Engineering Physics Laboratory (Course Code : PHY119)

Experiment Number: 2

AIM: To investigate the intensity of light coming through two crossed Polaroids and to verify the Malus' law

Learning Objectives

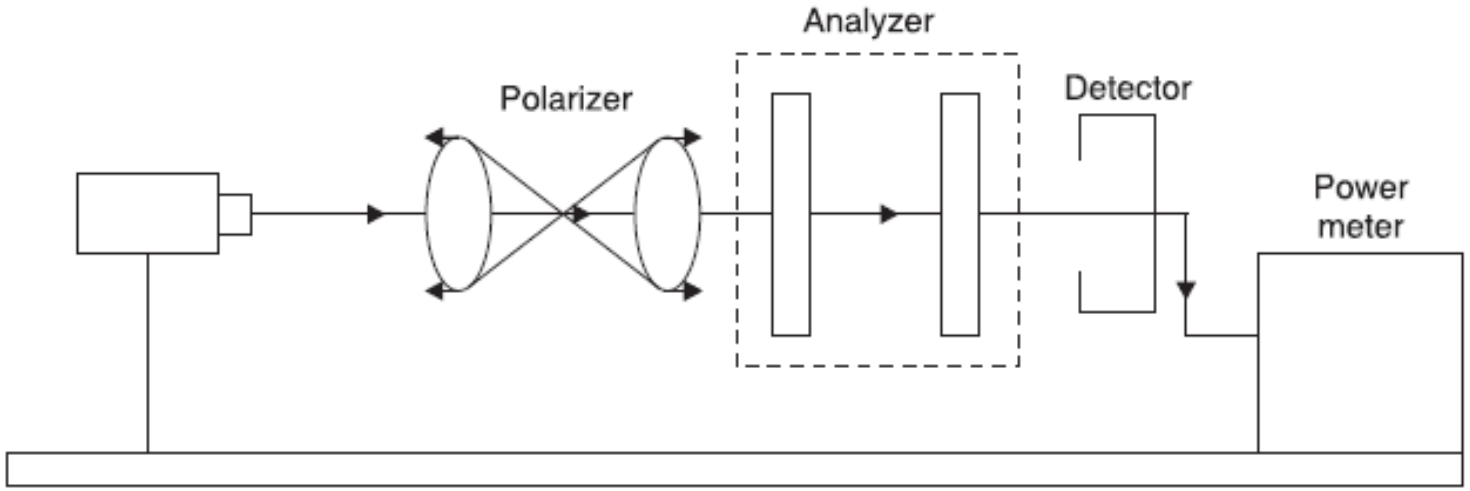
1. To understand the concept of polarization of light.

2. To learn about the position of the axis of the analyzer (θ) with respect to the axis of polarizer and the polarization intensity (I).

3. To verify the Malus' law, $I = I_0 \cos^2\theta$.

Theoretical background

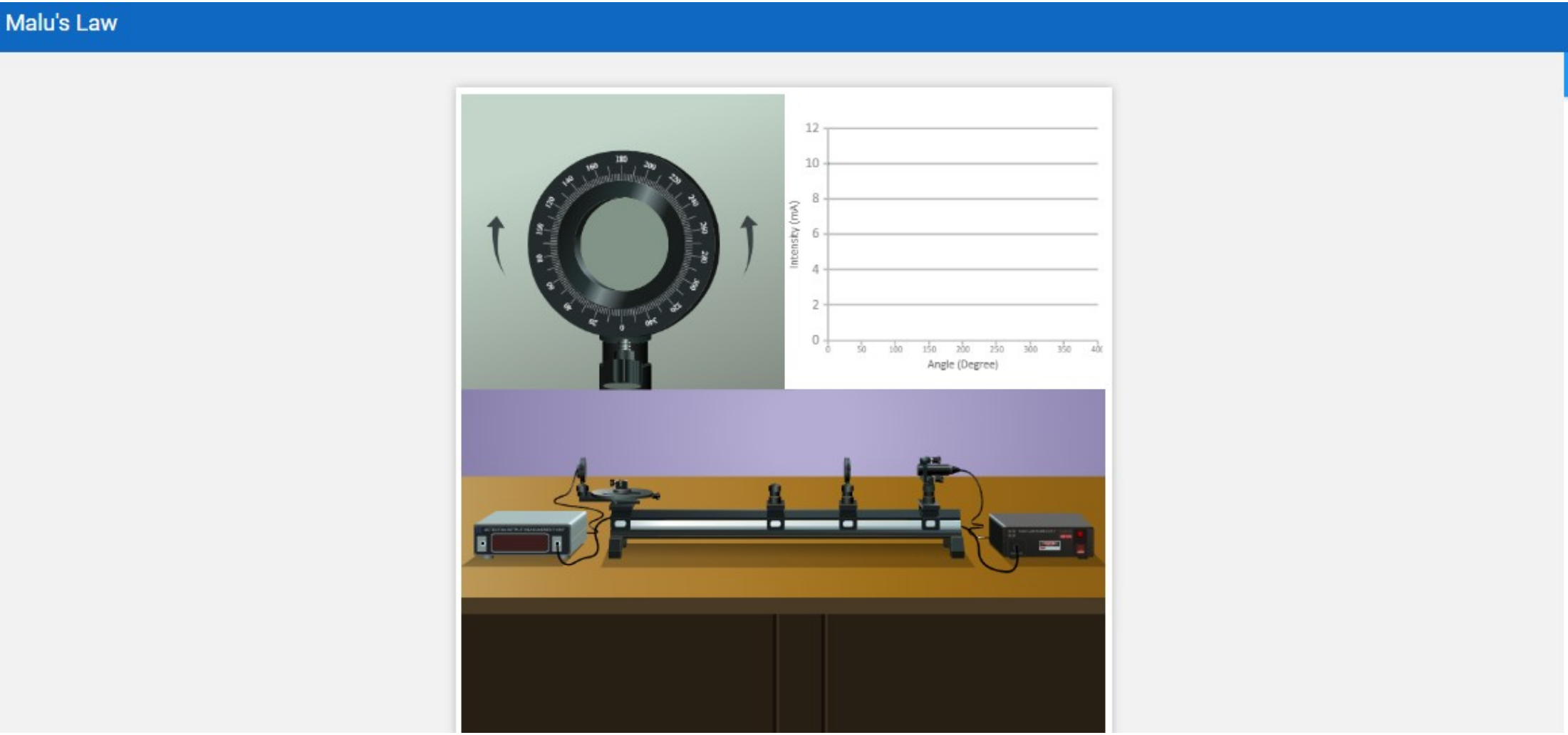
Malus cosine-squared law states that the intensity of a beam of plane-polarized light after passing through a rotatable polarizer varies as the square of the cosine of the angle through which the polarizer is rotated from the position that gives maximum intensity. Malus' law, $I = I_0 \cos^2 \theta$



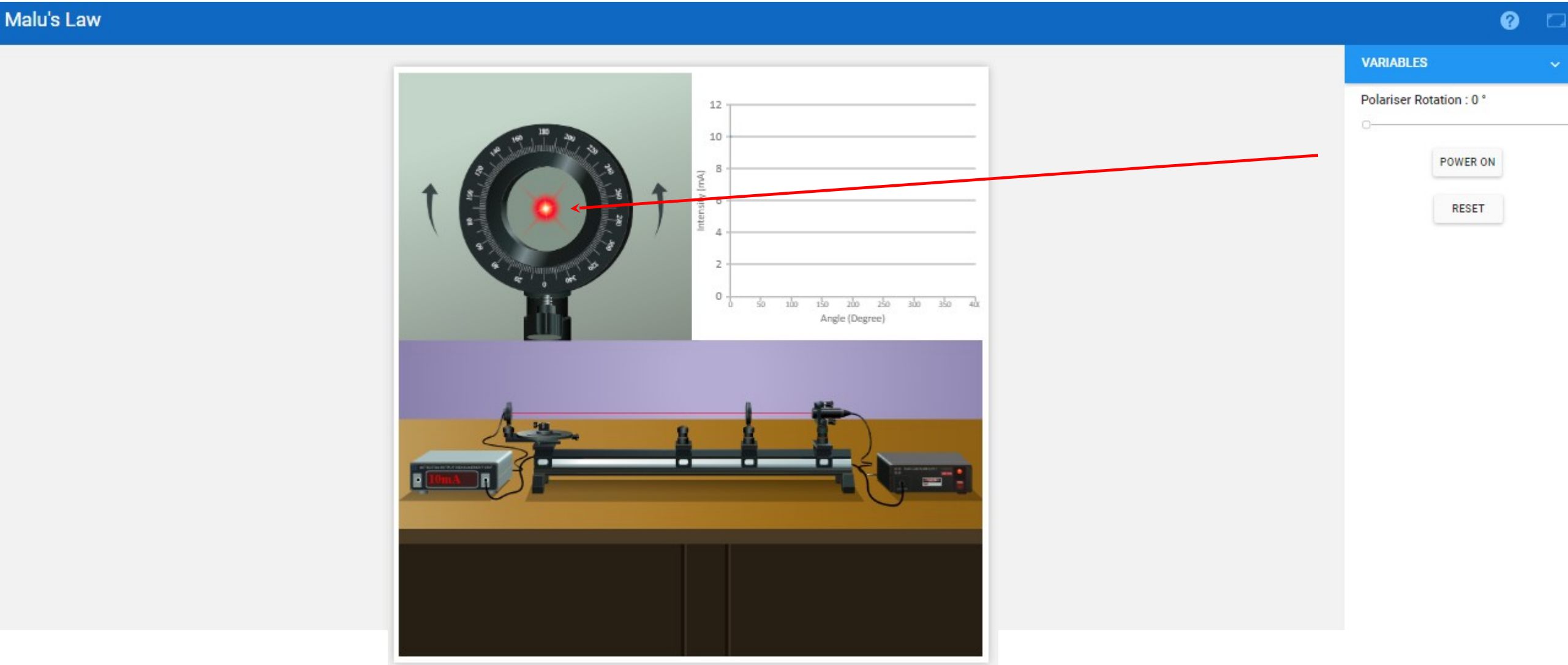
Step by Step guide to perform the experiment on Virtual platform

(1) Go to the link : http://lo-au.vlabs.ac.in/laser-optics/Malus_law/experiment.html

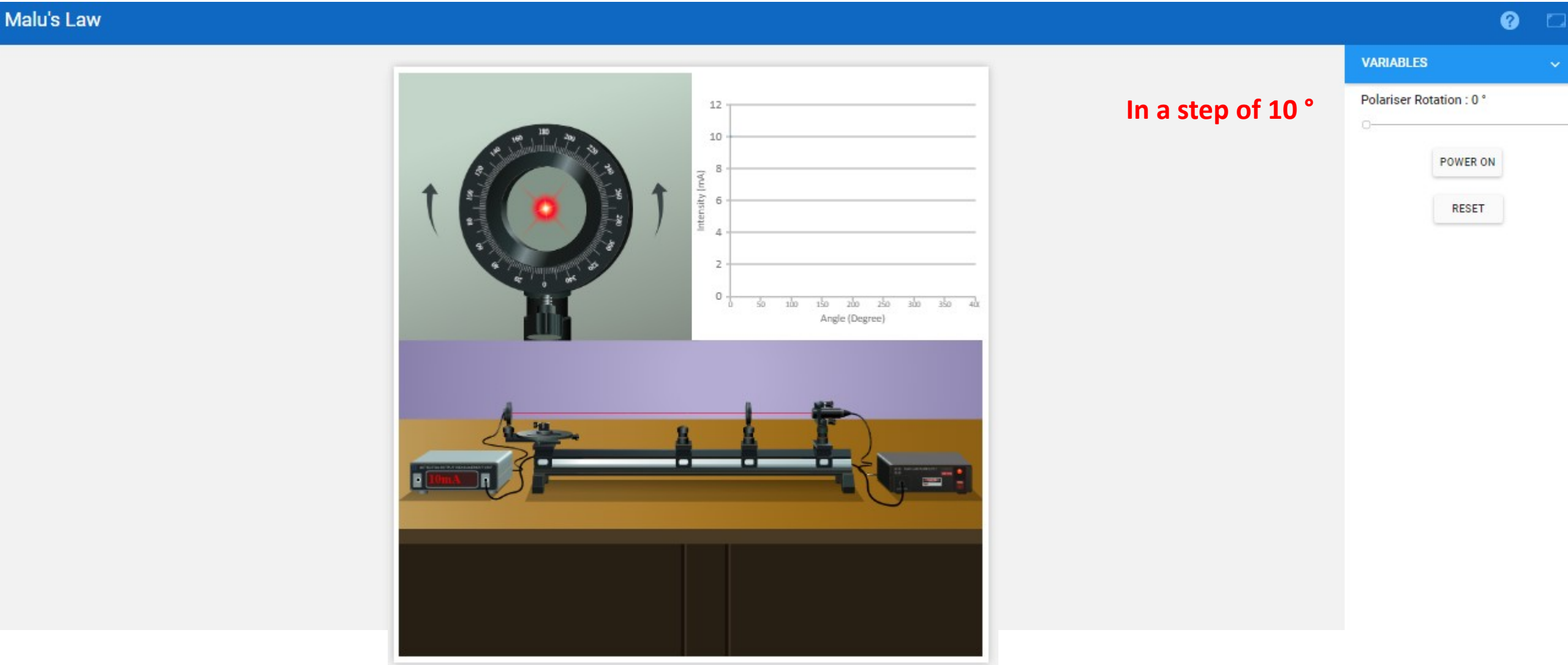
Home page to start experiment



Click on the power on button

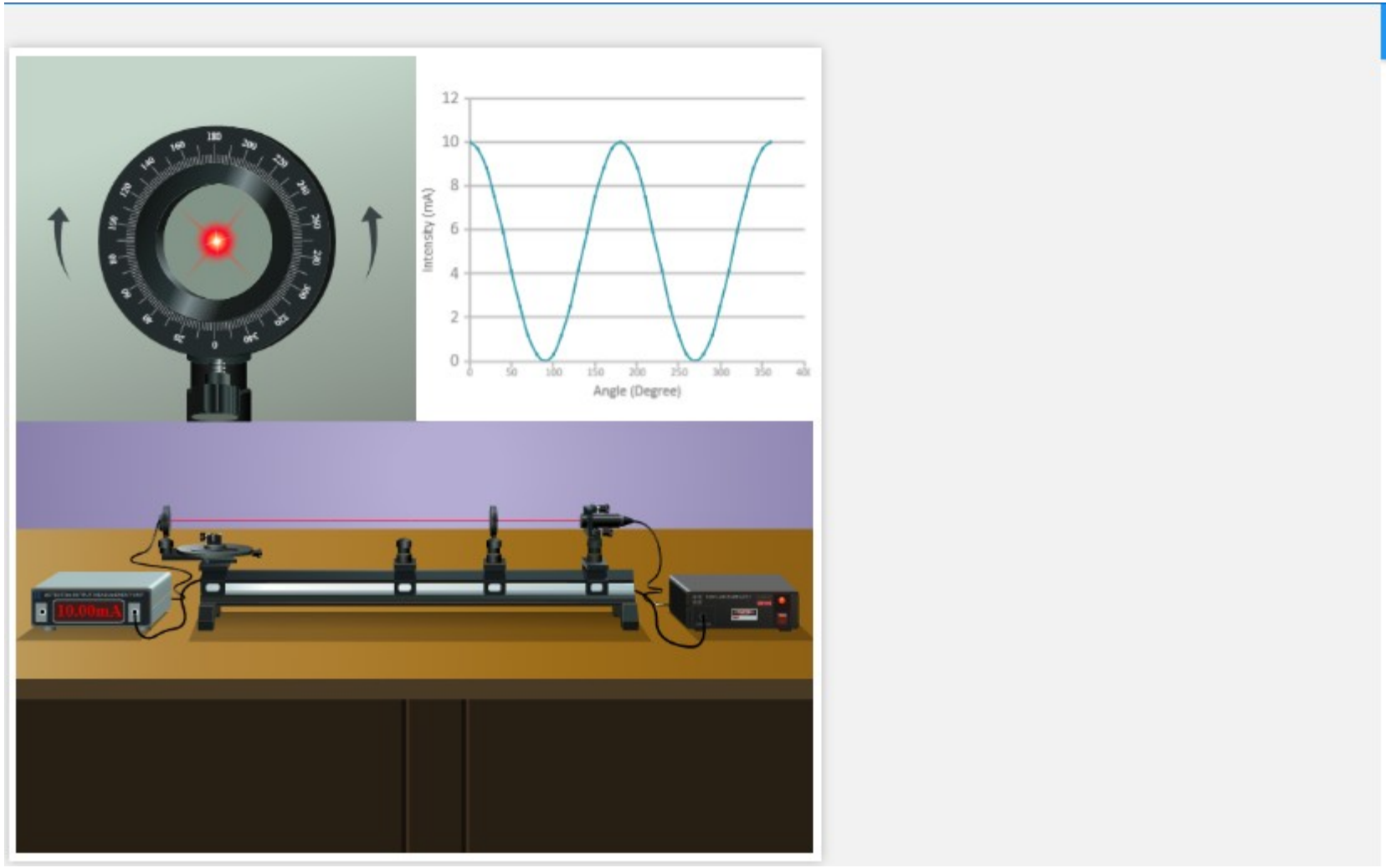


Change the polarizer rotation



In a step of 10 °

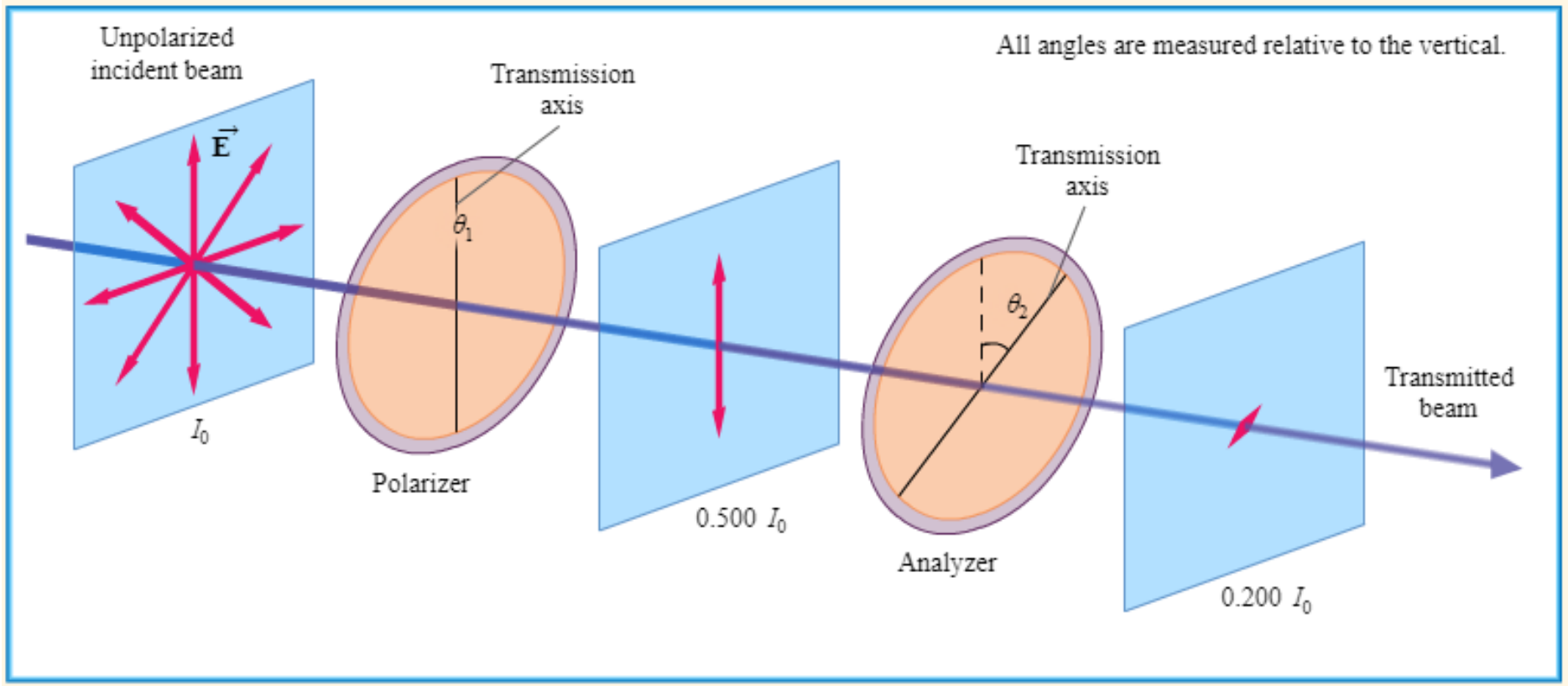
Refer graph for (x,y) coordinates and analyze the graph



Activity Based Session

(go to new link: http://tutor-homework.com/Physics_Help/polarized_light.html)

Select incident beam



Polarization of incident beam

Linearly polarized Unpolarized

Polarizer orientation: θ_1 = 0.0°

Analyzer orientation: θ_2 = 50.8°

Direction of polarization of incident beam: 0.0°

Direction of polarization between polarizer and analyzer: 0.000°

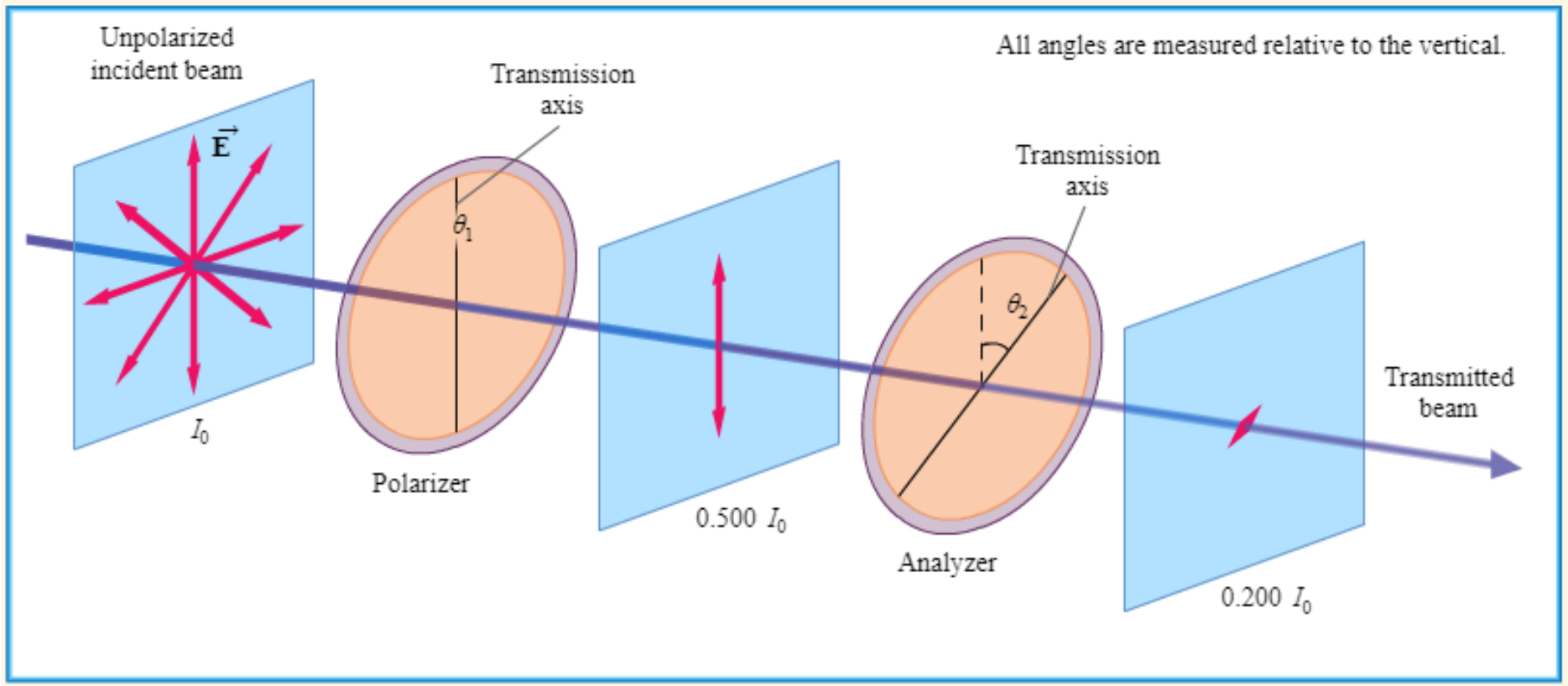
Intensity of light between polarizer and analyzer: 0.500 I_0

Direction of polarization after light passes through analyzer: 50.8°

Intensity of light after it passes through analyzer: 0.200 I_0

Help Reset to default

Select polarization orientation



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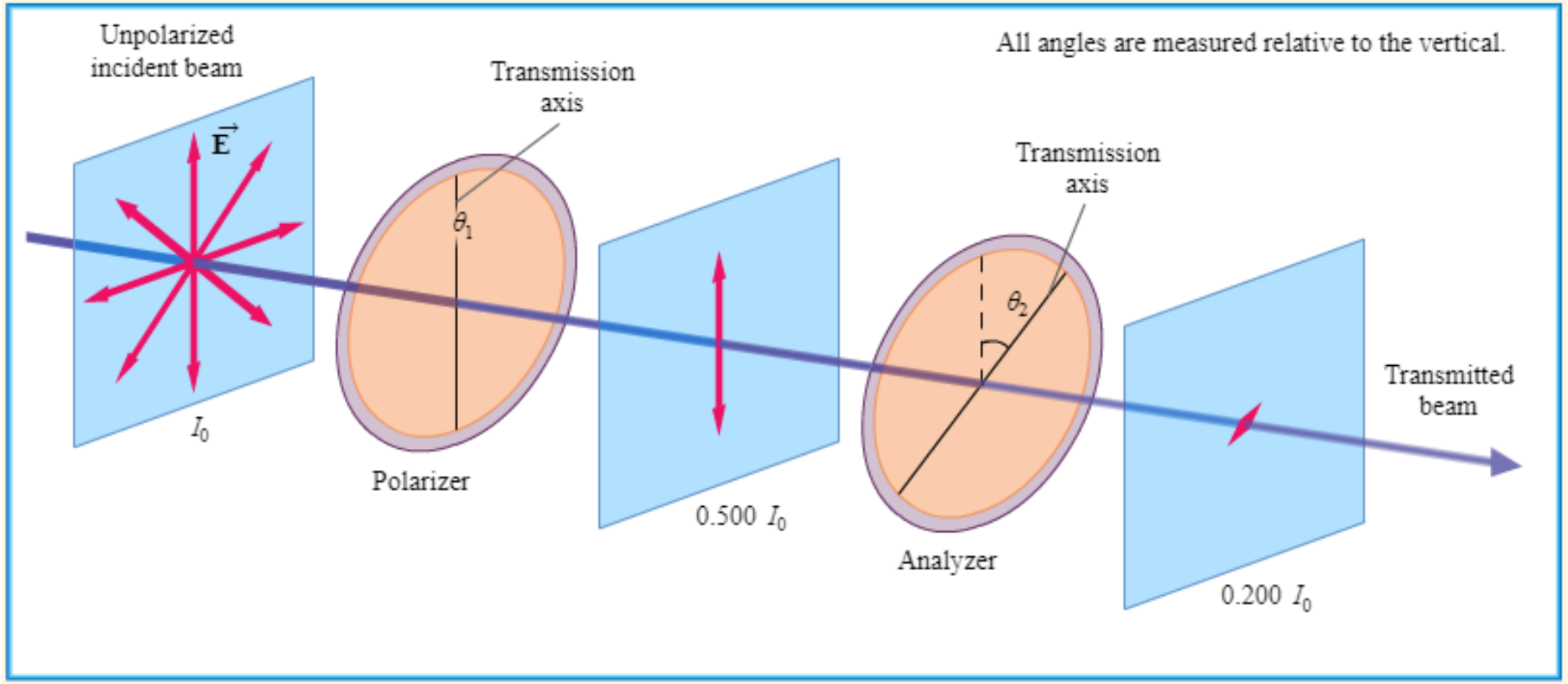
Help Reset to default

Note intensity by changing analyzer orientation



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Help Reset to default

Observation Table

Angle of analyzer, θ_a =

Angle of polarizer, θ_p =

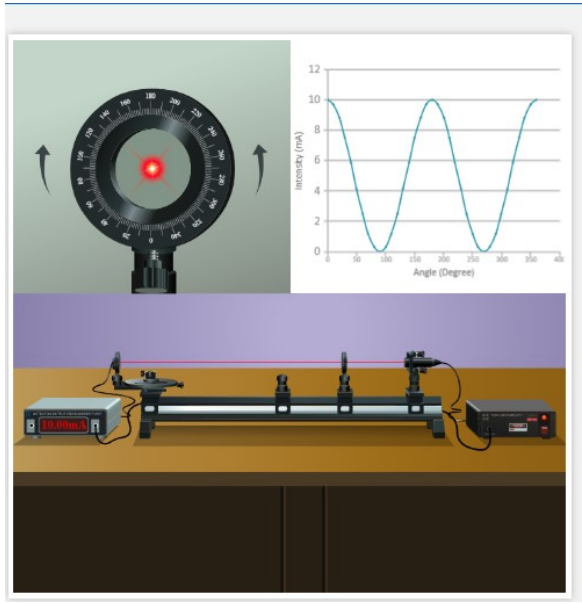
Maximum intensity, I_0 =

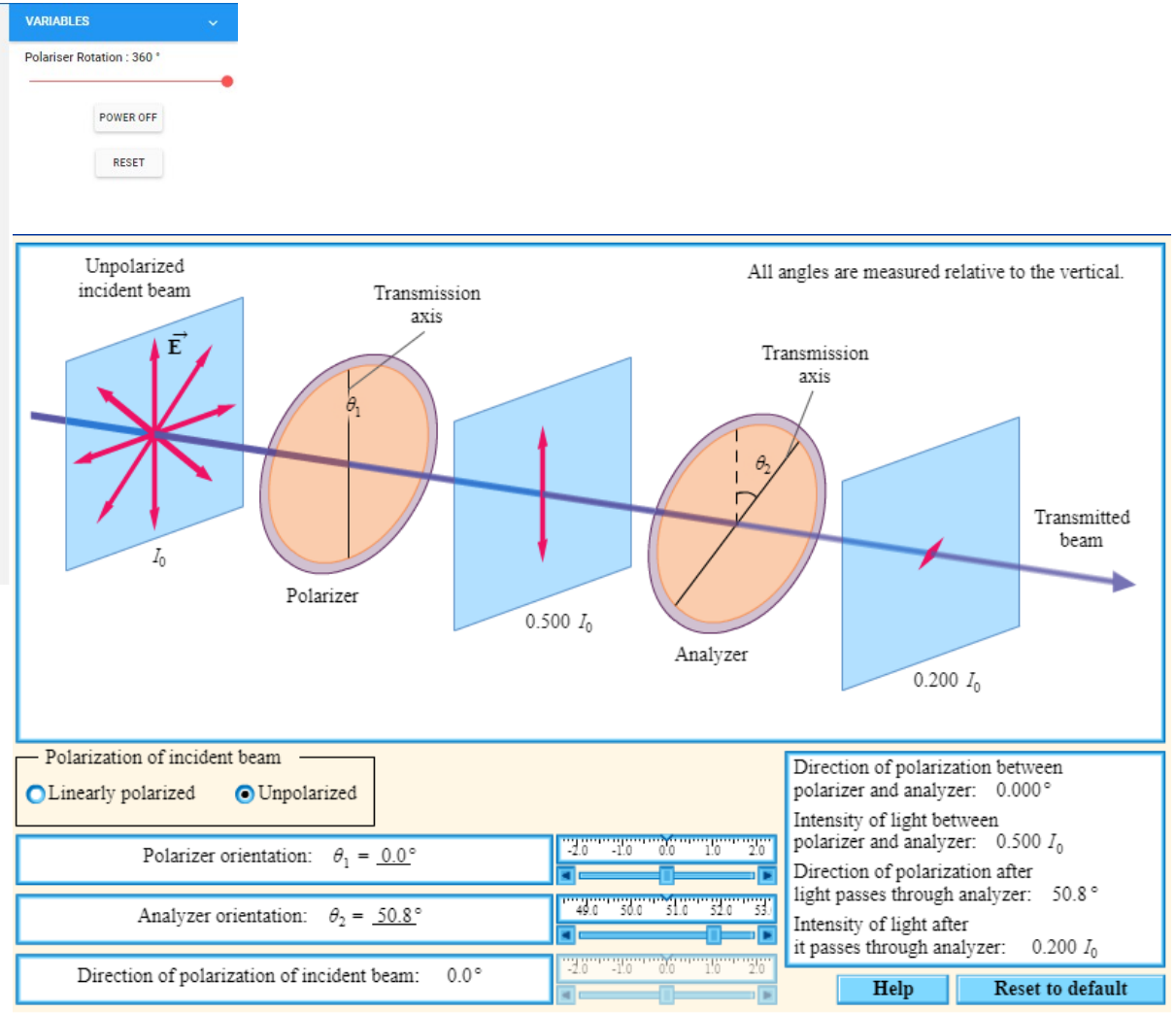
S. No.	$\theta_a - \theta_p$	Ammeter Reading (I_p)	Experimental Relative Intensity (I_p/I_0)	Theoretical Relative Intensity (I_{th}/I_o)

Calculation

- The validity of Malu's law can be verified by plotting a graph between θ vs I_p/I_0 and θ vs I_{th}/I_0
- For comparison, both the curves must be on the same graph paper

Prepare a graph (to match with vlab)





Precautions (in the lab)

1. Beam should be along with the axis of Polaroid
2. Good quality laser beam should be used
3. Power supply should be continuous
4. There should be dark room for this experiment.
5. No obstacle should lie in the path of beam.

Understanding based questions

Understanding based questions

Q

Q1 : A window which can transmit all the incident light without any reflection is called _____

a) Polarized Window
b) Malus Window
c) Brewster Window
d) Non-reflecting window

Understanding based questions

Q

Q2 : Sound waves can be polarized.

a) True
b) False

Understanding based questions

Q

Q3 : If the phase difference between two rays is π/2 and the angle of incidence is not equal to π/4, the emergent light is _____

a) Linearly Polarized
b) Elliptically Polarized
c) Circularly Polarized
d) Non-Polarized

Activity based questions

Activity based questions

Q

Q1 :Polarization of incident beam can be set to

a) Unpolarised
b) Linearly Polarized
c) Elliptically Polarized
d) Both (a) and (b)

Activity based questions

Q

Q2 :Analyzer orientation can be varied from _____ to _____

a) 0°, 360°
b) -90°, 90°
c) -180°, 180°
d) Automatic

Activity based questions

Q

Q3 : Least count of polarizer and analyzer is____

a) 0.1°
b) 0.01°
c) 0.001°
d) Undetermined

Activity based questions

Q

Q4 : Intensity of light after it passes through analyzer is _____when polarizer and analyzer set to 45° and 60°, respectively.

a) 0

b) 0.467 I_0

c) 0.5 I_0

d) I_0

Activity based questions

Q

Q5 : what should be the direction of polarization of incident beam to get maximum intensity (I_0) of light? Consider the polarizer and analyzer set to 45° each.

a) 0°
b) 45°
c) 90°
d) Cannot be achieved