calculate how much the real values of the distance skidded is different from the theoretical values firstly the average of the distances skidded of the 5 trials of the radius 2.5 cm is found.

$$x_{average} = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{5}$$

$$Average\ distance\ skidded\ of\ radius\ 2.5\ cm = \frac{64.51 + 59.84 + 47.47 + 68.72 + 47.69}{5}$$

$$\approx 57.65$$

The average value of the distances skidded are calculated nearly as 57.65 and it is seen that the theoretical value of the distance skidded is 58.06 for the radius 2.5 cm. The percentage difference of the measured values can be calculated as

$$\frac{|58.06 - 57.65|100}{58.06} \approx 0.71\%$$

The other percentage differences are calculated and shown in the following table.

	2.50 ± 0.05 cm radius from the center	5.00 ± 0.05 cm radius from the center	7.50 ± 0.05 cm radius from the center	10.00 ± 0.05 cm radius from the center	12.50 ± 0.05 cm radius from the center	15.00 ± 0.05 cm radius from the center
Percentage difference(%)	0.71	6.22	8.84	9.33	11.10	7.69

Table 8: Percentage differences of the measured values of the distance skidded from the theoretical values of the distance skidded

EVALUATION AND CONCLUSION

As an answer to the research question: **How does changing the radius of a toy car on a rotating platform affect the distance skidded by the car?** The research and experiment showed that if it is examined from the experiment and the data, the distance that the toy car skid away from the center of the rotating platform decreases as the radius of the turn increases. So, the experiment suggests us that while turning around a corner with a car it is important not to turn too close to the corner or too far away from the corner which will both result in crashing or causing accidents after skidding. Since the mass doesn't affect the mechanics of turning around a corner; the speed that you enter the turn, and the distance away from the corner while turning plays a crucial role on turning safe. In this experiment it can be seen that the real measured values of the distance skidded away from the center of the rotating platform is found to be different from the calculated theoretical values of the distance skidded. This experiment is useful in examining and researching the situation and the mechanics of turning around a corner. However, there are some limitations in this experiment. During this experiment small numbers are used mostly, which led the calculation to be done with small uncertainties. In this experiment specific measurement tools are used that have specific intervals. For example, the timer and the tape measure both have an uncertainty of ±0.01 and for the ruler it has an uncertainty of ±0.05. While doing the experiment there are errors caused by human and syntax error that can change decimal points of the calculated values which will cause the measurements to deviate from their original values. These errors can't completely disappear; however, they can be decreased by repeating the experiment more and by doing the calibration of electronic devices. The graphs are parallel with my hypothesis which supports the answer to the research question. During the calculations the rotating platform may not be spun with same speed in every trial which may result in deviations in the distances that are measured. Keeping in mind that this experiment is only a projection of the real world the results are not completely same with the real conditions while driving and turning around a corner. In conclusion, the data obtained from the experiment shows us various relations when examining a car turning around a corner. As seen from the ***Graph 2*** the moment of inertia has a value when the radius of the toy car is zero (car is not placed on the platform) which represents the initial value of the moment of inertia of the rotating platform. As the distance of the toy car from the center increases, the moment of inertia of the toy car increases directly proportional with the square of the radius (distance) of the toy car from the center. As the moment of inertia is proportional with the square of the distance, during the law of conservation of momentum the angular speed decreases parabolically. When calculating the rotational kinetic energies of the car in different distances the angular speed seem to affect more as the rotational kinetic energy is directly proportional with the square of the angular speed, however as the moment of inertia of the car increases with the square of the distance and it increases the value of the kinetic energy more the angular speed has less effect on the rotational kinetic energy compared to the moment of inertia. As the kinetic energy increases the linear speed while skidding increases.

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