Appendix 9: Tips of Digital Material

Tips of Digital materials. No.2

16/June 2002

1. Review of the Design
2. What is a digital material
3. Tips of Digital materials

1. Review of the Design

Sample(prototype) No.1

If programmers and designers develop digital material according to design as it is.

START

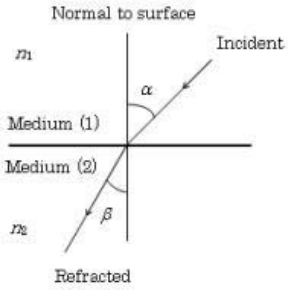
Introduction to Refraction *(Expected time 5min)*

◎**Refraction is the deviation in the course of light as a result of being transmitted between two transparent media.**

◎ **Angle of incidence : is the angle between the incident beam and the normal to the refracting surface at the point of incidence.**

◎ **Angle of refraction : is the angle between the refracted beam and the normal to the refracting surface at the point of refraction.**

◎ **Index of refraction: is the ratio between the speed of light in vacuum to the speed of light in a material medium**



(an animation corresponding to appearance of the lines.

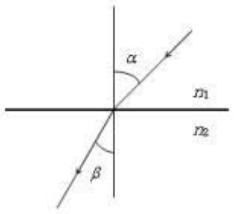
With a narration.)

NEXT

Snell's law(1) *(Expected time 5min)*

◎**This law relates the angle of incidence and refraction in two media on the one hand, and the indices of refraction of the two media on the other. Mathematically, Snell's law is expressed by the following formula:**

$$n_1 \sin\alpha = n_2 \sin\beta$$



(an animation.

With a narration.)

<u>You can notice from</u> the figure that light is refracted when it is transmitted from one medium having a given value of index of refraction to another medium having a different value of index of refraction .

<u>You can also notice</u> from the figure that if , then , and if then .

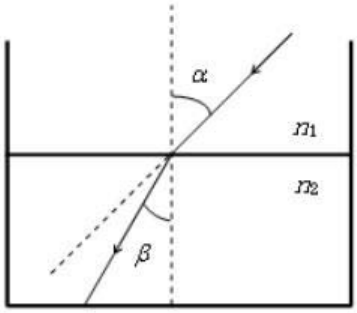
NEXT

Angle of deviation

(Expected time 5min)

This is the angle between the refracted beam and the extension of the incident beam, that is to say: .

Example: A beam of light is incident from air at angle of on a water surface, and is refracted at an angle , this means that the angle of deviation is:.



$$\delta = \alpha - \beta$$
$$= 65 - 43 = 22^\circ$$

(an animation. With a narration.)

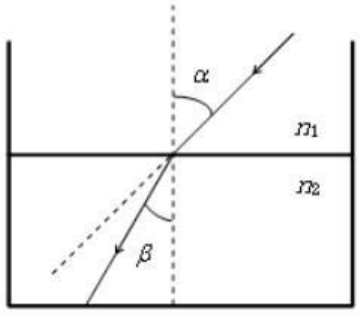
Continue

Angle of deviation

Exercise: If the angle of deviation of a refracted beam is 30 , and the angle of incidence is 70 , then the angle of refraction is equal to:

[ ] 100 [ ] 40 [ ] 50

:.



HINT

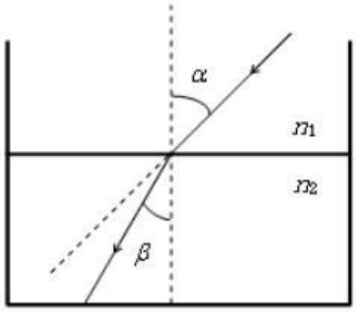
Evaluate

Angle of deviation

Exercise: **If the angle of deviation of a refracted beam is 30 , and the angle of incidence is 70 , then the angle of refraction is equal to:**

[ ] 100 [ ] 40 [ ] 50

:.



Check & explanation:

Good!.....

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NEXT

Snell's law:

(Expected time 5min)

Example: **A light beam is incident from glass at an angle onto water. The beam is then refracted at an angle of If the index of refraction of water is 1.33, then the angle of refraction in glass is:**

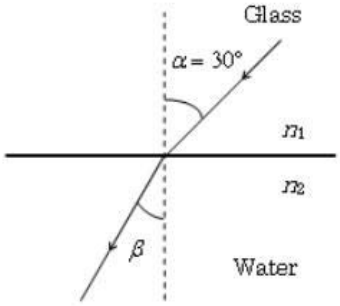
Solution:

Using Snell's law:

$$n_1 \sin\alpha = n_2 \sin\beta$$

$$n_1 \sin 30 = 1.33 \sin 40$$

$$n_1 = \frac{1.33 \sin 37}{\sin 30} = 1.6$$



(an animation.

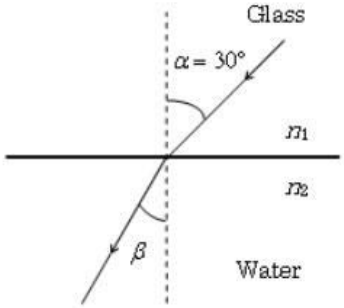
With a narration.)

Continue

Snell's law:

Exercise: **A beam of light is incident from air onto a transparent material having an index of refraction 1.4. If the angle of refraction in that material is 30 , then the angle of incidence is:**

[ ] 25 [ ] 30 [ ] 45



HINT

Evaluate

Snell's law:

Exercise: **A beam of light is incident from air onto a transparent material having an index of refraction 1.4. If the angle of refraction in that material is 30 , then the angle of incidence is:**

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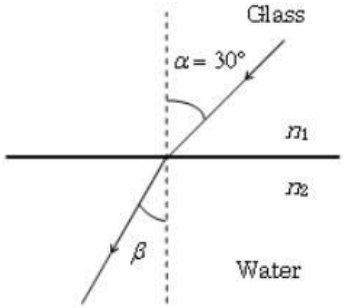

Check & explanation:

Good!.....

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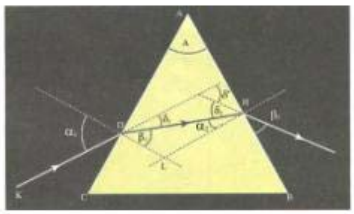
NEXT

Refraction of Light in a prism: *(Expected time 5min)*

When a light beam is incident on the surface of the prism at an angle it will behave as in the figure: at the first prism face, the light beam is refracted by an angle and is then incident on the other face of the prism at an angle , where it is refracted by an angle .



By changing the angle of incidence on the first face, the angle of refraction on the other face is changed. And it is noted that the light beam deviates from its original course twice; the first is caused by refraction at the first face , and the second by refraction at the second face . Therefore, total angle of deviation of the incident beam is the angle subtended by the extensions of the incident beam on the first face, and the refracted beam at the second face:

(an animation corresponding to appearance of the lines. With a narration.)

NEXT

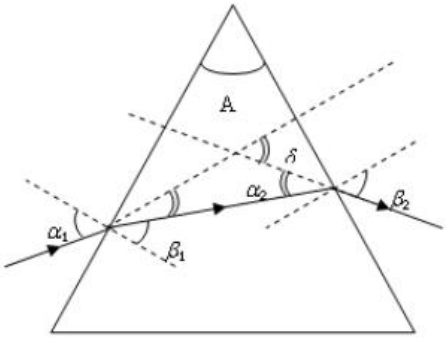
Total angle of deviation in a prism:

Example:

$$\Delta\delta' = \Delta\delta_2 - \Delta\delta_1$$
$$= \Delta\alpha_1 - \Delta\beta_1 + \Delta\alpha_2 - \Delta\beta_2$$

But , where is the apex angle.

$$\boxed{\Delta\delta = \Delta\alpha_1 + \Delta\beta_1 - \Delta A}$$



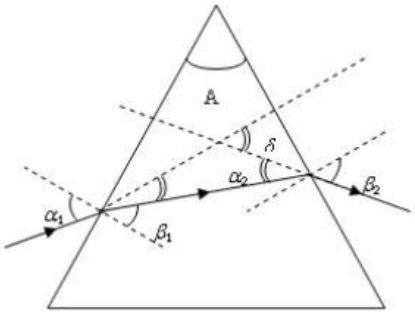
(an animation. With a narration.)

Continue

Total angle of deviation in a prism:

Question: **A light beam is incident at angle on a prism having apex angle , and it exits the prism at , angle of deviation:**

[ ] 25 [ ] 85 [ ] 15.



HINT

Evaluate

Total angle of deviation in a prism:

Question: **A light beam is incident at angle on a prism having apex angle , and it exits the prism at , angle of deviation:**

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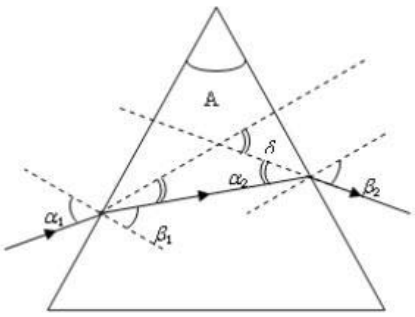

Check & explanation:

Good!.....

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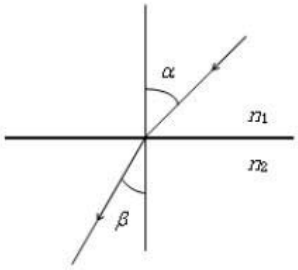
NEXT

Exercise (1):

(Expected time 7min)

A beam of light is incident from air on Perspex glass at an angle of , and is then refracted at an angle of . How much is the index of refraction for the Perspex glass?



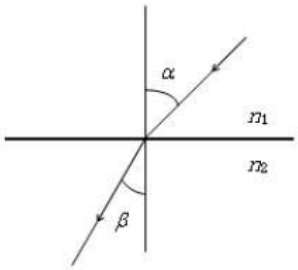
HINT

Solution

Exercise (1):

(Expected time 7min)

A beam of light is incident from air on Perspex glass at an angle of , and is then refracted at an angle of . How much is the index of refraction for the Perspex glass?



Solution of exercises:

$$n_1 \sin\alpha = n_2 \sin\beta$$

$$1 \times \sin 53 = n_2 \sin 30$$

$$n_2 = \frac{\sin 53}{\sin 30} = 1.6$$

NEXT

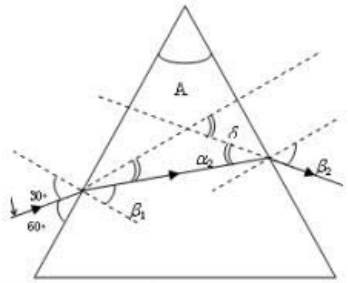
Exercise (2):

(Expected time 7min)

A beam is incident on a prism. The index of refraction for the material of the prism is 1.5, and its apex angle is , as depicted in the adjacent figure.

1.Trace the course of the incident beam inside the prism and outside it.

2.Calculate the angle of total deviation.



HINT

Solution

Exercise (2):

(Expected time 7min)

A beam is incident on a prism. The index of refraction for the material of the prism is 1.5, and its apex angle is , as depicted in the adjacent figure.

1.Trace the course of the incident beam inside the prism and outside it.

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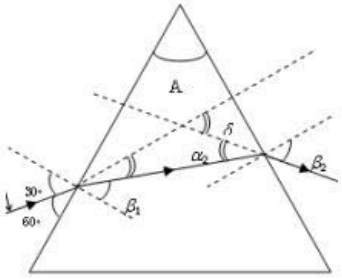

Solution of exercises:

$n_1 \sin\alpha_1 = n_2 \sin\beta_1$

$1\times\sin 30 = 1.5\times\sin\beta_1$

$\sin\beta_1 = \frac{0.5}{1.5} = 0.33 \Rightarrow \beta_1 = 19.47°$

$\angle A = \angle\alpha_2 + \angle\beta_1$

$\Rightarrow \angle\alpha_2 = \angle A - \angle\beta_1$

$= 60 - 19.47 = 40.53°$

$n_2 \sin\alpha_2 = n_1 \sin\beta_2$

$1.5\times\sin\alpha_2 = 1\times\sin\beta_2$

$\Rightarrow \sin\beta_2 = 1.5\sin\alpha_2 = 1.5\times 0.649 = 0.975$

$\therefore \beta_2 = 77.1°$

$\angle\delta = \angle\alpha_1 + \angle\beta_2 - \angle A$

$= 60 + 77.1 - 60 = 77.1°$

NEXT