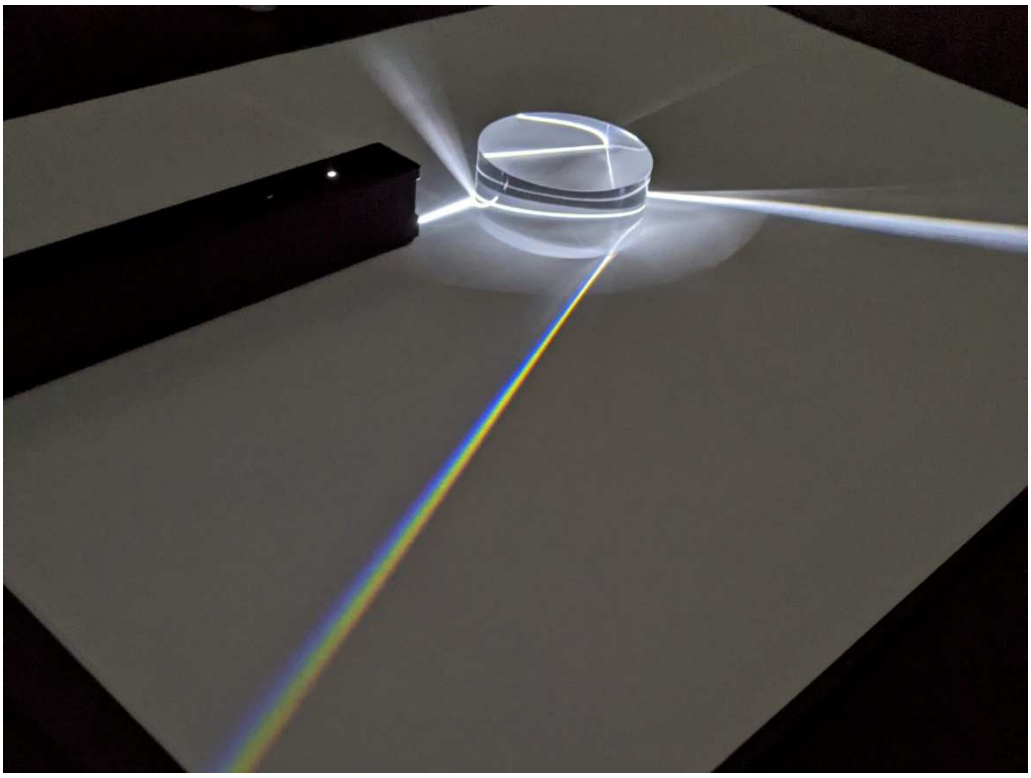
Circular Cylinder Lens

Cat. No. D20-1618-W0



October 2023

Precautions

- **Use a soft cloth or tissue paper when cleaning this product (do not use chemicals such as alcohol or organic solution as it will damage the lens).**
- **Always wear protective goggles if using a laser.**

Introduction

[Product Description]

Circular cylinder lens, with one white colored side, suitable for demonstrating how a rainbow is formed based on the properties of light such as dispersion, refraction and reflection.

[Overall Advantages to Users]

Unparalleled product because a circular-cylinder-shaped lens is not commonly available but indispensable for reproducing rainbow-like spectrum in labs.

Conventionally, learners learn how a rainbow is formed only out of their textbooks, etc. without conducting experiments. As opposed to such conventional learning method, this product is intended for learners to reproduce and analyze a rainbow-like spectrum in person.

[Keywords]

Dispersion, Reflection, and Refraction of Light
Refractive index (refraction index), Chromatic aberration
Light Spectrum
Rainbow

Specification

Size: ϕ50 x 20 mm
Material: Acrylic resin

Experiment Guide

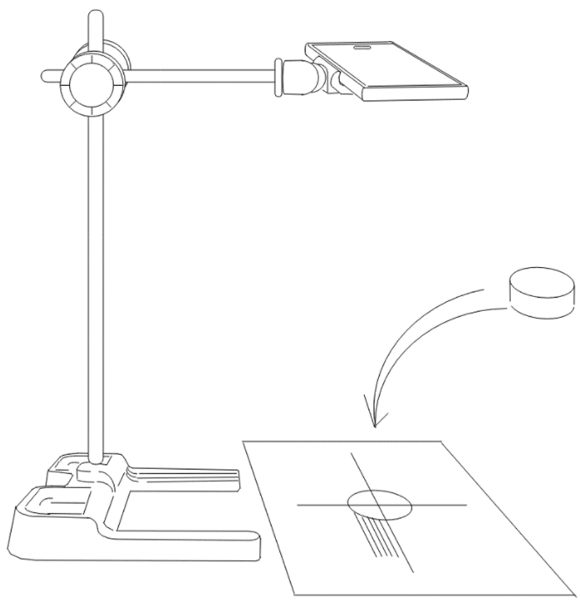
[1] Capturing the image of light paths passing through a lens

[What to prepare]

1. Light Source: 1
   - Narika's High-brightness LED Light Sticks RB-YW (White) (D20-1509-W1) is a recommended light source.
2. Support stand: 1
   - Narika's Tablet Holder for Support Stand (F35-5040-W5) is a recommended accessory.
3. Projection board of any size (white): 1
4. Smartphone or Tablet: 1
5. Lens mount (Appendix 1): To be printed by users. 1 (A4 size)

[How to reproduce and observe a rainbow]

1. Clamp everything including your smartphone/tablet to your support stand.
2. Set up your smartphone (or tablet) at about 30 cm height from the table.
3. Place the lens mount under the smartphone/tablet.
4. Set the lens exactly on the circle printed on the sheet.
5. Check if the sheet is fully displayed on the screen of the smartphone/tablet.
6. Set up the smartphone/tablet, so that the upper and lower outlines of the lens displayed on the screen are aligned and matched. *



*Rear-facing camera of the smartphone/tablet will be positioned to vertically face the lens, therefore a double image of the upper and lower circular outlines of the lens should be displayed on the screen.

By moving the smartphone/tablet vertically and/or horizontally, adjust the gap between the images of the upper/lower circular outlines of the lens, so that they are equally spaced at the entire circumference, and if possible, they form a nearly single circle when displayed on the screen.

7. Switch on a light source that emits a beam of white light (e.g. Narika's High-brightness LED Light Sticks RB-YW: D20-1509-W1) and place it on the sheet where the emitted beam is lined up with the printed line marked with "10º".
8. Darken the room and check if the emitted beam is precisely lined up with the printed line marked with "10º".

[Caution] Make sure the smartphone/tablet and the support stand do not move during the experiment.

9. Observe how a beam of white light will be projected on a small screen every time the beam is reflected, refracted and dispersed during passing through the lens.
10. Capture the image of the configuration by the smartphone/tablet once noticing a rainbow-like spectrum of colors is projected on the screen. The rainbow-like spectrum is what can be reproduced based on the same mechanism as a rainbow forming an arc in the sky (Photo 1).

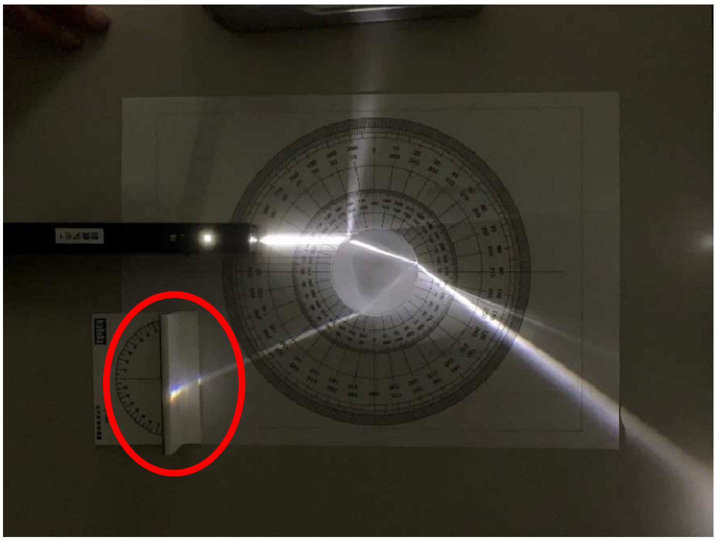


Photo 1. What is shown in the red circle is the projected rainbow-like spectrum of colors.

[2] Completing a traced drawing of the light paths passing through the lens

[What to prepare]

1. Printed digital photograph data similar to “Photo 1” that you captured in step 8 above: 1
2. Sheet of tracing paper: 1
3. Pen: 1
4. Ruler: 1

[How to draw traced light paths]

1. Print out your digital photograph data.
2. Place a piece of tracing paper on above 1.
3. Precisely trace the image of the light paths with a ruler (see Photo 2).

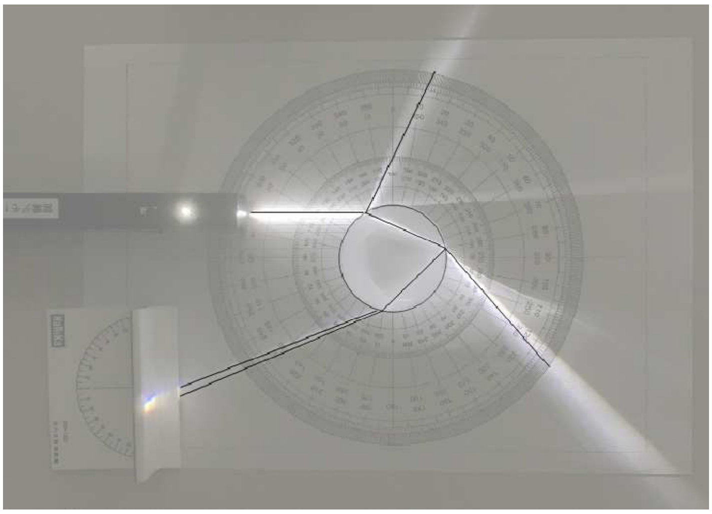


Photo 2. Black lines show the traced drawing of the image of the light paths

[How to measure the deviation angle]

[What to prepare]

1. Traced drawing as instructed above: 1
2. Protractor: 1

1. Extend the drawn line representing the beam of white light emitted from the light source using a ruler (see Fig.1).
2. Extend the two drawn lines from the surface of the screen until they intersect with the line extended from the light source (Fig.1).
3. Measure the angles ** of the two lines extended from the screen surface at the point of intersection using a protractor (Fig.1).

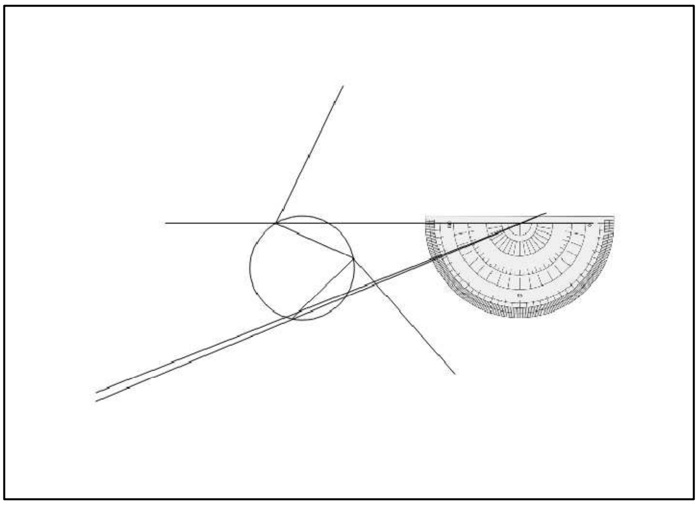


Fig.1 How to measure deviation angle

** This experiment results in the actual measured angles of 20º and 24º formed by each line respectively. Equivalent angles forming a real rainbow are 40º and 42º respectively. Difference in the angles can be attributed to the difference in the refraction indexes peculiar to the medium where a beam of white light passes through (Acrylic resin 1.49 > Water 1.33).

It is recommended to use a graphic editor when completing a traced drawing of the light paths. Carrying the experiment would be much easier for students if the procedure instructed in above [2] is entirely done based on the captured images (refer to Photo 2 and Fig.1 as such examples).

For your reference: Observe the light paths using a petri dish filled with water

Fill a small petri dish (diameter 50 mm) with water and place it in the same position as instructed in above [1] instead of the lens. Observe how a spectrum of colors is projected on the small screen like above [1] and capture its image (see Photo 3). However, the user should know that completing a traced drawing of the light paths passing through the water in the petri dish is not as easy as he/she did with the lens because the image has no visible light paths passing inside the water.

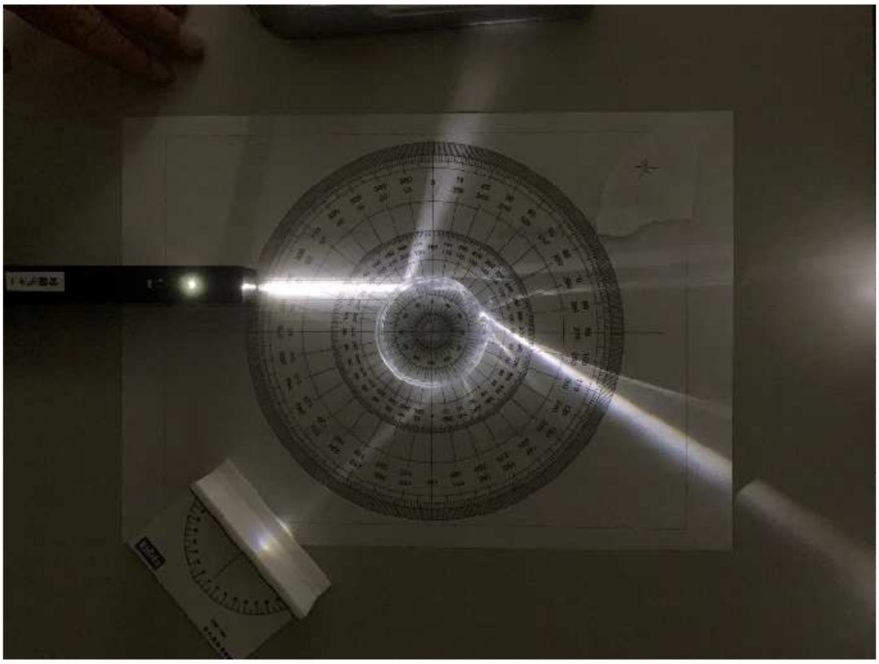
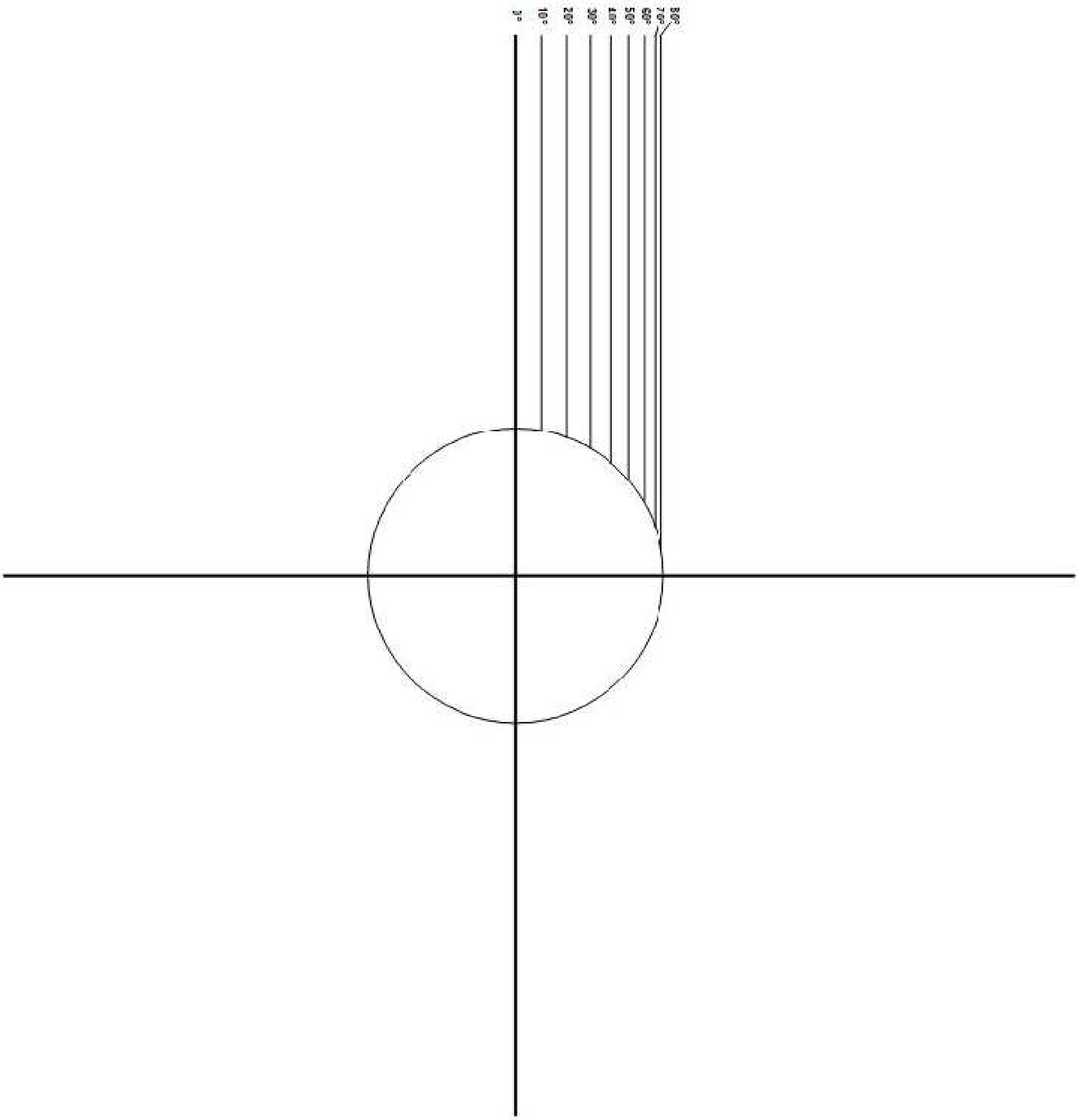


Photo 3

APPENDIX 1



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