Boğaziçi University

Introductory Phys Labs

REFLECTION AND REFRACTION

PHYL202

REFLECTION AND REFRACTION

In this experiment you will be tracing the light rays reflected or refracted from various optical elements and determine some relevant quantities of these elements.

light source

plane mirror

convex mirror

concave mirror

convex lens

concave lens

prism

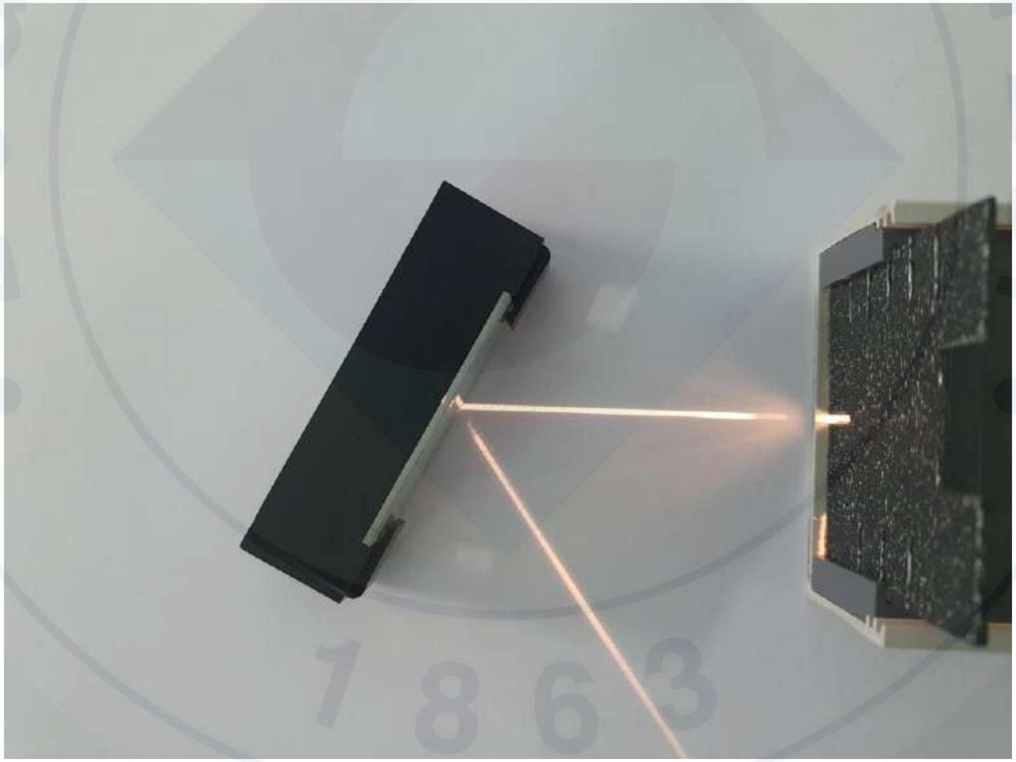
BOĞAZİÇİ UNIVERSITY

Physics Department

PART I: REFLECTION

A) PLANE MIRROR

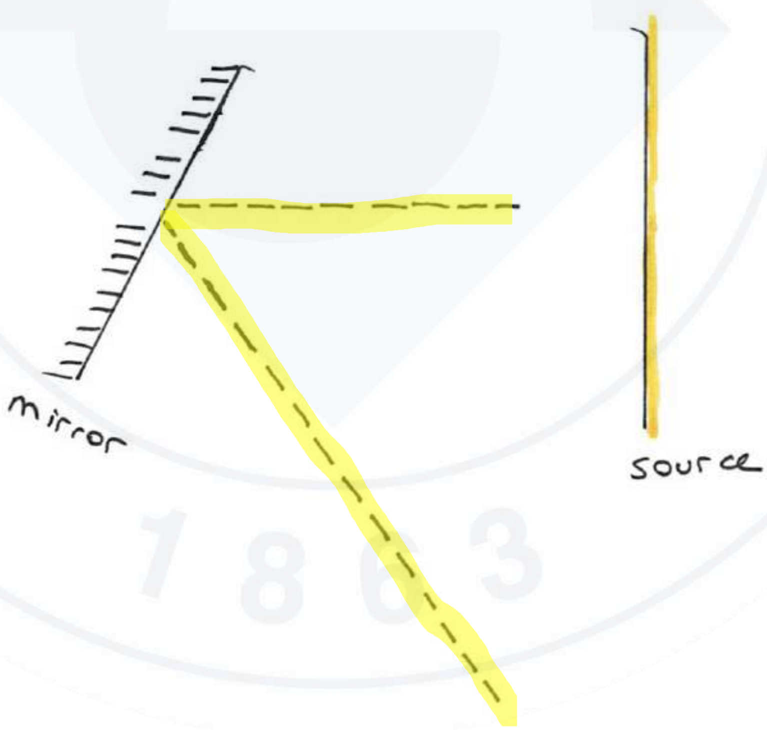
In a plane mirror the incident and reflected angles with respect to the normal are equal



REFLECTION AND REFRACTION

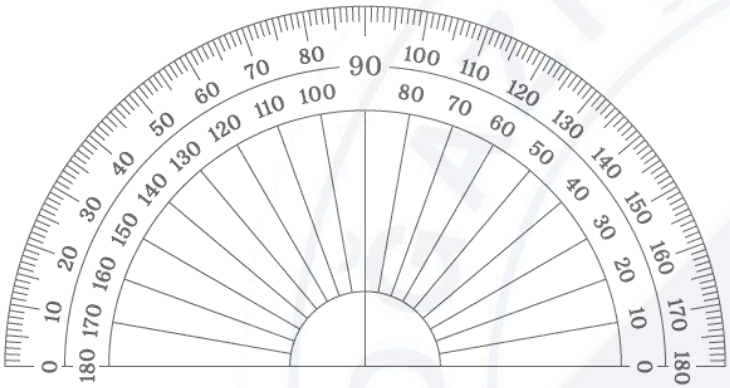
A) PLANE MIRROR

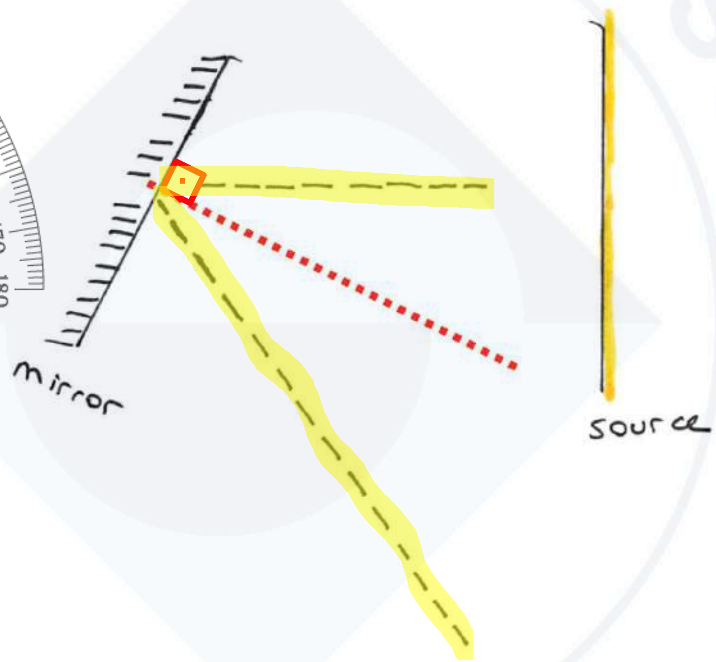
- Please watch the video, and prepare set of white papers, ruler, and protractor to draw your pictures and make your measurements.
- Draw the image on white paper, maximizing your screen lights and turning the lights off in your room will help you.
- With help of protractor, draw the normal line to the surface.
- Measure incident and outgoing angles, θ_i and θ_r respectively.



REFLECTION AND REFRACTION

Measure Incident and Reflected Angle θ_i and θ_r



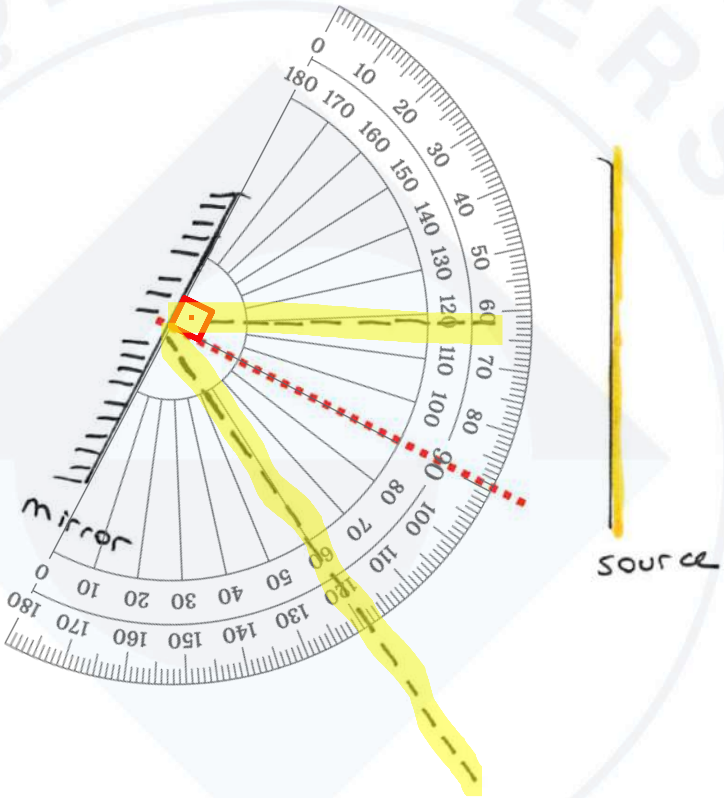


A) **Pla**

Incident ray angle θ_i = ...

Reflected ray angle θ_r = ...

Measure Incident and Reflected Angle θ_i and θ_r



A) **Pla**

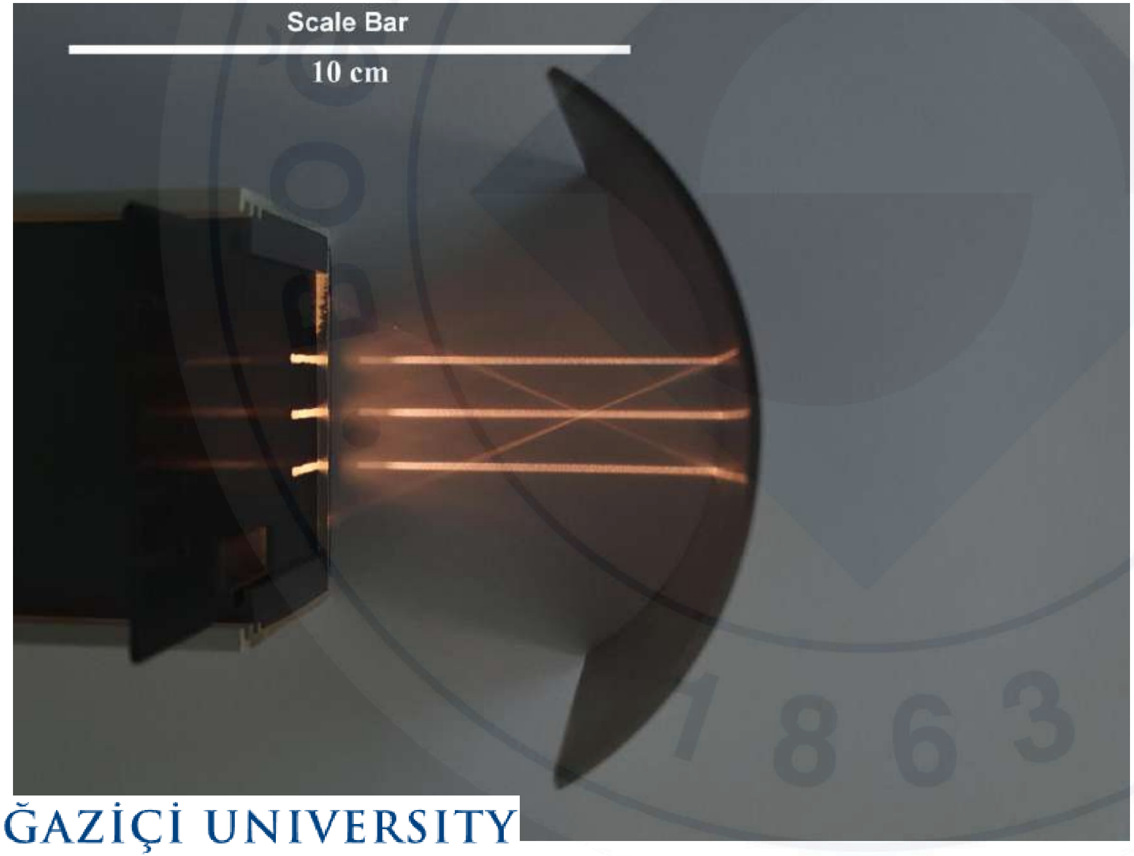
Incident ray angle θ_i = ...

Reflected ray angle θ_r = ...

B) CONCAVE – CONVERGING MIRROR

Focal lengths of concave and convex mirrors are simply half the radius (R) of curvature for the respective surface.

$$f = \frac{R}{2}$$ (R will be determined with help of Chord Method)



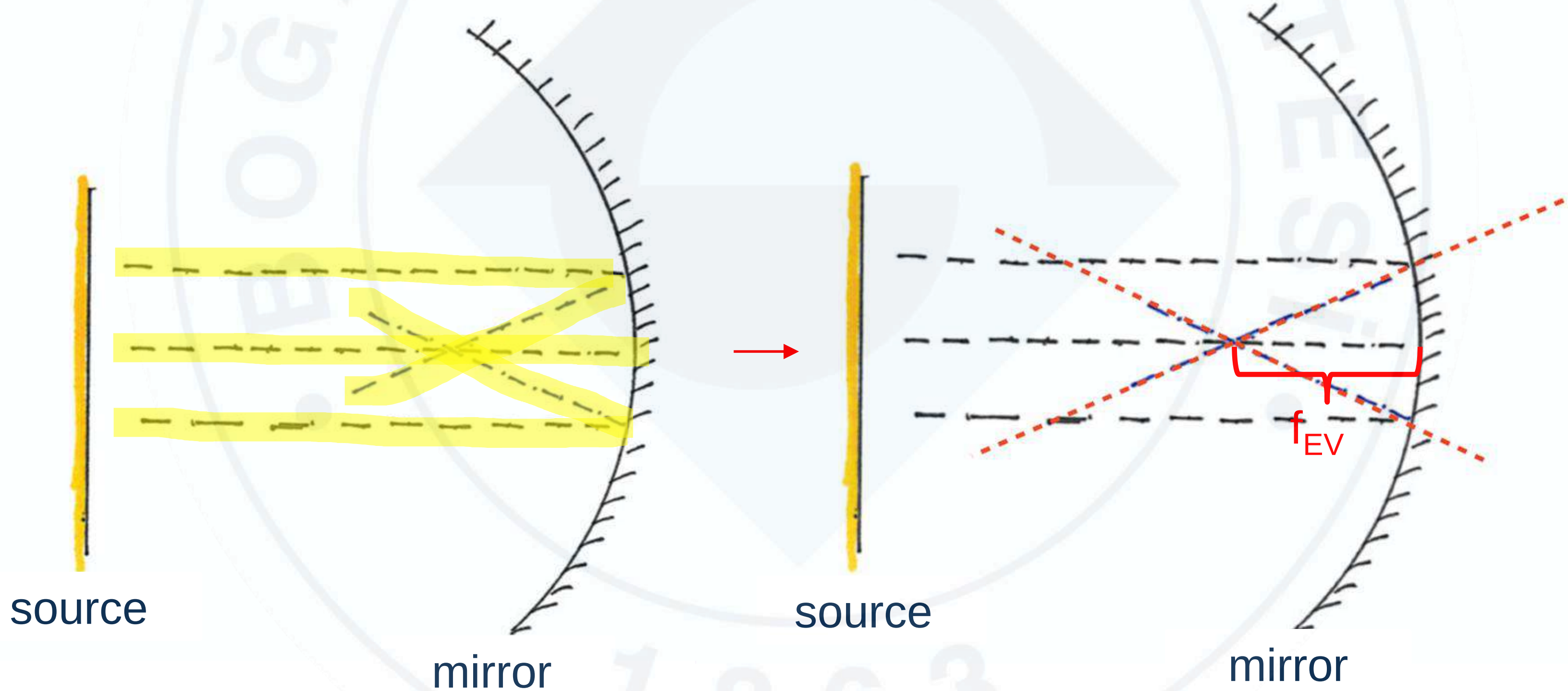
Arrange size of your video so that 10 cm of the picture matches **exactly** with 10.0 cm of your ruler **as it is already implied in your data video instructions!**

If not possible, you can scale to a smaller value than 10 cm, and rescale your measurements.

B) CONCAVE – CONVERGING MIRROR

Get a white paper and draw the picture while watching your data video

- **measure $f_{concave\ mirror}$**



B) CONCAVE – CONVERGING MIRROR

Fill the empty spaces accordingly.

B) Concave – Converging Mirror:

Focal Length of the mirror f_{EV} = ...

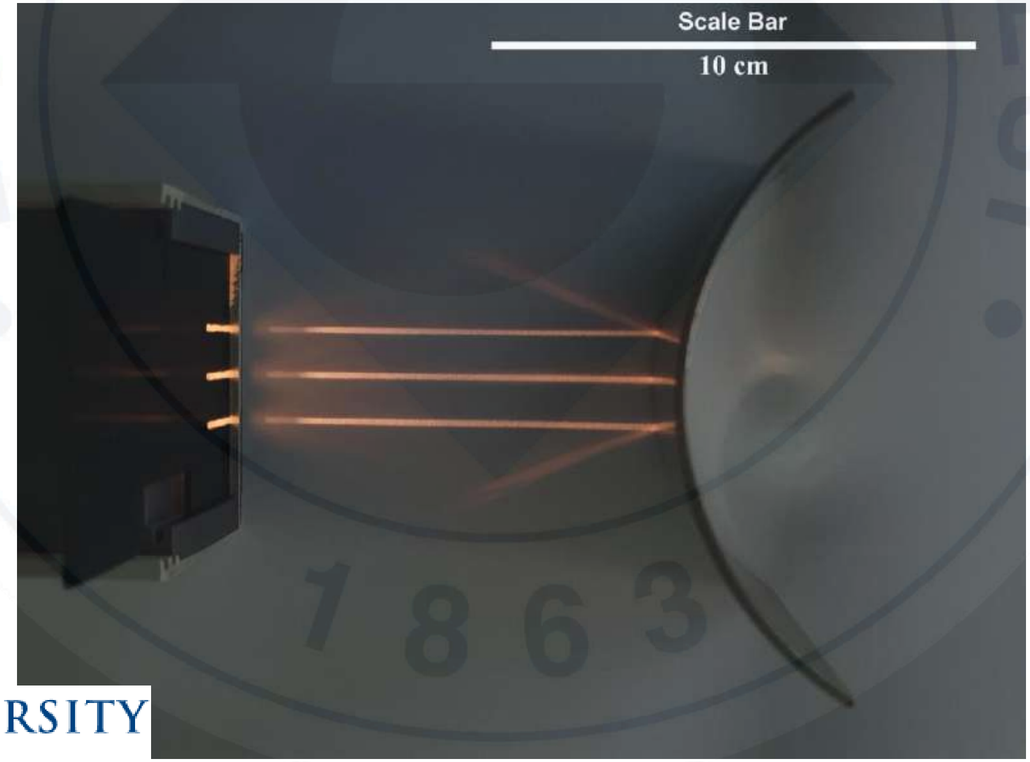
Radius of the mirror (From Chord Method) R = ...

Focal length of the mirror (From Chord Method) f_{CV} = ...

% difference in focal lengths = $\frac{|f_{CV} - f_{EV}|}{f_{CV}} \times 100$

C) CONVEX – DIVERGING MIRROR

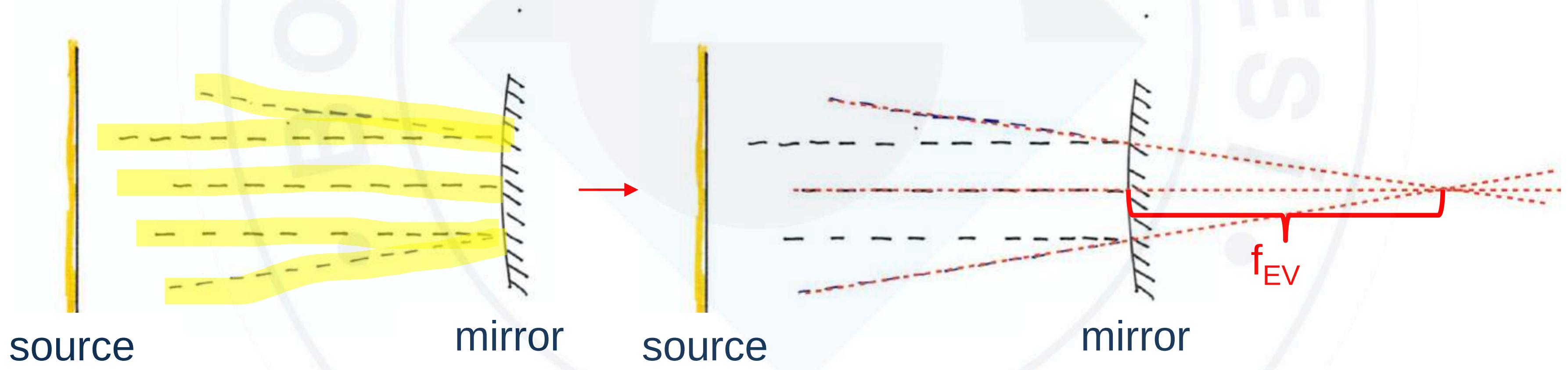
Focal lengths of concave and convex mirrors are simply half the radius of curvature for the respective surface.



C) CONVEX – DIVERGING MIRROR

Get a white paper and draw the picture

- **measure $f_{convex\ mirror}$.**



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C) CONVEX – DIVERGING MIRROR

Fill the empty spaces accordingly.

C) Convex – Diverging Mirror:

Focal Length of the mirror f_{EV} = ...

Radius of the mirror
(From Chord Method) R = ...

Focal length of the mirror
(From Chord Method) f_{CV} = ...

Thickness of the mirror x = ...

This is a sanity check, the result should be around ~0.5 cm, otherwise please check your chord method

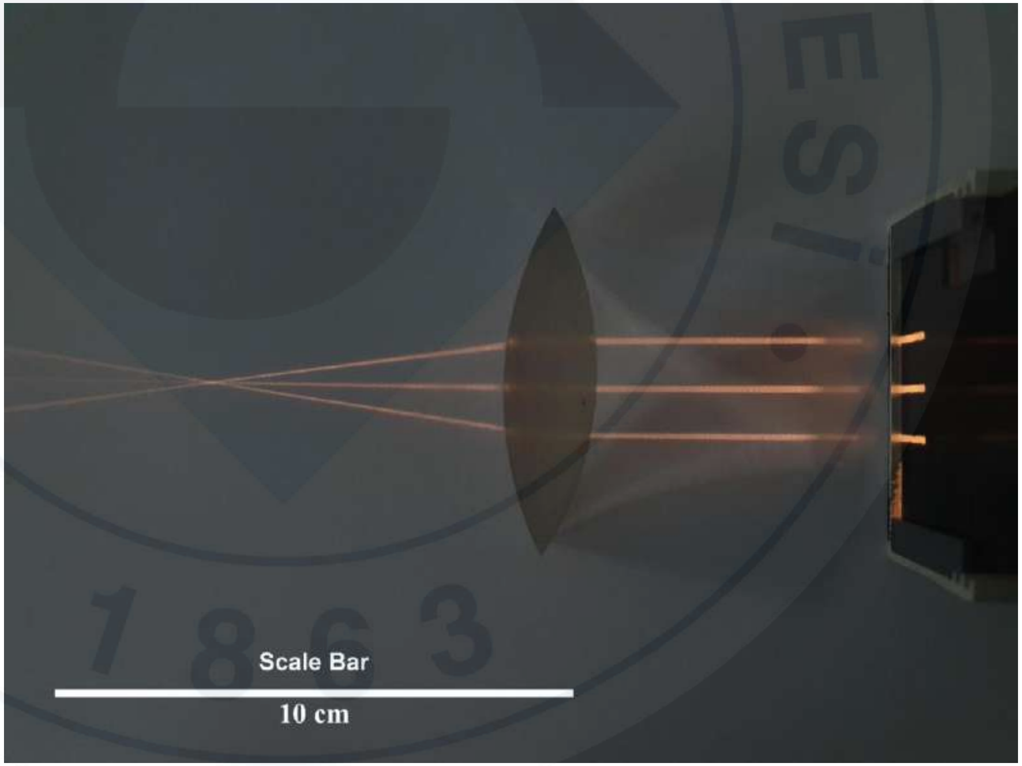
% difference in focal lengths = $\frac{|f_{CV} - f_{EV}|}{f_{CV}} \times 100$

PART II: REFRACTION

D) CONVEX – CONVERGING LENS

Focal length and the radius of curvature of a lens is related through the following expression:

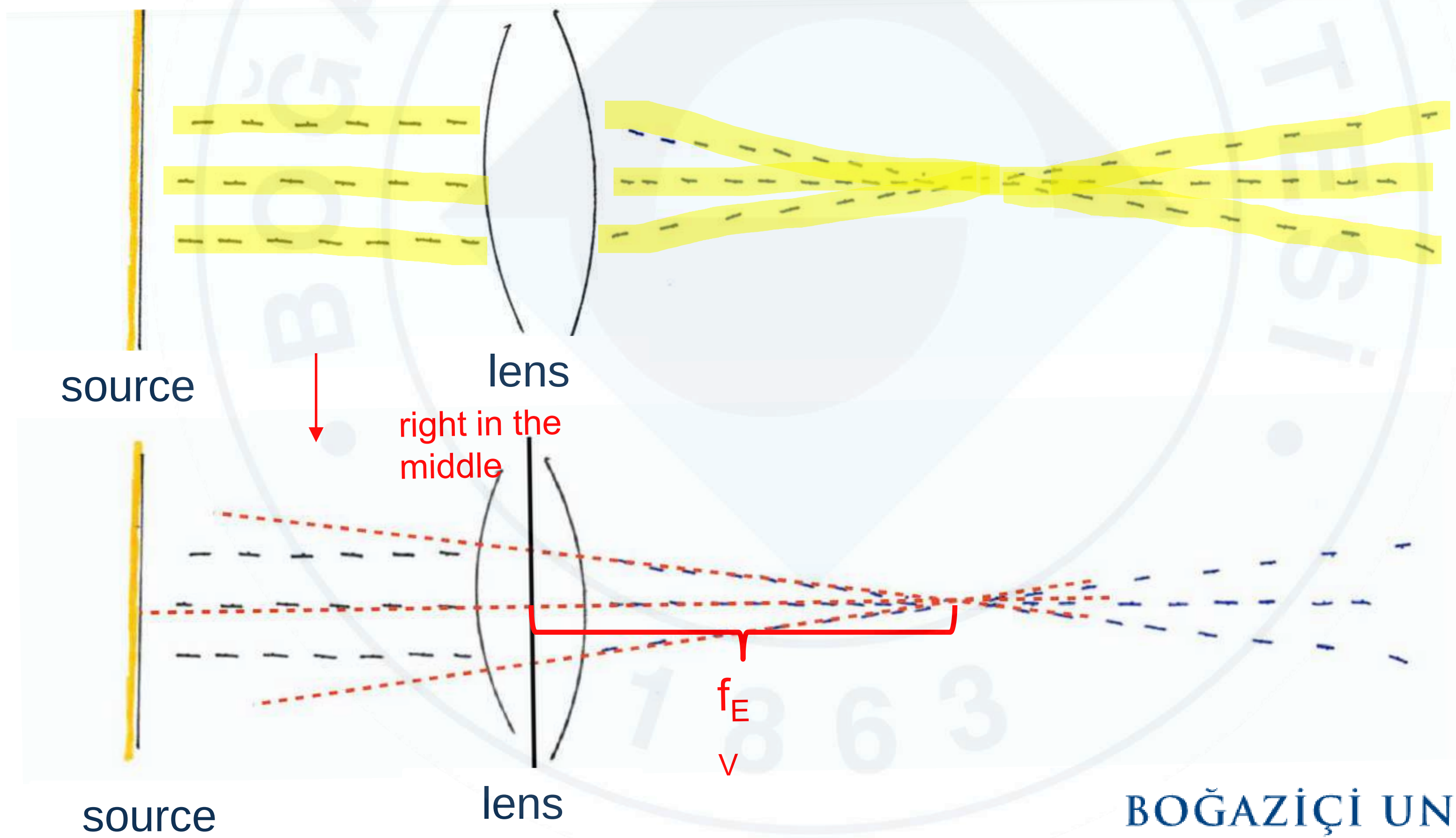
$$\frac{1}{f} = (n-1)\frac{2}{R}$$ (R will be determined with help of Chord Method)



D) CONVEX – CONVERGING LENS

Get a white paper and draw the picture

- **measure $f_{convex\ lens}$.**



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D) CONVEX – CONVERGING LENS

Fill the empty spaces accordingly.

D) Convex – Converging Lens :

It depends on material. You will read it from the data video.

Refraction Index n = ...

Focal Length of the lens f_{EV} = ...

Radius of the convex lens (From Chord Method) R = ...

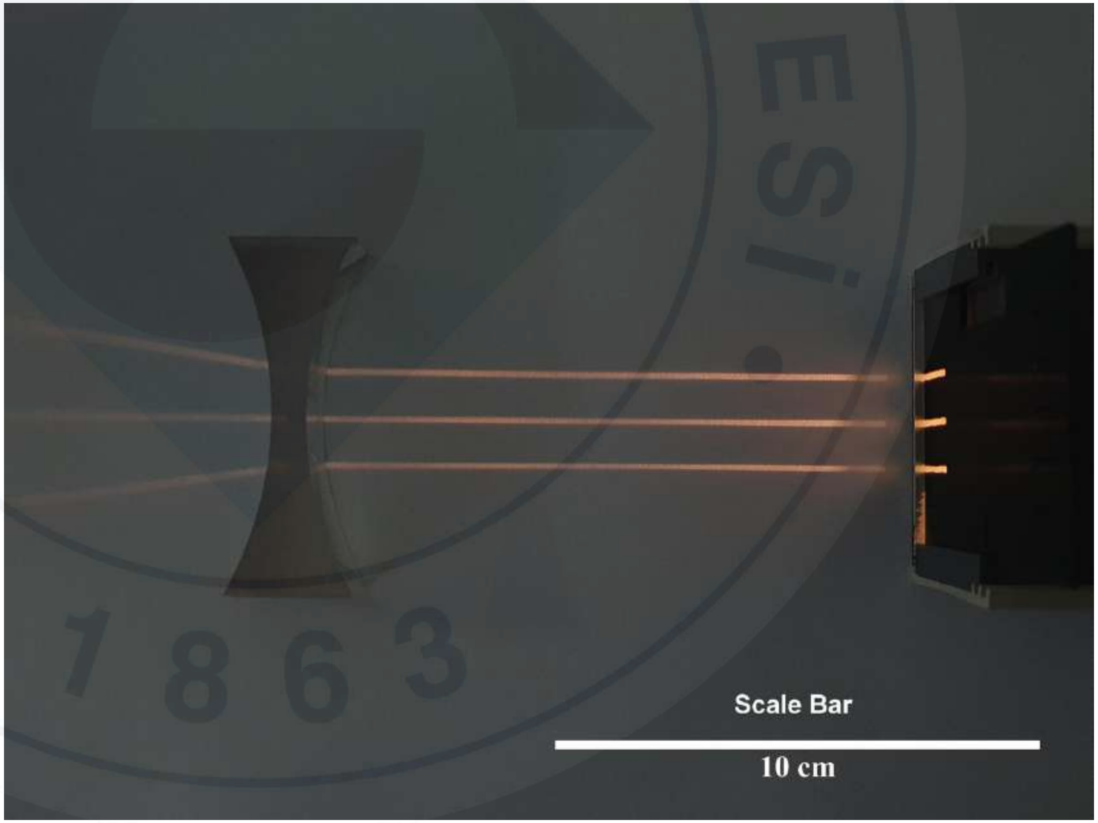
Focal length of the convex lens (From Chord Method) f_{CV} = ...

% difference in focal lengths = $\frac{|f_{CV} - f_{EV}|}{f_{CV}} \times 100$

E) CONCAVE - DIVERGING LENS

Focal length and the radius of curvature of a lens is related through the following expression:

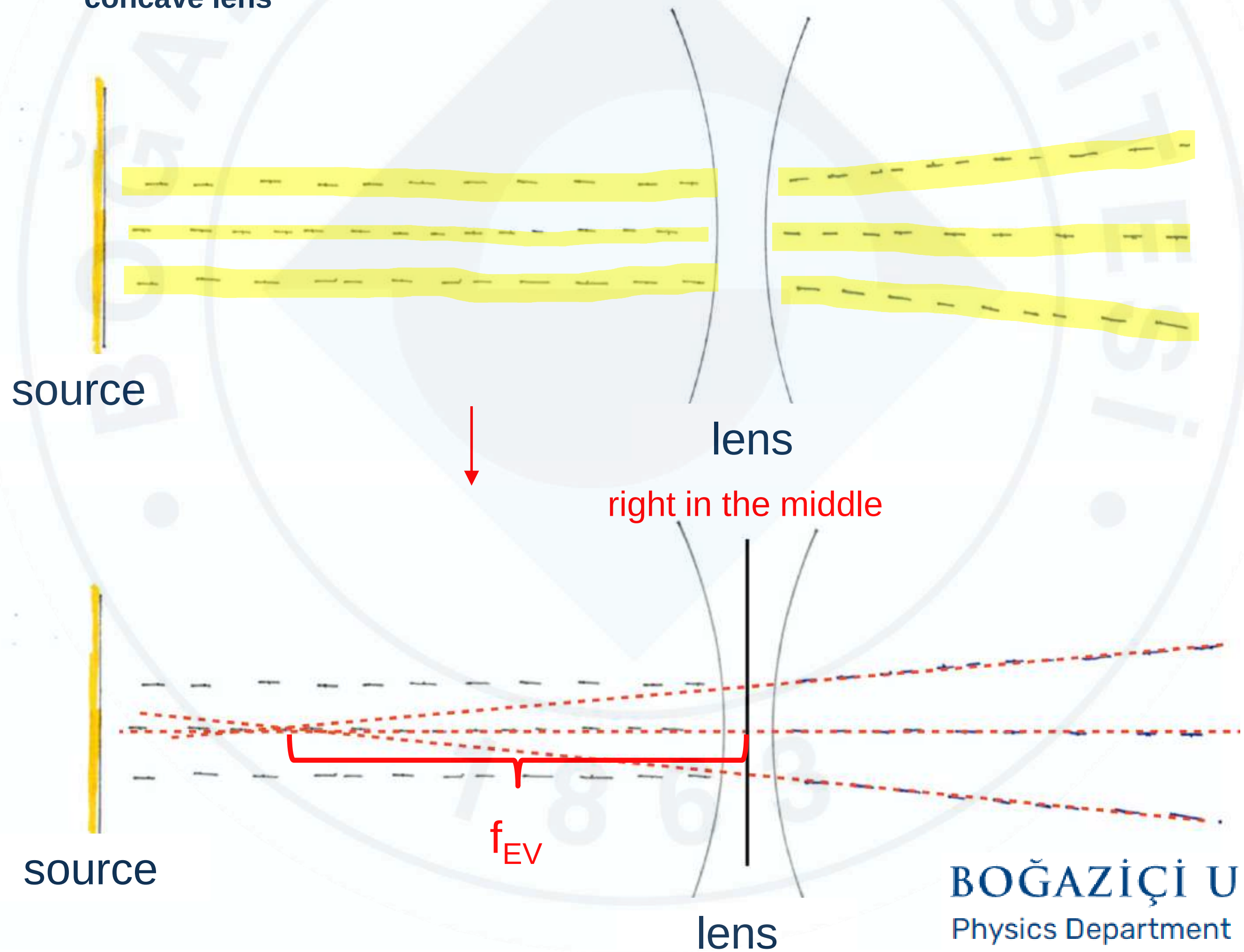
$$\frac{1}{f} = (n-1)\frac{2}{R}$$ (R will be determined with help of Chord Method)



E) CONCAVE - DIVERGING LENS

Get a white paper and draw the picture

- **measure $f_{\text{concave lens}}$.**



E) CONCAVE - DIVERGING LENS

Fill the empty spaces accordingly.

E) Concave – Diverging Lens:

It depends on material. You will read it from the data video.

Refraction Index n = ...

Focal Length of the lens f_{EV} = ...

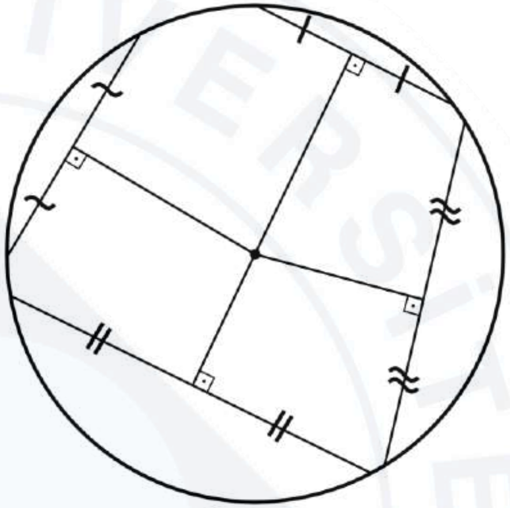
Radius of the concave lens (From Chord Method) R = ...

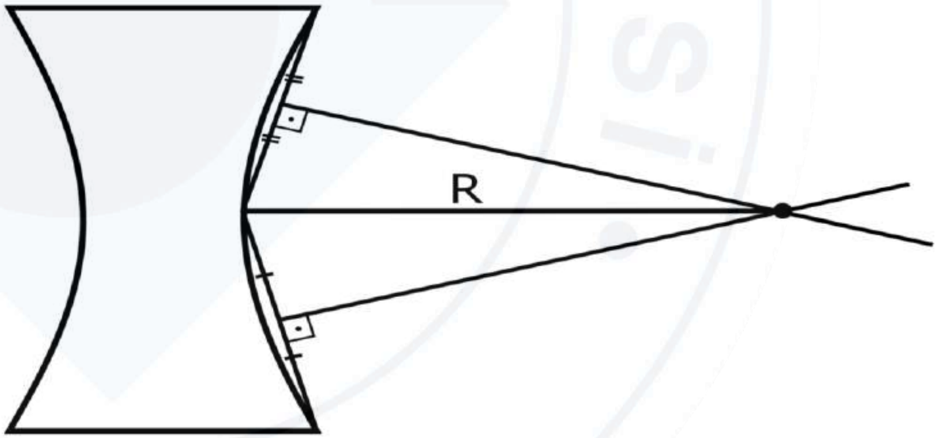
Focal length of the concave lens (From Chord Method) f_{CV} = ...

% difference in focal lengths = $\frac{|f_{CV} - f_{EV}|}{f_{CV}} \times 100$

CHORD METHOD

- Draw two chords as apart from each other as possible
- Draw perpendicular lines from center of each chord with help of a protractor
- Draw a line from point of intersection of perpendicular lines to the circle





$$f_{CV} = \frac{R}{2}$$

$$\frac{1}{f_{CV}} = (n-1)\frac{2}{R}$$

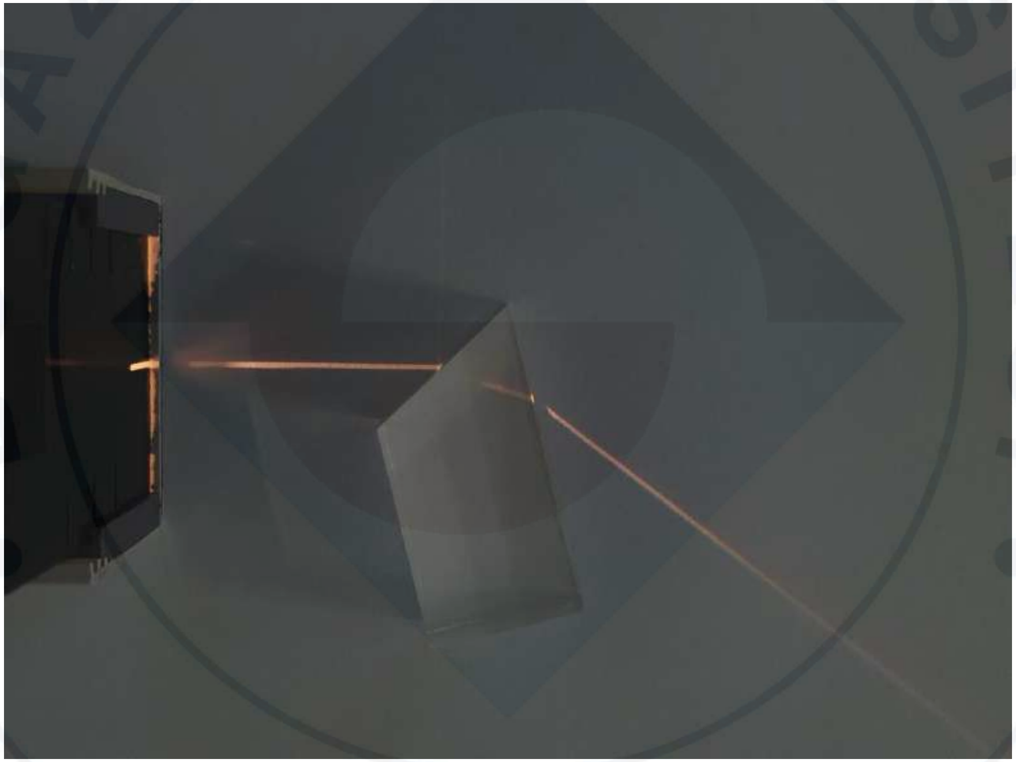
$$\%\, difference\, in\, focal\, lengths = \frac{|f_{CV} - f_{EV}|}{f_{CV}} \times 100$$

F) PRISM

We can calculate the index of refraction of a prism by measuring the angle of minimum deviation between incident and outgoing angles, and also prism angle.

$$n = \frac{sin(\frac{D_{min}+A}{2})}{sin(\frac{A}{2})}$$

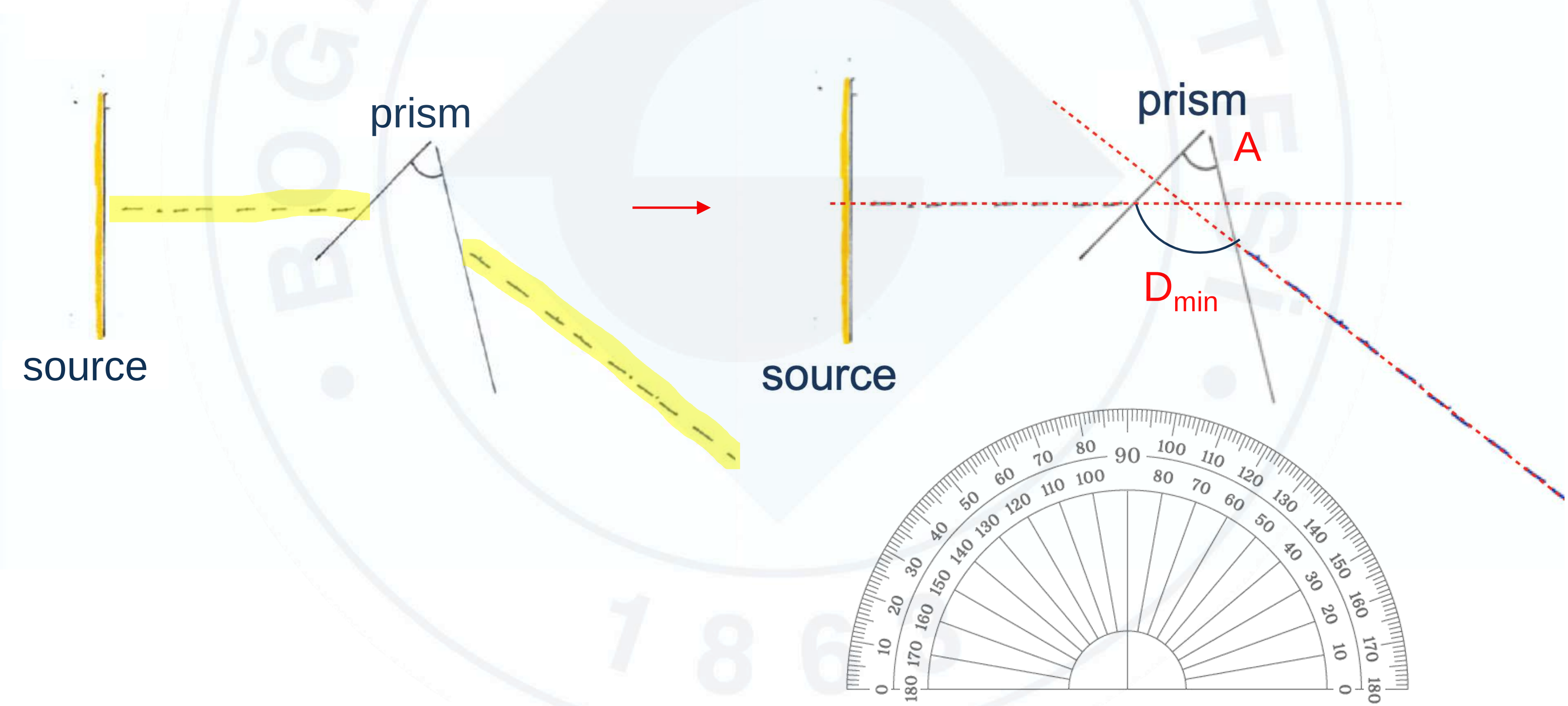
PRISM



F) PRISM

Get a white paper and draw the picture

Measure minimum deviation angle D_{min} and prism angle A.



F) PRISM

Fill the empty spaces accordingly.

F) **Prism:**

Minimum deviation between incident and refracted rays	D_{min}	=	....
Prism angle	A	=	....
Index of Refraction	n_{EV}	=	....
True Value for the Index of Refraction	n_{TV}	=	....
% difference for *n*		=	$\dfrac{\lvert n_{TV} - n_{EV} \rvert}{n_{TV}} \times 100$