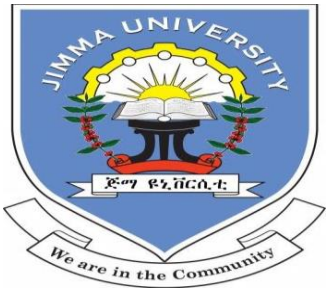
DIFFRACTION OF LIGHT WHEN IT PASSES THROUGH A SLIT.



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Abstract

The main objective of this study was to examine the Light bends when it passes around an edge or through a silt. This bending of light called diffraction. You can easily demonstrate diffraction using a candle or a small bright flash light bulb and a silt made with two pencils. Descriptive study was employed for this project to describe the theoretical demonstration of diffraction of light. The data tools that the researcher used was observation .The main source of data for this project was secondary data collected through review analysis. And final result discussion were presented with the form of qualitative and using certain explanation.

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1. Introduction

1.1 Background of the study

Light bends when it passes around an edge or through a silt. This bending is called diffraction .You can easily demonstrate diffraction using a candle or small bright flash light bulb and a silt made with two pencils. The deflection pattern, the pattern of dark and light created when light bends around an edge shows that light has wave like properties [1].

Diffraction is the slight bending of light as it passes around the edge of an object. The amount of bending depends on the relative size of wavelength of light to the size of the opening. If the opening is much larger than the lights wavelength, the bending will be almost unnoticeable. However, is the two are closer in size or equal, the amount of the bending is considerable, and easily seen with the naked eye [2]

For some time, the behavior of light has baffled scientists. Initially, and in accordance with classic physics light was through to be a wave, an in definable form of energy that simply flowed from a heated source. However, with the advent of quantum physics, scientists came to realize that photons, a tiny elementary particle responsible for all forms of electromagnetic radiation, was in face the source. The key understanding why light behaves like is in interference and diffraction. Interference and diffraction are the phenomena that distinguish waves from the bends around obstacles like wave do it is this bending which causes the single silt diffraction pattern [3]

Having the above information on mind, this project will be attempted to demonstrate the diffraction of light by using simple materials which are locally available and preferable by the investigator.

1.2 Objective of the project

1.2.1 General objective

- The main objective of the study is to study the diffraction of light when it passes through materials

1.2.2 Specific objectives

- To explain diffraction of light by using a candle or a small bright flash light and a silt made with two pencils.
- To demonstrate the diffraction of light

  To examine diffraction of light

1.3 Statement of the problem

By considering the above real facts the researcher wants to conduct the study on the description of diffraction of light by using a candle /small flash light and a silt made with two pencils to answer the following basic questions.

- How could light diffracted by using a candle/small flash light and a slit made by pencils?
- How diffraction of light created through the slit?
- What are the parameter of this?
- What are the indicators for the diffraction condition?
- What is the relation ship between the parameter?

1.4 Significance of the study

This project conducted for the purpose of to increase knowledge on the topic or title, (diffraction of pattern with practical), to develop theoretical concept on diffraction of light. Furthermore, it may be base of information for further on study.

1.5 Limitation of the study

The investigator was faced some challenges while conducting this project which includes:

- Time and budget adjustment
- Availability of required materials
- Lack of reference sources.

Are some of the main challenges which were faced the investigator the project and finally the sixth section gives summary and conclusion the project work.

Chapter Two

2.Review of Related Literature

Visible light (commonly referred to simply as light) is electromagnetic radiation that is visible to human eye, and responsible for the sense of sight [2]. Visible light usually defined and having a wave length in range of 400x 10^{-9}m to $^{70-9}$m between infrared, with longer wavelength and the ultraviolet with shorter wavelength [7-]

It is known that light is visible to us. By nature visible light is the light that human and animals can see by their necked eye. This visible light named as electromagnetic radiation.

The entire spectrum of these EM waves includes radio waves, which have very long wavelengths and both gamma rays and cosmic rays which are at the other end of the spectrum and have very small wavelengths [7-].

Light has varied properties. Among which some of its properties are:

Light :- travels in straight line

- Can be reflected
- Can be refracted
- It's a form of energy

Light does not travel in straight line at the level of classical physics in true universal strictness all motion is curved. Light not only can be reflected, but it can be absorbed so to speak. All light, which is classified as electromagnetic radiation exerts for ward impact pressure when it hits matter, light can enter into matter causing atomic and molecular increased activity light can be reflected, refracted and polarized. It also shows the phenomenon of interference in properties which defines light as awave (Young's double slit experiment).

Diffraction refers to various phenomena which occur when a wave encounters an obstacle. In classical physics, the diffraction phenomenon is described as the apparent bending of waves around small effects occur when alight wave travels through opening similar varying refractive index or a sound wave travels through one with varying acoustic impedance.

Francisco Maria Grimaldi who coined the term diffraction from the Latin differing ere, to break in to pieces' referring to light breaking up in to different directions. The results of Grimald's observations were published posthumously [3].

Isaac Newton studies these effects and attributed them to inflexition of light rays. James Gregory (16-38-1075) observed the diffraction patterns caused by a bird feather which was effectives the first diffraction grating to be discovered

Thomas Young performed celebrated experiment in 1003 demonstrating interference from two closely spaced slits. Explaining his results by interference of the waves emanating from the two different slits, he deduced that light must propagate as waves [5]

Diffraction arises because of the way in which waves propagate this is described by the Huygens- Frensel principle and the principle of superposition of waves. The propagation of a wave can be visualized by considering every point on a wave front as a point source for a secondary waves when waves are added together, their sum is determined by the relative phases as well as the amplitudes of the individual waves [5]

Since physical objects have wave like properties at the atomic level), diffraction also occurs with matters and can be studied according to the principles of quantum mechanics [5]

Chapter Three

3. Methodology of the study

3.1 Study Approach

This project was employed qualitative study approach. The project was selected this approach due to its project feature and the approach is convenient since the project was used texts, ideas and suggestions to describe its findings.

3.2 Study Design

Descriptive study was used for this project to describe the theoretical demonstration of diffraction of light.

3.3 Source of data

The research used only secondary source of data. There were looks journals, and other related project works in addition, other written materials that were related with his project study were also taken as source of data.

3.4 Methods of data collection tools

The methods the researcher used to collect data was only observation.

3.5 Materials

The following materials were used for demonstration of the project. Two clean pencil, apiece of transparent tape (Any thin tape will do). A candle or desk lamp, optional pieces of cloth a feather, plastic diffraction grating, a metal screen, a human hair, yard stick/meter stick. For other method it could be used

- Straight pin
- Index card, as alternatives in place of using pencils

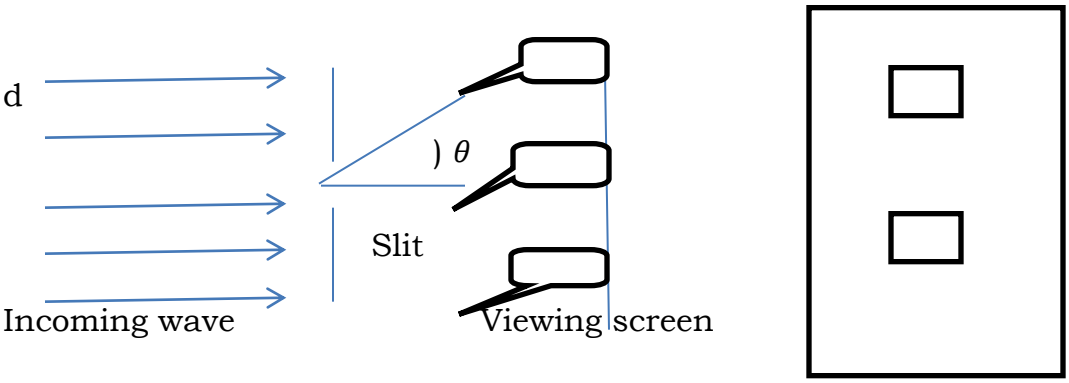
3.6Procedure

Regarding the procedures, first with five minutes candle was lighted and the desk lamp was switched on and made shine brightly the layer of the tape was wrapped around the top of the pencils and below eraser. Then the light was placed on arm length away from the observer. Then the two pencils would be hold vertically, side by side with the erasers at top. The tape wrapped around one pencil should kept the pencils slightly apart and forming a thin slit between the pencils just below the tape .then, hold the pencils and one eye was closed (about 1 inch (2.5cm) award and looked at the light source through the slit between the pencils. Then what the observer did see? After (15) minutes I measured distances on the diffraction patter, I could calculate the wavelength of light emitted by the candle or bulb.

Chapter four

4. Results and Discussion

In this section what were revealed on the conducted project presented with scientific justification as a means of meaningful interpretation for the observed events.



Data Analysis

N. of s.	Division of viewing	The position of the dark fringes (bond)
1	Above the central line	$\sin\theta = \frac{3\lambda}{d}$
		$\sin\theta = \frac{\lambda}{d}$
		$\sin\theta = \frac{\lambda}{d}$
2	Central line	$\sin\theta = 0$
3	Below the central line	$\llbracket \sin\theta = \quad \llbracket \lambda/d \rrbracket , \theta = sin - 1(- \lambda/d$
		$\sin\theta = \frac{2\lambda}{d}, \theta = sin - 1(-\frac{2\lambda}{d})$
		$\sin\theta = \frac{3\lambda}{d}, \theta = sin - 1(-\frac{3\lambda}{d})$

θ-the angle that light passes through slit.

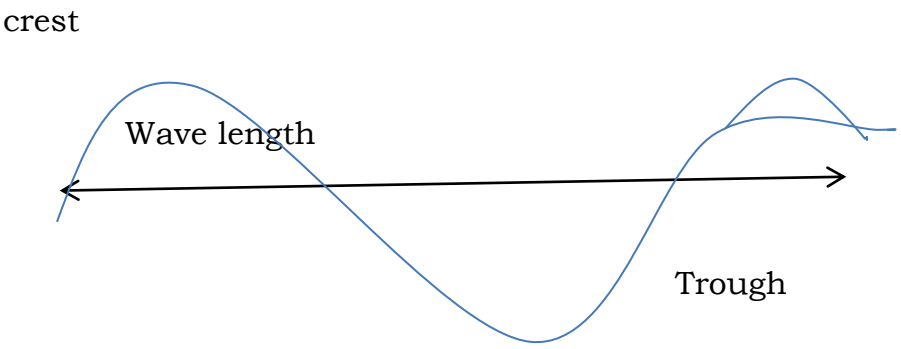
d- the distance made by two slit (the width of the slit)

λ the wavelength of light

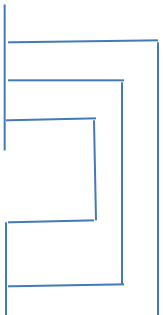
You see dark bands a cross the light in the thin slit which is formed by the two pencils. Why this dark band observed?

This event could happen where the trough of one wave over laps with the crest of another waves cancel one another out, and you see a dark band.++

Light is a form of energy that travels in the transverse waves similar to water waves in shape .Light waves are distribute that can travel through space in a regular pattern. Traverse waves have a crest (the high point of a wave) and a trough (the lowest point of a wave). The distance from any point of one wave to the same point of the next wave is called wave length.



When you look at the light through the slit formed between the two pencils, some of the light passing through the thin opening of the slit spreads out instead of travelling straight ahead. This behavior of light is called diffraction (the change of direction a ray of light around the edge of an object or through a small hole).The light that passes through the center of the hole /slit goes straight but light hitting the edge of the slit/hole is reflected. Each point on the openings that reflects light act as source of light, when rays of light from different source meet each other, they create bands of dark and light. This behavior of light is caused by the rays wave shapes.



Point source with
Wave ray and wave
Fronts

The blank bands between the blobs of light show that there is a wave associated with the light. The light waves that go through the slit spread out, overlap, and add together, interacting in complex ways to produce the diffraction that we have seen where the crests of one wave over laps with the crests of another wave, the two waves combine to make a bigger wave, and we see a bright blob of light. This event is called constructive interference. But when the crests and troughs of the overlapping waves are opposite, the light energy is can called, causing a dark area .This is called destructive inference.(1)

Despite the name, interference has no effect on the waves themselves, just on the way we see them. After meeting, the waves continue to move as they did before they met. The angle at which the light bends is proportional to the wave length of the light. The narrow the slit, the more the light spreads out, in fact, the angle between two adjacent dark bands in the diffraction pattern is inversely proportional to the width of the slit. For destructive interference between two narrow slits a distance a part that is half the width of the slit. The path difference is:-

Given by $\sin\theta = \frac{2\lambda m}{d} -$

So that the minimum intensity occurs at an angle θ min given by:

d sin θ $min = m\lambda$ where m = 0,1,2…..

Where ;d is the width of the slit

$\theta\, min$– is the angle of incidence at which minimum intensity occurs and λ- is the wavelength of the light.

Thin objects, such as a strand of hair, are also diffracting light that passes around the hair spreads out, overlaps, and produce a diffraction pattern. A piece of cloth or a feather, which are both made up of many smaller, thinner parts, produce complicated diffraction patterns. According to the investigation in this project, when the pencils squeeze together, making the slit smaller, notice that there is a line of light perpendicular to the slit while looking through the slit, rotate the pencils until they are horizontal, and notice that the line of light becomes vertical. The change observed in this events could be due to the change on the width of the slit. (3)

This project also identifies, if we look closely you may see that the line is composed of thing blobs of light. As you squeeze the slit together, the blobs of light grow longer and spread a part, moving away from the central light source and becoming easier to see. Notice that the blobs have blue and red edges and that the blue edges are closer to the light source. This effect could observed due to the effect of wave length. When light passes through a small opening, comparable in size to the wave length of the light, in other wise opaque obstacles, the wave front on the other side of the opening resembles the wave front shown on the right. The light spreads around the edge of the obstacle. This phenomena is called diffraction of light.(5)

According to theoretical justification reflection involves a change in direction of waves they bounce off a barrier. Refraction of waves happens when the wave pass from one medium to another. However, this project could identifies the wave property of light through its diffraction. It involves a change in direction of waves as they pass through an opening or around a barrier in their path. The amount of diffraction (The sharpness of the bending) increases with increasing wave length and decreases with decrease wavelength(7).

$$I \propto \lambda$$

Chapter five

5 Conclusio, and Recommendation

5.1 Conclusion

According to the finding that obtained from project work and other sources of data, the researcher was draw the following conclusion physical object have wave properties at the atomic level. Diffraction occurs with matter and studied and this project indicated as the time of diffraction and its pattern was depend on the light source which the project has been used. Back and white band were formed through the diffraction pattern of the light which indicated the association of wave of light. Wavelength of the light was determined at the point of angle at which the light bands, and finally, this project described about the diffraction of the light and the wave properties of light through the identified diffraction pattern.

5.2 Recommendation

According to finding and conclusion the research for warded the following recommendation:

Even though, the diffraction intensity and rate were varied different light sources could be used for the project. And also we should have to identify the light properties through project. And finally the project should be a means for investigating the properties of light.

Reference

1. Gardner, Robert, Science project about light, spring field N.S. Enslow, 1994
2. Glover, David, Sound and light, New York, King fischer books, 1993
3. William brain, Science and Technology, New York, 1995
   Matt Williams, Diffraction of light, 2011
4. CIE. International light vocabulary, 17(4), 1987, fourth edition, ISBN 978-3-900734-07-7
5. Buser, pierre A, Vision , 1992:50
6. Francesco Maria Grimaldi. The physician mathematics of light, color and rainbow Bologna, Italy, 1665:1-11
7. Young, Thomas: Experiments and calculations relative to physical optics, Royal Society of London, 1804:94:1-16
8. PAL,G.K, Text book of practical physiology, 2001 first edition.

9.william brain, science and Technology, New York,1993.