

Gcse Physics Investigation - displacement

Introduction

In this experiment I have been asked to investigate the relationship between the thickness of a glass block through which a beam of light will be passed and the resultant amount of lateral displacement of the beam.

Background knowledge

We know that light travels in straight lines however there are substances which will refract (bend) light. Refraction is the change in direction in which waves travel when they pass from one kind of matter to another. Waves are refracted when they pass from one medium to another in which the velocity of light is different. A pencil standing in water appears broken at the water line because light travels slower in water than air. When the light passes into a more dense medium it bends towards the normal when it travels into a less dense medium it bends away from the normal. The denser a substance the more light will bend towards the normal and the less dense the substance the more it will bend away from the normal.

Prediction

Due to what I already know I will predict that the thicker the glass block that is used the larger the displacement will be. This is because as the light travels further through the block it will continue in the same line and be displaced more. The thicker the block is the more refraction will take place because the light travelling from the air into the block will be bent more by a thicker medium.

Variables

The independent variable will be the thickness of the glass block this is changed throughout the experiment. The dependant variable is the lateral displacement of the beam of light this is what is recorded and is determined by the independent variable. Variables to be controlled (kept the same) are angle of incidence, size and material of block used and the distance of the ray box from the blocks.

Apparatus

- Power supply
- Paper
- Ray box
- 8 glass blocks
- ruler
- pencil
- protractor

Diagram

Safety

It is important that all experiments are carried out following safety procedures there are a few for this experiment.

- The ray box will heat up after it has been switched on for a length of time, do not touch it or it may cause a degree of discomfort it should allowed to be cooled once switched off.
- Water should never be near the experiment as water and electricity are highly dangerous
- Glass blocks can be dangerous and care should be taken when handling them

Method

- 1) Draw a straight horizontal line roughly in the middle of a piece of paper
- 2) Draw a line in the centre of this line perpendicular to it. this is the normal.
- 3) With the aid of a protractor mark on a 40 degree angle with a pencil. This will be the angle of incidence
- 4) Shine the ray box down the line that has just been drawn, extend the line along the beam of light.
- 5) Put a glass block on the page touching the first line drawn so the light passes through it mark the emerging ray with a pencil.
- 6) Measure the distance between the ray and the extended line and note the lateral difference.
- 7) Change the block and repeat, do this for a further six blocks.
- 8) In the interests of making an accurate experiment as possible the whole experiment will be repeated and an average found.

Recording results – sample table and graph

Results

Analysis

My graph is a straight line this shows that the thickness and the lateral displacement are directly proportional. As the thickness increased so did the displaced by a proportional amount 0.5 cm with each block added

Conclusion

After carrying out the experiment I have found that the thicker the piece of glass, the more a light beam is refracted and there is a greater lateral displacement of light. As I predicted this is due to the fact that the longer the light travels through the glass the more it will be displaced because it continues to move closer to the normal. This is because when light travels from air to a denser transparent substance such as glass or water it slows down this causes it to bend this is refraction. I have proved that refraction happens to a greater extent when travelling through thicker materials.

Reliability of evidence

Throughout the experiment everything was kept accurate, the controls were all kept the same as the graph is a straight line as expected this shows the results I obtained were reliable, I repeated the experiment 2 times in order to give me more accurate results and also to check that I hadn't made any mistakes, I found that the results in the 2 experiments were near identical proving their reliability.

My graph and results support my prediction and all the background knowledge I had researched.

Suitability of procedure

The experiment was very simple suitably for a school lab. The procedure was also simple and easy to carry out.

If I were to repeat the experiment and I had more time I would take the time to make sure the glass blocks are all lined up and were as close together as possible.