DPP - Daily Practice Problems

Name :

Date :

Start Time :

End Time :

PHYSICS 50

SYLLABUS : RAY OPTICS - II (Refraction on plane surface, total internal reflection, prism)

Max. Marks : 108 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 27 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 A thin prism of angle $A = 6°$ produces a deviation $\delta = 3°$. Find the refractive index of the material of prism.

(a) 1.5 (b) 1.0

(c) 2.5 (d) 0.5

Q.2 A ray of light is incident at an angle of 60° on one face of a prism which has an angle of 30°. The ray emerging out of the prism makes an angle of 30° with the incident ray. Calculate the refractive index of the material of the prism

(a) 1 (b) $\sqrt{2}$

(c) $\sqrt{3}$ (d) 2

Q.3 Light of wavelength 6000Å enters from air into water (a medium of refractive index 4/3). Find the speed and wavelength [$c = 3 \times 10^8$ m/s]

(a) 2.25×10^8 m/s, 4500Å (b) 1.25×10^8 m/s, 2500Å

(c) 3.15×10^8 m/s, 3500Å (d) 3.45×10^8 m/s, 5500Å

Q.4 A ray of light is incident on a transparent glass-slab of refractive index 1.5. If the reflected and refracted rays are mutually perpendicular, what is the angle of incidence ?

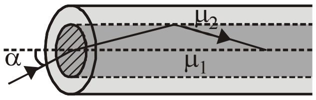
(a) 30° (b) $\sin^{-1}\frac{2}{3}$

(c) $\tan^{-1}\frac{2}{3}$ (d) $\tan^{-1}\frac{3}{2}$

RESPONSE GRID				
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

Space for Rough Work

Q.5 An optical fibre consists of core of μ_1 surrounded by a cladding of $\mu_2 < \mu_1$. A beam of light enters from air at an angle α with axis of fibre. The highest α for which ray can be travelled through fibre is



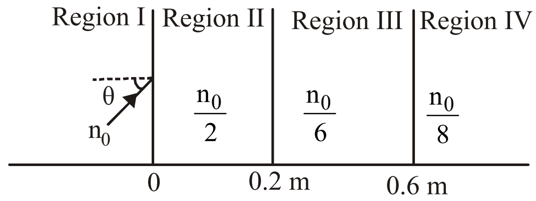
(a) $\cos^{-1}\sqrt{\mu_2^2-\mu_1^2}$
(b) $\sin^{-1}\sqrt{\mu_1^2-\mu_2^2}$
(c) $\tan^{-1}\sqrt{\mu_1^2-\mu_2^2}$
(d) $\sec^{-1}\sqrt{\mu_1^2-\mu_2^2}$

Q.6 A glass plate 4 mm thick is viewed from the above through a microscope. The microscope must be lowered 2.58 mm as the operator shifts from viewing the top surface to viewing the bottom surface through the glass. What is the index of refraction of the glass ?
(a) 1.61 (b) 1.55 (c) 3.24 (d) 1.21

Q.7 A vertical microscope is focussed on a point at the bottom of an empty tank. Water ($\mu = 4/3$) is then poured into the tank. The height of the water column is 4cm. Another lighter liquid, which does not mix with water and which has refractive index 3/2 is then poured over the water. The height of liquid column is 2cm. What is the vertical distance through which the microscope must be moved to bring the object in focus again ?
(a) 2.61 m (b) 1.55 m (c) 3.12 m (d) 1.67 m

Q.8 Light from a sodium lamp (λ_0 = 589 nm) passes through a tank of glycerin (refractive index 1.47) 20m long in a time t_1. If it takes a time t_2 to traverse the same tank when filled with carbon disulphide (index 1.63), then the difference $t_2 - t_1$ is
(a) 6.67×10^{-8} sec (b) 1.09×10^{-7} sec
(c) 2.07×10^{-7} sec (d) 1.07×10^{-8} sec

Q.9 A light beam is travelling from Region I to Region IV (Refer Figure). The refractive index in Regions I, II, III and IV are $n_0, \frac{n_0}{2}, \frac{n_0}{6}$ and $\frac{n_0}{8}$, respectively. The angle of incidence θ for which the beam just misses entering Region IV is



(a) $\sin^{-1}\left(\frac{3}{4}\right)$ (b) $\sin^{-1}\left(\frac{1}{8}\right)$
(c) $\sin^{-1}\left(\frac{1}{4}\right)$ (d) $\sin^{-1}\left(\frac{1}{3}\right)$

Q.10 The refractive index of the material of a prism is $\sqrt{2}$ and its prism angle is 30º. One of its refracting faces is polished. The incident beam of light will return back for the angle of incidence
(a) 60º (b) 45º (c) 30º (d) 0º

Q.11 A ray of light incident on a prism surface at an angle of 50º in the minimum deviation position. If the angle of prism is 60º then the values of δ_m and μ will be respectively –
(sin 50º = 0.766)
(a) 40º and 1.532 (b) 60º and 1.532
(c) 90º and 1.532 (d) 0º and 1.532

Q.12 A glass prism of refractive index 1.5 and angle of prism 6º is put in contact with another prism of refractive index 1.6 when a ray of light is made incident on this combination normally then it emerges out undeviated. The angle of second prism will be –
(a) 6º (b) 5º (c) 4º (d) 3º

Q.13 A crown glass prism of angle 5° is to be combined with a flint glass prism in such a way that the mean ray passes undeviated. Find the angle of the flint glass prism needed and the angular dispersion produced by the combination when white light goes through it. Refractive indices for red, yellow and violet light are 1.514, 1.517 and 1.523 respectively for crown glass and 1.613, 1.620 and 1.632 for flint glass.
(a) 4.2°, 0.0348° (b) 4.2°, 0.0138°
(c) 1.2°, 0.0348° (d) 4.4°, 0.0218°

Q.14 Calculate the dispersive power for crown glass from the (given data : μ_v= 1.5230, μ_r =1.5145)
(a) 0.0163 (b) 0.0183 (c) 0.0142 (d) 0.0112

RESPONSE GRID	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ

Space for Rough Work

Q.15 A prism of dispersive power 0.021 and refractive index 1.53 form an achromatic combination with prism of angle 4.2° and dispersive power 0.045 having refractive index 1.65. Find the resultant deviation.

(a) 1.12° (b) 2.16° (c) 3.12° (d) 4.18°

Q.16 A ray of light fall normally on a refracting face of a prism of refractive index 1.5. Find the angle of the prism if the ray just fails to emerge from the prism.

(a) 55° (b) 22° (c) 12° (d) 42°

Q.17 The refractive indices of material of a prism for blue and red colours are 1.532 and 1.514 respectively. Calculate angular dispersion produced by the prism if angle of prism is 8°.

(a) 0.144° (b) 0.122° (c) 0.133° (d) 0.111°

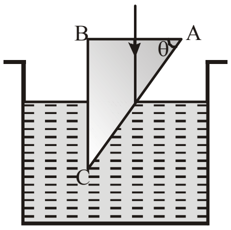
Q.18 A ball is dropped from a height of 20 m above the surface of water in a lake. The refractive index of water is 4/3. A fish inside the lake, in the line of fall of the ball, is looking at the ball. At an instant, when the ball is 12.8 m above the water surface, the fish sees the speed of ball as [$g = 10\ m/s^2$]

(a) 9 m/s (b) 12 m/s (c) 16 m/s (d) 21.33 m/s

Q.19 The dispersive powers of crown and flint glasses are 0.03 and 0.05 respectively. The refractive indices for yellow light for these glasses are 1.517 and 1.621 respectively . It is desired to form an achromatic combination of prisms of crown and flint glasses which can produce a deviation of 1° in the yellow ray. The refracting angle of the flint glass prism is

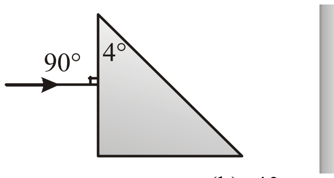
(a) 2.4° (b) 1.4° (c) 3.4° (d) 5.2°

Q.20 A glass prism ($\mu = 1.5$) is dipped in water ($\mu = 4/3$) as shown in figure. A light ray is incident normally on the surface AB. It reaches the surface BC after T.I.R



(a) $\sin\theta \geq 8/9$ (b) $2/3 < \sin\theta < 8/9$
(c) $\sin\theta \leq 2/3$ (d) It is not possible

Q.21 A prism having an apex angle 4° and refraction index 1.5 is located in front of a vertical plane mirror as shown in figure. Through what total angle is the ray deviated after reflection from the mirror



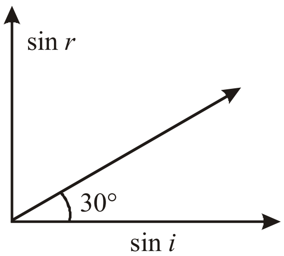
(a) 176° (b) 4°
(c) 178° (d) 2°

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 A ray of monochromatic light is incident on the plane surface of separation between two media x and y with angle of incidence i in the medium x and angle of refraction r in the medium y. The graph shows the relation between sin i and sin r.



(1) The speed of light in the medium y is $\sqrt{3}$ times than in medium x

(2) The speed of light in the medium y is $\frac{1}{\sqrt{3}}$ times than in medium x.

(3) The total internal reflection can take place when the incidence is in x.

(4) The total internal reflection can take place when the incidence is in y

RESPONSE GRID					
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ		

Space for Rough Work

Q.23 Dispersive power does not depend upon

(1) The shape of prism (2) Angle of prism
(3) Height of the prism (4) Material of prism

Q.24 The wrong statements are

(1) The order of colours in the primary and the secondary rainbows is the same
(2) The intensity of colours in the primary and the secondary rainbows is the same
(3) The intensity of light in the primary rainbow is greater and the order of colours is the same than the secondary rainbow
(4) The intensity of light for different colours in primary rainbow is greater and the order of colours is reverse as that in the secondary rainbow

DIRECTIONS (Qs. 25-Q.27) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement -1 is False, Statement-2 is True.
(d) Statement -1 is True, Statement-2 is False.

Q.25 Statement-1: There is no dispersion of light refracted through a rectangular glass slab.

Statement-2: Dispersion of light is the phenomenon of splitting of a beam of white light into its constituent colours.

Q.26 Statement-1: Dispersion of light occurs because velocity of light in a material depends upon its colour.

Statement-2: The dispersive power depends only upon the material of the prism, not upon the refracting angle of the prism.

Q.27 Statement-1: If a plane glass slab is placed on the letters of different colours all the letters appear to be raised up to the same height.

Statement-2: Different colours have different wavelengths.

RESPONSE GRID				
23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 50 - PHYSICS			
Total Questions	27	Total Marks	108
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	28	Qualifying Score	46
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

50

(1) (a) We know that $\delta = A(\mu - 1)$

or $\mu = 1 + \dfrac{\delta}{A}$

Here A = 6 °, δ = 3° , therefore

$\mu = 1 + \dfrac{3}{6} = 1.5$

(2) (c) According to given problem
$A = 30°, i_1 = 60°$ and $\delta = 30°$ and as in a prism
$\delta = (i_1 + i_2) - A,\ 30° = (60 + i_2) - 30$ i.e., $i_2 = 0$
So the emergent ray is perpendicular to the face from which it emerges.
Now as $i_2 = 0, r_2 = 0$
But as $r_1 + r_2 = A,\ r_1 = A = 30°$
So at first face
$1 \times \sin 60° = \mu \sin 30°$ i.e., $\mu = \sqrt{3}$

(3) (a) As are know, $\mu = \dfrac{c}{v} \Rightarrow v = \dfrac{c}{\mu} = \dfrac{3}{4} \times 3 \times 10^8$

$= 2.25 \times 10^8$ m/s

As, $c = \nu\lambda_0$ and $v = \nu\lambda$

$\Rightarrow \lambda/\lambda_0 = \dfrac{v}{c} = \dfrac{1}{\mu}$

i.e., $\lambda = \lambda_0/\mu = \dfrac{3}{4} \times 6000Å = 4500Å$

(4) (d) Herer + 90º + r′ = 180º
$\Rightarrow r' = 90° - r$
or, $r' = (90° - i)$ as $\angle i = \angle r$
Now, according to Snell's law :
$\sin i = \mu \sin r' = \mu \sin(90° - i)$
or, $\tan i = \mu$
or, $i = \tan^{-1}\mu = \tan^{-1}(1.5)$

(5) (b) Here the requirement is that $i > c$

$\Rightarrow \sin i > \sin c \Rightarrow \sin i > \dfrac{\mu_2}{\mu_1}$

From Snell's law $\mu_1 = \dfrac{\sin\alpha}{\sin r}$

Also in ΔOBA
$r + i = 90° \Rightarrow r = (90 - i)$
Hence from equation (ii)
$\sin\alpha = \mu_1 \sin(90 - i)$

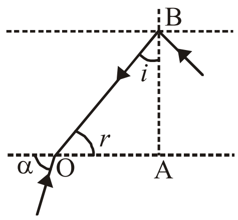
$\Rightarrow \cos i = \dfrac{\sin\alpha}{\mu_1}$

$\sin i = \sqrt{1 - \cos^2 i} = \sqrt{1 - \left(\dfrac{\sin\alpha}{\mu_1}\right)^2}$ ...(*iii*)

From equation (i) and (ii)

$\Rightarrow \sin^2\alpha < \left(\mu_1^2 - \mu_2^2\right) \sin\alpha < \sqrt{\mu_1^2 - \mu_2^2}$

$\alpha_{max} = \sin^{-1}\sqrt{\mu_1^2 - \mu_2^2}$



(6) (b) From the information given, it is clear that the apparent depth is 2.58 mm and the real depth is 4mm. Therefore, the refractive index will be

$\mu = \dfrac{R}{A} = \dfrac{4}{2.58} = 1.55$

(7) (d) The apparent shift of the bottom point upwards will be
$x = x_1 + x_2$

$= t_1\left(1 - \dfrac{1}{\mu_1}\right) + t_2\left(1 - \dfrac{1}{\mu_2}\right)$

$= 4\left(1 - \dfrac{1}{(4/3)}\right) + 2\left(1 - \dfrac{1}{(3/2)}\right)$

$= 4\left(1 - \dfrac{3}{4}\right) + 2\left(1 - \dfrac{2}{3}\right) = 1.67$ cm.

(8) (d) Since $v = \dfrac{C}{n}$

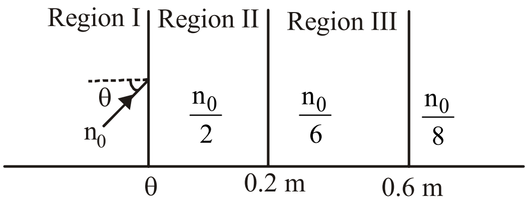
The time taken are

$t_2 = \dfrac{20\,(1.63)}{C},\ t_1 = \dfrac{20\,(1.47)}{C}$

Therefore , the difference is

$t_2 - t_1 = \dfrac{20(1.63 - 1.47)}{C} = \dfrac{20 \times 0.16}{3 \times 10^8} = 1.07 \times 10^{-8}$ sec.

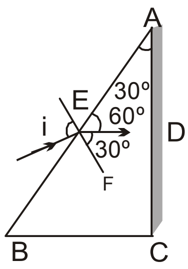
(9) (b) As the beam just suffers TIR at interface of region III and IV



$n_0 \sin\theta \dfrac{n_0}{2}\sin\theta_1 = \dfrac{n_0}{6}\sin\theta_2 = \dfrac{n_0}{8}\sin 90°,$

$\sin\theta\frac{1}{8} \Rightarrow \theta = \sin^{-1}\frac{1}{8}$

(10) (b) The ray of light returns back from the polished face AC.



$\therefore \angle ADE = 90°$. From the figure it is clear that the angle of refraction at face AB is 30°. Hence from Snell's law

$\mu = \frac{\sin i}{\sin r}$

As $\mu = \sqrt{2}$ and $r = 30°$ $\therefore \sqrt{2} = \frac{\sin i}{\sin 30°}$

or $\sin i = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}} = \sin 45°$

$\therefore i = 45°$

(11) (a) $A = r_1 + r_2 = 60$ ....(1)

In minimum deviation position

$r_1 = r_2$ ....(2)

From eqs. (1) and (2)

$A = 2r_1 = 60°$

$\therefore r_1 = 30°$

$\therefore n = \frac{\sin i}{\sin r} = \frac{\sin 50°}{\sin 30°} = 1.532$

$$n = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}} \text{ or } 1.532 = \frac{\sin\frac{60+\delta_m}{2}}{\sin 30°}$$

$$\sin\frac{60+\delta_m}{2} = \frac{1.532}{2} = 0.766$$

$\therefore \delta_m = 40°$

(12) (b) $\delta_1 = \delta_2$

$(\mu_1 - 1) A_1 = (\mu_2 - 1) A_2$

$(1.5 - 1) 6 = (1.6 - 1) A_2$

$A_2 = 5°$

(13) (a) The deviation produced by the crown prism is

$\delta = (\mu - 1) A$

and by the flint prism is

$\delta' = (\mu' - 1) A'$

The prisms are placed with their angles inverted with respect to each other . The deviations are also in opposite directions. Thus, the net deviation is

$D = \delta - \delta' = (\mu - 1) A - (\mu' - 1) A'$ ....(1)

If the net deviation for the mean ray is zero,

$(\mu - 1) A = (\mu' - 1) A'$

or, $A' = \frac{(\mu-1)}{(\mu'-1)} A = \frac{1.517-1}{1.620-1} \times 5° = 4.2°$.

The angular dispersion produced by the crown prism is

$\delta_v - \delta_r = (\mu_v - \mu_r) A$

and that by the flint prism is

$\delta'_v - \delta'_r = (\mu'_v - \mu'_r) A'$

The net angular dispersion is ,

$\delta = (\mu_v - \mu_r) A - (\mu'_v - \mu'_r) A'$

$= (1.523 - 1.514) \times 5° - (1.632 - 1.613) \times 4.2°$

$= -0.0348°$.

The angular dispersion has magnitude 0.0348°.

(14) (a) $\mu_v = 1.5230, \mu_r = 1.5145, \omega = ?$

Mean refractive index,

$\mu = \frac{\mu_v + \mu_r}{2} = \frac{1.5230 + 1.5145}{2}$

$\mu = 1.5187$

$\omega = \frac{\mu_v - \mu_r}{\mu - 1}$

$= \frac{1.5230 - 1.5145}{1.5187 - 1} = \frac{0.0085}{0.5187} = 0.0163$

(15) (c) Here, $\omega = 0.021; \mu = 1.53; \omega' = 0.045;$

$\mu' = 1.65;$ $A' = 4.2°$

For no dispersion, $\omega\delta + \omega'\delta' = 0$

or $\omega A(\mu - 1) + \omega' A'(\mu - 1) = 0$

or $A = -\frac{\omega' A'(\mu' - 1)}{\omega(\mu - 1)}$

$= -\frac{0.045 \times 4.2 \times (1.65 - 1)}{0.021 \times (1.53 - 1)} = -11.04°$

Net deviation,

$\delta + \delta' = A(\mu - 1) + A'(\mu' - 1)$

$= -11.04 (1.53 - 1) + 4.2 (1.65 - 1)$

$= -11.04 \times 0.53 + 4.2 \times 0.65$

$= -5.85 + 2.73 = 3.12°$

(16) (d) At first face of the prism as $i_1 = 0$,

$\sin 0 = 1.5 \sin r_1$ i.e., , $r_1 = 0$

And as for a prism

$r_1 + r_2 = A$ so $r_2 = A$ ......(1)

But at second face, as the ray just fails to emerge

i.e., $r_2 = \theta_C$ ......(2)

So from Eqn,.(1) and (2)

$A = r_2 = \theta_C$

But as $\theta_C = \sin^{-1}\left[\frac{1}{\mu}\right] = \sin^{-1}\left[\frac{2}{3}\right] = 42°$

So A = 42°

(17) (a) Here, $\mu_b = 1.532$ and $\mu_r = 1.514$ $A = 8°$.

Angular dispersion

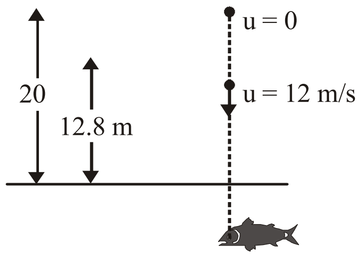
$= (\mu_b - \mu_r) A = (1.532 - 1.514) \times 8$

$= 0.018 \times 8 = 0.144°$.

(18) (c) Velocity of the ball when it reaches at the height of 12.8 m. above the surface is $v = \sqrt{2 \times 10 \times 7.2} = 12\ m/s$

Height of the ball from surface as seen by fish

$$h' = \mu_h \Rightarrow \frac{dh'}{dt} = \mu \frac{dh}{dt}$$



$$\Rightarrow v' = \mu v = \frac{4}{3} \times 12 = 16\ m/s.$$

(19) (a) Suppose, the angle of the crown prism needed is A and that of the flint prism is A′. We have

$$\omega = \frac{\mu_v - \mu_r}{\mu - 1} \text{ or, } \mu_v - \mu_r = (\mu - 1)\,\omega$$

The angular dispersion produced by the crown prism is

$(\mu_v - \mu_r)A = (\mu - 1)\,\omega A$

Similarly, the angular dispersion produced by the flint prism is $(\mu' - 1)\,\omega' A'$

For achromatic combination, the net dispersion should be zero. Thus,

$(\mu - 1)\,\omega A = (\mu' - 1)\,\omega' A'$

$$\text{or, } \frac{A'}{A} = \frac{(\mu - 1)\,\omega}{(\mu' - 1)\,\omega'} = \frac{0.517 \times 0.03}{0.621 \times 0.05} = 0.50 \quad ......(1)$$

The deviation in the yellow ray produced by the crown prism is $\delta = (\mu - 1)A$ and by the flint prism is $\delta' = (\mu' - 1)A'$. The net deviation produced by the combination is

$\delta - \delta' = (\mu - 1)A - (\mu' - 1)A'$

or $1° = 0.517\,A - 0.621\,A'$ ......(2)

Solving (1) and (2), $A = 4.8°$ and $A' = 2.4°$. Thus, the crown prism should have its refracting angle 4.8° and that of the flint prism should be 2.4°.

(20) (a) For TIR at AC

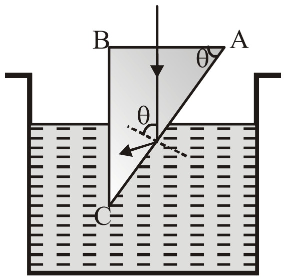
$\theta > C$

$\Rightarrow \sin\theta \ge \sin C$

$$\Rightarrow \sin\theta \ge \frac{1}{{}_w\mu_g}$$

$$\Rightarrow \sin\theta \ge \frac{\mu_w}{\mu_g}$$

$$\Rightarrow \sin\theta \ge \frac{8}{9}$$

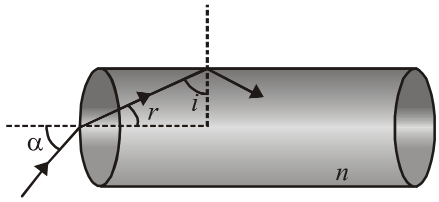


(21) (c) $\delta_{Prism} = (\mu - 1)A = (1.5 - 1)4° = 2°$

$\therefore\ \delta_{Total} = \delta_{Prism} + \delta_{Mirror}$

$= (\mu - 1)A + (180 - 2i) = 2° + (180 - 2 \times 2) = 178°$

(22) **(a)** From the following figure



$r + i = 90°$ Þ $i = 90° - r$

For ray not to emerge from curved surface $i > C$

$\Rightarrow \sin i > \sin C \Rightarrow \sin(90° - r) > \sin C \Rightarrow \cos r > \sin C$

$$\Rightarrow \sqrt{1 - \sin^2 r} > \frac{1}{n} \qquad \left\{\therefore\ \sin C = \frac{1}{n}\right\}$$

$$\Rightarrow 1 - \frac{\sin^2\alpha}{n^2} > \frac{1}{n^2} \Rightarrow 1 > \frac{1}{n^2}\left(1 + \sin^2\alpha\right)$$

$$\Rightarrow n^2 > 1 + \sin^2 a \Rightarrow n > \sqrt{2} \qquad \{\sin i \to 1\}$$

$\Rightarrow$ Least value $= \sqrt{2}$

(23) (a) ω depends only on nature of material.

(24) (a)

(25) **(c);**

26. (b), 27 (a)

The normal shift produced by a glass slab is,

$$\Delta x = \left(1 - \frac{1}{\mu}\right)t = \left(1 - \frac{2}{3}\right)(6) = 2cm$$

i.e., for the mirror, the object is placed at a distance $(32 - \Delta x) = 30$ cm from it.

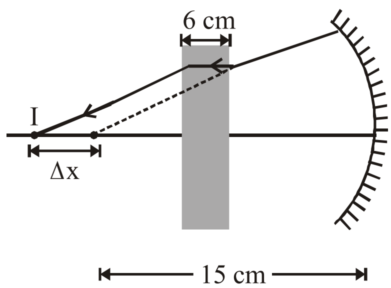
Applying mirror formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} + \frac{1}{30} = -\frac{1}{10}$$

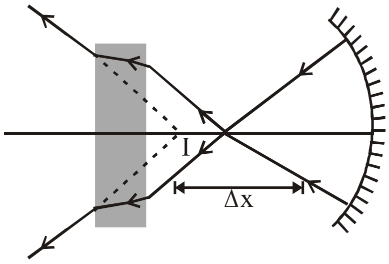
or, $v = -15$ cm

(a) When x = 5 cm: The light falls on the slab on its return journey as shown. But the slab will again shift it by a distance.



Δx = 2 cm. Hence, the final real image is formed at a distance (15 + 2) = 17 cm from the mirror.

(b) When x = 20 cm: This time also the final image is at a distance of 17 cm from the mirror but it is virtual as shown.



(28) (b) As rays of all colours emerge in the same direction (of incidence of white light), hence there is no dispersion, but only lateral displacement in a glass slab.

(29) (b) The velocity of light in a material medium depends upon its colour (wavelength). If a ray of white light is incident on a prism, then on emerging the different colours are deviated through different angles.

Also dispersive power $\omega = \frac{(\mu_V - \mu_R)}{(\mu_Y - 1)}$

i.e. ω depends upon only μ

(30) (c) Apparent shift for different coloured letter is

$$d = h\left(1 - \frac{1}{\mu}\right)$$

$\Rightarrow \lambda_R > \lambda_V$ so $\mu_R < \mu_V$

Hence $d_R < d_V$ i. e. red coloured letter raised least.