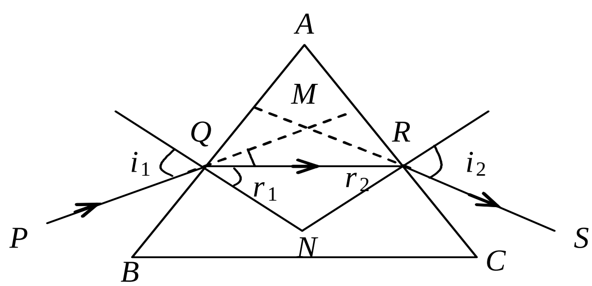
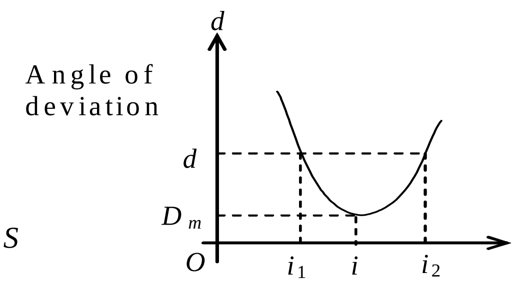
RAY OPTICS
5. PRISM

POINTS TO REMEMBER

1. Prism

a) A prism is a piece of gas or any other transparent material, bounded by two triangular and three rectangular surfaces.





b) When a light ray passes through a prism it bends towards the base of the prism.
c) The angle made by emergent ray with incident ray is called angle of deviation (d).
d) $d=i_1+i_2-A$, $A=r_1+r_2$ where i_1 – angle of incidence, i_2 – angle of emergence, A – angle of prism, r_1 – angle of refraction at first retracing face, r_2 – angle of refraction at second refracting face.
e) As the angle of incidence increases, angle of deviation first decreases to a minimum value (D) and then increases.
f) If d=D, then $i_1=i_2=i$ and $r_1=r_2=r$

$\Rightarrow D = 2i - A, \; A = 2r$

g) $\mu = \dfrac{\sin\left(\dfrac{A+D}{2}\right)}{\sin\dfrac{A}{2}}$

h) As refractive index (μ) of material of prism increases the angle of deviation increases.
i) As angle of prism (A) increases, the angle of deviation increases.
j) As wavelength of light increases, the angle of deviation decreases. Ex : The angle of deviation for red is minimum as it has maximum wavelength. The angle of deviation of violet is maximum as it has minimum wavelength.
k) If D=A, then $\mu = 2\cos\dfrac{A}{2}$
l) The prism whose angle is very small is called thin prism.
m) For a thin prism $D=(\mu-1)A$.

2. Refraction through a prism :

A → angle of the prism or refracting angle
D → angle of deviation
i_1, i_2 → are the angles of refraction
i) Angle of prism, $A=r_1+r_2$
ii) Angle of deviation $D=i_1+i_2-A$
iii) Refractive index of the prism, $\mu = \dfrac{\sin i_1}{\sin r_1} = \dfrac{\sin i_2}{\sin r_2}$

3. Limiting angle of the prism :

a) It is the angle of the prism for which a ray grazing on one of the face of the prism after refraction grazes out from the second face.

b) In this case $i_1=i_2=90°$, $r_1=r_2=C$

As $A=r_1+r_2$

$\therefore$ A=2C

c) $\mu = \frac{1}{\sin C} = \frac{1}{\sin(A/2)}$

d) Angle of deviation, $D=i_1+i_2-A=90+90-2C$. $\therefore D=180-2C$

i. Deviation in a small angled prism :

a) From snell's law

$\sin i_1=\mu \sin r_1$ and $\sin i_2=\mu \sin r_2$

For a small angled prism, i_1, i_2, r_1 and r_2 are small

$\therefore$ $i_1=\mu r_1$ and $i_2=\mu r_2$

$d=(i_1+i_2)-A=\mu(r_1+r_2)-A=\mu A-A$

$\therefore$ $d=(\mu-1)A$

b) As $\mu_V > \mu_R$. Therefore the deviation for violet colour is more than the deviation for red colour ($d_v>d_r$).

c) For a given colour of light the deviation increases as the angle of the prism increases.

d) For a given monochromatic light $\frac{d_1}{d_2} = \frac{A_1}{A_2}$.

e) In case of thin prism, the angle of minimum deviation, $d_m=(\mu-1)A$.

LONG ANSWER QUESTIONS

1. Derive prism formula. On what factors does the angle of minimum deviation depend?

A. ABC is the cross section of a glass prism and A is the angle of the prism. PQ is the incident light ray. QR is the refracted light ray and RS is the emergent light ray.

i_1 is the angle of incidence and i_2 is the angle of emergence.

r_1 and r_2 are the angles of refraction.

In the quadrilateral AQNR, $\angle$Q and $\angle$R are 90°

Therefore $\angle A + \angle N = 180°$.

In the triangle QNR,

$r_1 + r_2 + \angle N = 180°$

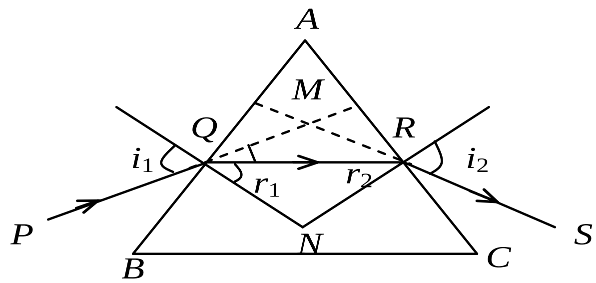
$r_1 + r_2 + \angle N = \angle A + \angle N$

$r_1 + r_2 = \angle A$…………(1)

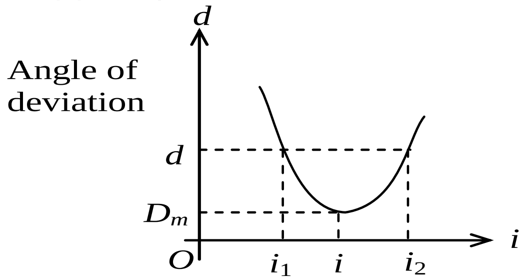
In the ΔMQR,

$\angle MQR = i_1 - r_1$

$\angle MRQ = i_2 - r_2$



Also, $\angle d = \angle MQR + \angle MRQ$
$= i_1 - r_1 + i_2 - r_2$
$\therefore \angle d = (i_1 + i_2) - (r_1 + r_2)$
(The external angle is equal to the sum of internal opposite angles)
Using eq (1)
$i_1 + i_2 = A + d$ …………(2)
A graph plotted between the angle of incidence and the corresponding angle of deviation (d) is a parabola as shown.



As the angle of incidence increases the angle of deviation first decreases, becomes minimum and again increases.
The angle of incidence for which the deviation produced by the prism is minimum is called angle of minimum deviation.
base of the prism.
At $d = D_m$
$i_1 = i_2 = i$ and $r_1 = r_2 = r$
$\therefore$ From eq. (1) and (2) $i = \dfrac{A + D_m}{2}$ and $r = \dfrac{A}{2}$

From Snell's law, $\mu = \dfrac{\sin i}{\sin r}$

$\therefore \mu = \dfrac{\sin\left(\dfrac{A + D_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$ Where μ is the refractive index of the material of the prism.

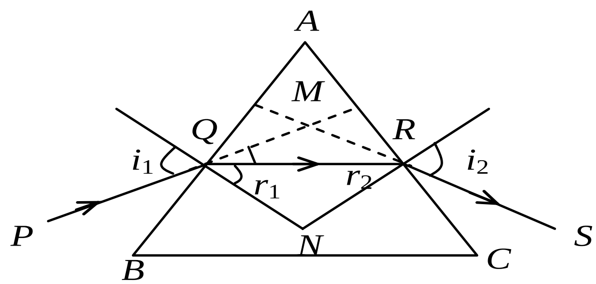
The angle of deviation of a prism depends on a) Angle of incidence b) Angle of the prism c) Reactive index of the material of the prism

2. Prove the rotation $A + D = i_1 + i_2$ for a prism. What does this relation become when the prism is placed in minimum deviation position?

A. ABC is the cross section of a glass prism and A is the angle of the prism. PQ is the incident light ray. QR is the refracted light ray and RS is the emergent light ray.
i_1 is the angle of incidence and i_2 is the angle of emergence.

r_1 and r_2 are the angles of refraction.
In the quadrilateral AQNR, $\angle$Q and $\angle$R are 90°

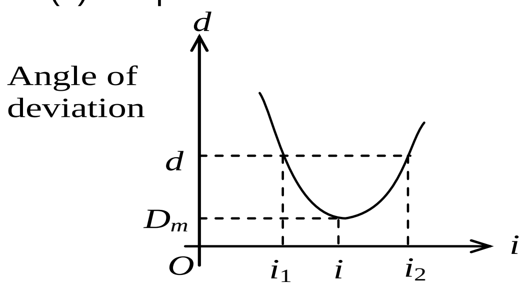
Therefore $\angle A + \angle N = 180°$.In the triangle QNR,
$r_1 + r_2 + \angle N = 180°$
$r_1 + r_2 + \angle N = \angle A + \angle N$
$r_1 + r_2 = \angle A$…………(1)
In the ΔMQR,
$\angle MQR = i_1 - r_1$
$\angle MRQ = i_2 - r_2$



Also, $\angle d = \angle MQR + \angle MRQ$
$= i_1 - r_1 + i_2 - r_2$
$\therefore \angle d = (i_1 + i_2) - (r_1 + r_2)$
(The external angle is equal to the sum of internal opposite angles)
Using eq (1)

$$i_1 + i_2 = A + d \text{ …………(2)}$$

A graph plotted between the angle of incidence and the corresponding angle of deviation (d) is a parabola as shown.



As the angle of incidence increases the angle of deviation first decreases, becomes minimum and again increases.
The angle of incidence for which the deviation produced by the prism is minimum is called angle of minimum deviation.
At this angle of minimum deviation, the refracted light ray in the prism is parallel to the base of the prism.
At $d = D_m$

$$i_1 = i_2 = i \text{ and } r_1 = r_2 = r$$

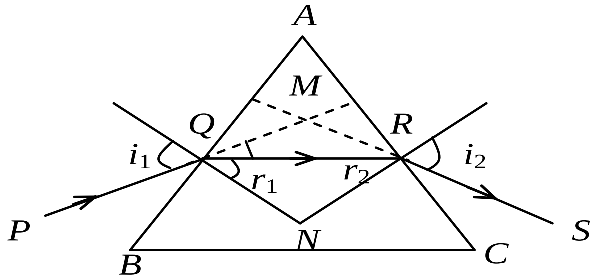
$\therefore$From eq. (1) and (2)

$$i = \frac{A + D_m}{2} \quad \text{and} \quad r = \frac{A}{2}$$

3. Discuss the phenomenon of refraction through a prism. Prove that $\delta = A(\mu - 1)$ for a small angled prism, where the symbols have their usual

meanings. How does this formula change if the prism is made of material of refractive index μ_2 kept in a medium of refractive index μ_1.

A. ABC is the cross section of a glass prism and A is the angle of the prism. AB and AC are the refracting surfaces and BC is the base of the prism. PQ is the incident light ray. QR is the refracted light ray and RS is the emergent light ray. Let i_1 is the angle of incidence and i_2 is the angle of emergence. Let r_1 *and* r_2 be the angles of refraction and'd' is the angle of deviation.



As the angle of incidence increases, the angle of deviation gradually decreases and reaches the minimum value which is known as the angle of minimum deviation and again gradually increases.

When the angle of deviation (D) decreases the two angles i_1 *and* i_2 come closer to each other and the two angles of incidence become same at the angle of minimum deviation (δ)

$$\therefore As\, i_1 = i_2 \Rightarrow r_1 = r_2$$

We know that $i_1 + i_2 = A + D\, and\, r_1 + r_2 = A$

$\therefore 2i = A + \delta \quad 2r = A \quad (\therefore D_m = \delta)$

$i = \dfrac{A+\delta}{2} \quad \Rightarrow r = \dfrac{A}{2}$

From Snell's law $\mu = \dfrac{\sin i}{\sin r}$

$$\therefore \mu = \frac{\sin\left(\dfrac{A+\delta}{2}\right)}{\sin \dfrac{A}{2}}$$

<u>For thin prism or small angled prism:</u>

If the prism is very thin then it processes the very small angle of prism. And its angle of deviation is minimum (δ)

For small angles $\sin\dfrac{A}{2} \approx \dfrac{A}{2} \quad and \quad \sin\dfrac{A+\delta}{2} = \dfrac{A+\delta}{2}$

The deviation produced by a thin prism of refractive index of μ is given by

$$\mu = \frac{\sin\left(\dfrac{A+D_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)} when\, \theta < 10^0$$

$$\mu = \left(\frac{A+D_m}{A}\right) \Rightarrow \mu A = A + D_m \Rightarrow D_m = (\mu - 1)A$$

If the prism of refractive index of μ_2 is placed in a medium of refractive index of μ_1 the deviation produced by a thin prism is given by $\delta = \left(\frac{\mu_2}{\mu_1} - 1\right) A$

SHORT ANSWER QUESTIONS

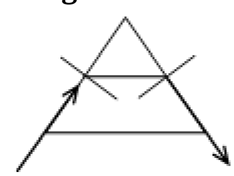
1. A glass prism has a minimum angle of deviation δ for air. State with reason, how the angle of minimum deviation will change if the prism is immersed in a liquid of refractive index greater than 1.
When does a ray of light incident on a prism deviate away from the base?

A. Refractive index of the material of the prism is $\mu \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\left(\frac{A}{2}\right)}$ where δ the angle of minimum deviation. If the prism is immersed in a liquid of refractive index greater than one , the angle of minimum deviation will increase,. This is because for a small angled prism $\delta = A(\mu - 1)$. So as the μ decreases δ decreases.

The ray of light incident on a prism deviate away from the base, when the prism is immersed in liquid whose μ greater than that the prism.

2. Show that the limiting value of the angle of prism is twice its critical angle.

A. The angle at which grazing incidence and grazing emergence occurs is called the limiting angle for a prism



$i_1 = 90^0$ and $r_1 = C$;
$i_2 = 90^0$ and $r_2 = C$
$\therefore r_1 + r_2 = A$ or $A = 2C$

That is the angle of the prism (Limiting angle) is double the critical angle.

SOLVED PROBLEMS

1. An equilateral glass prism is made of a material of refractive index 1.500. Find its angle of minimum deviation.

A. $A = 60^0; \mu = 1.5; \delta = ?$

Substituting in $\mu = \frac{\sin\frac{A+\delta}{2}}{\sin\frac{A}{2}}$ $\Rightarrow 1.5 = \frac{\sin\left(\frac{60^0+\delta}{2}\right)}{\sin\left(\frac{60^0}{2}\right)}$ $\Rightarrow \delta = 37^0 10'$

2. A prism of refracting angle 4^0 is made of a material of refractive index 1.652. Find its angle of minimum deviation.

A. $A = 4^0, \mu = 1.652, \delta = ?$

Substituting in $\delta = A(\mu - 1) = 4^0(1.652 - 1) = 2.608^0$

3. The angle of minimum deviation produced by a 60^0 prism is 40^0. Calculate the refractive index of the material of the prism.

A. $A = 60^0, \mu = 40^0, \delta = ?$

Refractive index of the material of the prism,

$$\mu = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\frac{A}{2}} - \frac{\sin\left(\frac{60^0+40^0}{2}\right)}{\sin\left(\frac{60^0}{2}\right)} = 1.532$$

4. Calculate the angle of incidence one face of a prism of refracting angle 60^0 and of refractive index 1.5 for which the emergent ray just grazes the other face.

Sol. $\mu = \frac{\sin i_2}{\sin r_2} \Rightarrow 1.5 = \frac{\sin 90}{\sin r_2} \Rightarrow r_2 = 41^0 49'$

But $r_1 + r_2 = A$; $r_1 = A - r_2 = 60^0 - 41^0 49' = 18^0 11'$

Also, $\mu = \frac{\sin i_1}{\sin r_1}$

Or $\sin i_1 = \mu \sin r_1 = 1.5 \sin 18^0 11' = 1.5 \times 0.3121 = 0.4682 \Rightarrow \quad i_1 = 27^0 55'$

5. Light falls at normal incidence on one face of a glass prism of refractive index 1.5. What will be the angle of emergence when the angle of the prism is a) 30^0 b) 50^0?

A. $i_1 = 0$ and $r_1 = 0$

a) $A = 30^0$

But , $r_1 + r_2 = A \Rightarrow \quad r_2 = 30^0$

$\sin i_2 = \mu \sin r_2 = 1.5 \sin 30^0 = 0.75 \Rightarrow \quad i_2 = 48^0 35'$

b) $A = 50^0$

Again, $r_1 + r_2 = A \quad \Rightarrow r_2 = 50^0$

$\sin i_2 = \mu \sin r_2 = 15 \sin 50^0 = 1.149$

No value of i_2 can satisfy this relation. SO, there is no refraction at the second surface i.e., there is no emergent ray from the face AC of the prism. The light is totally reflected as r_2 is greater than the critical angle.

6. A ray of light is incident normally on one of the refracting surfaces of a prism of refracting angle A. The emergent ray grazes the other refracting surface, find the refractive index of the material of the prism.

A. For normal incidence on one of the refracting faces of the prism, $i_1 = 0$ and $r_1 = 0$.

But, $r_1 + r_2 = A \quad \Rightarrow \quad r_2 = A$

Since the emergent light grazes the second surface, r_2 becomes the critical angle (C)

i.e., C = A and hence $\mu = \frac{1}{\sin C} = \frac{1}{\sin A}$

7. A glass prism is made of a material of refractive index 1.5. When it is placed in air what will be the maximum value of the angle of the prism so that there will be an emergent ray? (Assume that $\mu \, of \; air \approx 1$)

A. The critical angle for glass – air interface,

$$C = \sin^{-1}\left(\frac{1}{\mu}\right) = \sin^{-1}\left(\frac{1}{1.5}\right) = \sin^{-1}(0.6667) = 41^0 49'$$

Neither $r_1 \; nor \; r_2$ cannot be greater than C for an emergent ray.

In the limiting case, $r_1 + r_2 = 2C$.

But, $r_1 + r_2 = A$

$\therefore$ A = 2C $= 2 \times 41^0 49' = 83^0 38'$

8. A glass prism placed in air has refractive index 1.5 and its refracting angle is 60^0. Find the range of the values of the angle of incidence for which it is possible to have an emergent ray.

A. To have an emergent ray r_2 must lie between 0^0 and the critical angle C.

$$\therefore \mu = \frac{1}{\sin C}; \sin C = \frac{1}{\mu} = \frac{1}{1.5} = 0.6667; C = 41^0 49'$$

i) When $r_2 = C = 41^0 49', r_1 = A - r_2 = 60^0 - 41^0 49' = 18^0 11'$ $\quad (\therefore r_1 + r_2 = A)$

Sin $i_1 = \mu \sin r_1 = 1.5 \sin 18^0 11' = 1.5 \times 0.3121 = 0.4682; i_1 = 27^0 55'$

ii) When $r_2 = 0, r_1$ must be equal to the critical angle i.e., $r_1 = 41^0 49^0$ so that the emergent ray is normal to the other surface.

$\sin i_1 = \mu \sin r_1 = 1.5 \sin 41^0 49' = 1.5 \times 0.6667 = 1.0; i_1 = 90^0.$

Hence the range of angle of incidence is $29^0 55'$ and 90^0.

UNSOLVED PROBLEMS :

1. Light falls at normal incidence on one face of a glass prism of refractive index 1.5. What will be the angle of emergence, when the angle of the prism is 40^0 ?

A. In the fig At surface AB

$i_1 = 0, r_1 = 0$

From , $r_1 + r_2 = A$ $\qquad \Rightarrow r_2 = A = 40^0$

Again, $$\mu = \frac{\sin i_2}{\sin r_2} = \frac{\sin i_2}{\sin A}$$

$\sin i_2 = \mu \sin A = 1.5 \sin 40^0 = 1.5 \times 0.6428$, $\Rightarrow i_2 = 74^0 37'$

2. A glass prism of refractive index 1.5 is placed in water of refractive index 1.33. What will be the minimum value of the angle of the prism so that it will not be possible to have any emergent ray?

A. $\mu_g = 1.5 \mu_w = 1.33$

When prism is placed in water,

$$\frac{\mu_g}{\mu_w} = \frac{1}{\sin c} \Rightarrow \frac{1.5}{1.33} = \frac{1}{\sin c} \Rightarrow \sin C = 0.8866 \Rightarrow C = 62^0 27'$$

For the ray not be emerge out from prism, $\quad A = 2C = 2\left(62^0 27^1\right) = 125^0 \left(nearly\right)$

3. Find the refractive index of the material of a prism of refracting angle $59^0 30'$, when the angle of minimum deviation is $36^0 44'$

A. $A = 59^0 30^1$; $\qquad D_m = 36^0 44'$

$$\mu = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{59^0 30^1 + 36^0 44^1}{2}\right)}{\sin\left(\frac{59^0 30^1}{2}\right)} \qquad \Rightarrow \mu = 1.5 \quad \text{(Nearly)}$$

4. Find the angle of emergence and deviation, when light is incident at an angle of 45^0 on one of the refracting faces of an equilateral prism of refractive index 1.52.

A. $i_1 = 45^0$; $A = 60^0$; $\mu = 1.52$

$$\mu = \frac{\sin i_1}{\sin r_1} \Rightarrow 1.52 = \frac{\sin 45^0}{\sin r_1}$$

$$\sin r_1 = \frac{1}{\sqrt{2}\times 1.52} = 0.4652 \Rightarrow r_1 = 27^0 44^1$$

But, $r_1 + r_2 = A \Rightarrow r_2 = A - r_1 = 60 - 27^0 44' = 32^0 16^1$

$$\mu = \frac{\sin i_2}{\sin r_2} \Rightarrow \sin i_2 = \mu \sin r_2 = 1.52 \sin r_2 = 1.52 \times 0.5339 \Rightarrow i_2 = 54^0 15^1$$

And $d = i_1 + i_2 - A = 45^0 + 54^0 15^1 - 60^0 = 39^0 15^1$

5. A ray enters normally one face of an equilateral prism of crown glass. From which face does it emerge? Find the angle of deviation. (Refractive index of crown glass = 1.5)

A. $\mu = \frac{1}{\sin C} \Rightarrow \sin C = \frac{1}{\mu} = \frac{1}{1.5} = \frac{2}{3} \Rightarrow C = 41^0 54'$

$i_1 = 0; r_1 = 0$

But, $r_1 + r_2 = A \Rightarrow r_2 = 60^0$

Since $r_2 > C$,the light ray undergoes total internal reflection at the second face and emerges from the base of prism .

Angle of deviation $= d = 180 - 2i = 180 - 120 = 60^0$

6. A ray of light suffers minimum deviation while passing through an equilateral prism of refractive index 1.5. Calculate the angle of deviation, angle of incidence and angle of refraction.

A. $\mu = 1.5, A = 60^0$

At minimum deviation position

$i_1 = i_2 = i$ and $r_1 = r_2 = r$

But, $r_1 + r_2 = A \Rightarrow 2r = 60^0 \Rightarrow r = 30^0$

$$\mu = \frac{\sin i}{\sin r} \Rightarrow \sin i = \mu \sin r = \frac{3}{2}\sin 30^0 = \frac{3}{4}$$

$i = 48^0 35^1$

$$d = i_1 + i_2 - A = 2i - A = 2\left(48^0 35^1\right) - 60 = 97^0 10^1 - 60^0 = 37^0 10^1$$

7. An equilateral prism of refractive index 1.53 is placed in water of refractive index 1.33. Calculate the angle of minimum deviation in water.

A. $A = 60^0, \mu_g = 1.53$

$$\mu = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} \Rightarrow 1.53 = \sin\frac{\left(\frac{60 + D_m}{2}\right)}{\sin\left(\frac{60}{2}\right)}$$

$$\sin\left(\frac{60+D_m}{2}\right)=1.53\times\frac{1}{2}=0.7650 \quad \Rightarrow \sin\left(\frac{60+D_m}{2}\right)=0.7650 \Rightarrow \frac{60+D_m}{2}=49^0 54^1$$

$$D_m = 2\left(49^0 54^1\right)-60^0 = 99^0 48' - 60 = 39^0 48^1$$

Prism in water($\mu_w = 1.33$)

$$\frac{\mu_g}{\mu_w}=\frac{\sin\left(\frac{60+D_m}{2}\right)}{\sin\left(\frac{60}{2}\right)} \quad \Rightarrow \quad \frac{1.53}{1.33}=\frac{\sin\left(\frac{60+D_m}{2}\right)}{\left(\frac{1}{2}\right)}$$

$$\Rightarrow \sin\left(\frac{60+D_m}{2}\right)=0.5751$$

$$\Rightarrow \sin\left(\frac{60+D_m}{2}\right)=\sin 35^0 6^1$$

$$\Rightarrow \frac{60+D_m}{2}=35^0 6^1 \Rightarrow D_m = 70^0 12^1 - 60 = 10^0 12^1$$

8. A ray of light incident on an equilateral prism shows minimum deviation of 30^0. Calculate the speed of light through the glass prism.

A. $A = 60^0, D_m = 30^0$

From , $\mu = \dfrac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\frac{A}{2}} \Rightarrow \mu_g = \dfrac{\sin\left(\frac{60+D_m}{2}\right)}{\sin\frac{60}{2}} = \sqrt{2}$

$$\Rightarrow \frac{\mu_g}{\mu_a}=\frac{v_a}{v_g}=\frac{3\times 10^8}{v_g} \quad \Rightarrow \sqrt{2}=\frac{3\times 10^8}{v_g}=2.121\times 10^8\, ms^{-1}$$

9. A ray of light passes through an equilateral glass prism such that the angle of incidence is equal to the angle of emergence. If the angle of emergence is $\frac{3}{4}$ times the angle of prism, calculate the refractive index of the glass prism.

A. $A = 60^0 \quad and \quad i_1 = i_2$ i.e prism is in minimum deviation position.

$$i_2 = \frac{3}{4}A. = \frac{3}{4}(60) = 45^0$$

$$\therefore i_1 = i_2 = i = 45^0$$

From $d = i_1 + i_2 - A$

$$\Rightarrow D_m = 2i - 60 = 2\left(45^0\right) - 60^0 = 30^0$$

$$\mu = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{60^0+30^0}{2}\right)}{\sin\left(\frac{60^0}{2}\right)} = \frac{\sin 45^0}{\sin 30^0} = 1.414$$

10. A thin prism of 4^0 angle gives a deviation of 2.4^0. What is the value of refractive index of the material of the prism?

A. $A = 4^0, d = 2.4^0$

Angle of deviation $d = A(\mu - 1) \Rightarrow 2.4 = 4(\mu - 1)$

$$\therefore \mu = 1.6$$

11. A ray of light is incident on the face AB of a glass prism ABC having the vertex angle A equal to 30^0. The face AC is silvered and a ray of light incident on the face AB retraces its path. If the refractive index of the material of prism is $\sqrt{3}$, find the angle of incidence on the face AB.

A. For the ray to retrace its path, the ray should incident normally on the second face therefore $r_2 = 0, A = 30^0, \mu = \sqrt{3}$

But, $r_1 + r_2 = A \quad \Rightarrow r_1 = A - r_2 = 30^0 - 0 = 30^0$

Also, $\mu = \frac{\sin i_1}{\sin r_1} \Rightarrow \sqrt{3} = \frac{\sin i_1}{\sin r_1} \Rightarrow \sin i_1 = \sqrt{3} \times \frac{1}{2} = \frac{\sqrt{3}}{2} \Rightarrow i_1 = 60^0$

ASSESS YOURSELF

1. In the minimum deviation position of a prism, how is the refracted ray?

A. The refracted ray is parallel to the base of the prism.

2. Are the incident and emergent rays symmetrical with respect to the base of a prism in minimum deviation position? If so, state the reason.

A. Yes. $i_1 = i_2 = i$ .Hence the angle of incidence and the angle of emergence are equal.

3. Is the angle of minimum deviation different for different wavelengths?

A. Yes.

4. Can a prism be used to produce inversion (refracted in opposite direction) without deviation?

A. Yes

5. Can right angled isosceles prism made of glass be used as total reflection prism?

A. Yes.These are used in periscopes.