Coursework physics

Planning

by : Ibrahim al Saieg

Aim :

The aim of my experiment is to measure the earth's gravitational field strength, which is also the acceleration due to gravity. This involves mass, which is the amount of matter an object contains and weight which is the force of gravity pulling down on a object with a mass. Mass is measured in Kg and weight is measured in Newton's. Gravity is the weakest of the four fundamental forces, yet it is the dominant force in the universe for shaping the large scale structure of galaxies, stars, etc.

The earth's gravitational field strength is calculated by the weight (N) / Mass (Kg), therefore the earth's gravitational field strength (g) is measured in (N/Kg). As an object is in free-fall it accelerates at the rate of g. The gravitational field strength is measured by doing an experiment with a trolley rolling down a tilted runway with the force of g causing it to accelerate down the slope.

Hypothesis

Isaac Newton firstly discovered gravity when an apple fell on his head. He then discovered that every object has a mass and that two masses attract each other. This attraction has a gravitational field strength, Newton wanted to calculate the gravitational field strength of the earth. There is a pendulum that involves g and calculates T the time the pendulum will swing for.

Where l is the length of the pendulum. The pendulum is shown in diagram 5. Through this Isaac Newton discovered that g = 9.81 N/Kg. This is now a well now fact and is accepted as the earth's gravitational field strength.

I will use a different experiment to try and prove that g = 9.81 N/Kg. I predict when I do the experiment as shown in Diagram 2, I will find g = 9.8 N/Kg and if the experiment is accurate and reliable enough I may be able to show g = 9.81 N/Kg but I would be satisfied with the answer accurate to two significant figures.

The parts equation represent as follows, y = y axis, x = x axis, m = gradient, c = intercept. When this is put into the equation of a straight line the lines are replaced as follows, a = y, sin = x, g = m, (-F / m) = c. When the results are put into a graph , I can find g by finding the gradient of the line on the graph as shown in Diagram 3.

Definitions

Gravity Force , Fgrav
The force of gravity is the force at which the earth, moon, or other massively large object attracts another object towards itself. By definition, this is the weight of the object. All objects upon earth experience a force of gravity which is directed "downward" towards the centre of the earth. The force of gravity on earth is always equal to the weight of the object as found by the equation:

Fgrav = m * g
where g = 9.8 m/s2 (on Earth)
and m = mass (in kg)

Normal Force, Fnorm
The normal force is the support force exerted upon an object which is in contact with another stable object. For example, if a book is resting upon a surface, then the surface is exerting an upward force upon the book in order to support the weight of the book. On occasions, a normal force is exerted hori zontally between two objects which are in contact with each other.

Friction Force, Ffrict
The friction force is the force exerted by a surface as an object moves across it or makes an effort to move across it. The friction force opposes the motion of the object. For example, if a book moves across the surface of a desk, then the desk exerts a friction force in the opposite direction of its motion. Friction results from the two surfaces being pressed together closely, causing intermolecular attractive forces between molecules of different surfaces. As such, friction depends upon the nature of the two surfaces and upon the degree to which they are pressed together.

Implementation

I will use the following apparatus in my experiment to find "g":

A wooden trolley- the trolley will be able to roll down the runway with a negligible amount of friction acting upon it as it rolls down.

A wooden runway- the runway is wide and long enough to enable the trolley to have a sufficient length run and also be wide enough so t he trolley won´t touch the edges.

A light gate and picket fence- the picket fence will pass through the light gate and the velocity at which the picket fence passed through the light gate can be measured.

A CBL2 data logger- this will be connected to the light gate , the data measured by the light gate such as the velocity and time at which the picket fence passed through the light gate can then be displayed as a graph on the data logger.

Blue-tack- this was used to hold the picket fence securely to the top of the trolley, this is so that when a trolley does a run, the picket fence will pass through the light gate and therefore measure the velocity and time of the trolley.

Books- the only resource that was available to elevate one end of the runway to slope the runway was books, so I used different amounts of these to alter the height of elevation and therefore altering the angle of the runways slope.

A metre rule- this was used to measure the height of elevation on one end of the runway and the length of the runway.

A set square- this was used to make sure the picket fence was perpendicular to the trolley and the light gate was perpendicular to the picket fence on the trolley.

A clamp stand- this was used to hold the light gate up above the runway so it could allow the picket fence to pass through it.

The apparatus were set up as shown in Diagram one. The runway would first be put at a very small slope to start off the experiment. The picket fence was checked and adjusted to make sure it was inline with the trolley and not at an angle to the trolley. I then checked and adjusted the light gate to make sure the picket fence could pass through the light gate without colliding with it and that it was perpendicular to the light gate. Every time a run was done the apparatus was re-checked to make sure the apparatus was still accurate.

Each time the angle of slope was increased, the position of the light gate would have to be raised so the picket fence would not hit it. The angle of the light gate would also have to be changed so it is still perpendicular to the picket fence. Each run I would note down the results from the data logger. Three runs were taken for each runway angle and the averages of those three were put into the results. The books were used to increase the angle of the runway.

If there was an occurrence that would cause a incorrect result such as the trolley hitting the side of the runway, I would do the run again and ignore the results I got from the run that hit the side of the runway, as the increase in friction from the trolley hitting the side would cause the velocity of the trolley to significantly decrease. I also made sure that the picket fence was fully cutting the light gate beam each run so the reading on the data logger would be accurate. The apparatus I use was the same through out the whole experiment to keep things like the mass and friction of the trolley upon the runway.

The factor of safety is very important in every experiment. Unsafe experiments tend to be inaccurate so fully meeting all of the safety requirements increases the accuracy of the experiment. In this particular experiment I found there to be a few safety factors that needed to be taken into consideration as well as the safety rules of the laboratory. The first safety factor I found was the angle of the runway. I decided that the angle of the runway should be kept fairly small because I wanted to limit the speed of the trolley as it rolled down the runway so it wouldn´t travel to fast. This is important because at the bottom end of the runway the trolley had to be caught by hand, if it was travelling to fast the person stopping it may be injured.