Hi students.

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We will be looking at Brewster's law, which is module number 4

under unit one that is light as an electromagnetic wave.

This is the outline of the presentation. Will be looking

at polarization of light through reflection, Brewster's

angle and Brewster's law.

These are the learning outcomes, by the end of the presentation,

the student will be able to explain the polarization of

light and explain Brewster's angle and Brewster's law.

Coming to polarization of light through reflection.

There was this scientist called as David Brewster, Sir David Brewster

he put forth, this concept of polarization of light

through reflection. So, what is light? we have seen that light

is an electromagnetic wave. It comprises of electric field and

magnetic field which are transverse in nature. So, this

light coming from any conventional source like a tubelight

or sunlight, it's said to be unpolarized light. Why

unpolarized? because it

comprises of vertical and horizontal vibrations. So, if you

see this figure here, you will see that these are vertical

vibrations, and the dots represent horizontal vibrations.

The horizontal vibrations are going and coming in and out of

the screen, whereas vertical vibrations are perpendicular to

the surface of the floor. Now, when this light hits the surface

, we know that some of the light is refracted and some of

it is reflected. So, the light that is coming and

hitting the surface, this light is unpolarized. It

comprises of vertical and horizontal vibrating components.

Now when it hits this surface it is seen that the vertical

components are absorbed and they are refracted, whereas the horizontal

components most of them they get reflected from the surface and

they travel in the same medium as that of the incident light.

So, if you see this figure here, this is the unpolarized light,

comprising of the vertical and horizontal components, and when

it hits the surface between air and liquid, it seen that the

light which is refracted or absorbed into the liquid is

unpolarized that is it comprises of both the components, that is

the vertical and horizontal components. But the reflected

light it comprises of more of the horizontal components, that

is, the dots than the vertical

components. So, you can say this light is slightly

polarized, so when one kind of vibrations dominate over the other type of vibrations it is said to be polarized light. And here if you see closely you will see that the horizontal vibrations are three out of five. So here we can say that the horizontal vibrations are dominating over the vertical vibrations and hence it is said to be slightly polarized light and it is 60% polarized. That is because.

three out of five are horizontal vibrations.

So, this was put forward by Sir David Brewster.

David Brewster, he played along with this concept. What he did was he kept on increasing or decreasing this angle of incidence and he notice that at one angle called i_p, he saw that the reflected light is totally polarized. The reflected light is totally polarized or it is fully polarized light and that angle of incidence at which this happens is called as the Brewster's angle, whereas the

refracted light, you can say it is slightly polarized, or it didn't make much difference, but the reflected light was totally or fully polarized.

Another thing over here to be noted is bruised. According to Brewster, the angle that was measured between the reflected

light and the refracted light was 90 degrees. That is, it was

perpendicular to each other.

This was the Scottish physicist Sir David Brewster who proposed

this. In the year 1811.

So, coming to Brewster’s law.

So as said, when the incident light is incident to the normal

at an angle of incidence which is i_p or Brewster's angle, at

this angle the reflected light is 100% polarized, while the

refracted light is slightly polarized and both the

reflected as well as the refracted light they form an

angle of 90 degrees with each other. So, let's prove

Brewster's law.

by using this.

So here if this is i_p which is an angle with the normal, then

we know that this angle, is the angle of refraction given as r.

So, if this is r and this is a normal, this angle is 90

degrees. So, if this is 90, this angle will be 90 -r and we

also know that the angle between the reflected ray and the

refracted ray is

90 degrees so if this is 90 -r, this is r and again if this

is 90 this again is 90-r and by the law of reflection we know

that angle of incidence is equal to angle of reflection. So, this

90 -r is equal to i_p.

So here by Snell's law we have the refractive index, which is μ is

equal to and n_2 by n_1 , where n_2 is the refractive index of the

medium two and n_1 is the refractive index of medium one.

So, we know that according to Snell's Law it is equal to sine

of the angle of incidence to sige of the angle of reflection.

So here we know that the angle of incidence is i_p and

in the denominator, the angle of refraction is 90 minus i_p

That is this. How we got that? That is obtained from this

equation. So, if we get 90-i_p on the left-hand side and

take r on the other side, we have the angle of refraction

which is 90 minus i_p. So that'show we get the denominator. So

we have sine i_p divided by cos i_p and sine i_p by cos i_p

gives us tan of i_p, So Brewster's law states that refractive

index is equal to the tangent of

the brewster's angle, that is mu is equal to tan of i

subscript P, where i_p is the Brewster's angle.

Coming to the application of Brewster's Law, so one of the

very common application is sunglasses, which you all must

have used. So, these glasses they use the principle of Brewster's

angle. Now the polarized glasses, they reduce the glare

that is reflected directly from the sun or from horizontal

surface is like road or water.

Also, photograph's use the same law to reduce reflection from

reflective surface is by using the polarizing filter for the

lens. So, these are some of the applications of Brewster's law.

Coming to one of the example of Brewster's law, we have a solved

example here. So that is what will be the Brewster's angle of

light. If the light travels from air into water. So here we have

medium one which is air and we have medium two which is water.

So refractive index of air is 1 and refractive index of water is

1.33. So, we know as

per Snell's law. That mu is equal to n_2 by n_1 that is

equal to sine of the angle of incidence to sine of the angle

of refraction. But for Brewster's law this is cos i_p

so sine upon cos gives us tan i_p. So now the Brewster's

angle i_p is given as tan inverse take tan on the other side. So

we have tan inverse of n_2 by n_1. So, solving this

substituting the values of.

n_2 and n_1 that this tan inverse of 1.33 / 1 we get an

angle of 53.1 degrees. So hence we can say that Brewster's angle

is 53.1 degrees. So, at this angle the reflected light will

be totally polarized, that is it is 100% polarized.

This is the summary, so we've looked at polarization

of light through reflection. We covered the Brewster’s angle

and last we saw the Brewster's law, which is nothing but the

refractive index is equal to tangent of the angle of Brewster.

These are the references.

Thank you.