Optics

Question1

Given below are two statements:

Statement I: Image formation needs regular reflection and/or refraction.

Statement II: The variety in colour of objects we see around us is due to the constituent colours of the light incident on them.

In the light of the above statements, choose the most appropriate answer from the options given below :

[NEET 2024 Re]

Options:

A.

Statement I is correct but statement II is incorrect

B.

Statement I is incorrect but Statement II is correct

C.

Both Statement I and Statement II are correct

D.

Both Statement I and Statement II are incorrect

Answer: C

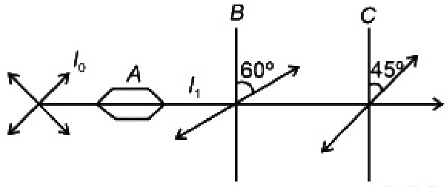
Solution:

Regular reflection is necessary for image formation, that is why we can see our image in a mirror but not in wall.

Different colours in white light as its constituent are responsible for the variety in colour of objects.

Question2

A beam of unpolarized light of intensity I_0 is passed through a polaroid A, then through another polaroid B,oriented at 60º and finally through another polaroid C, oriented at 45º relative to B as shown. The intensity of emergent light is:



[NEET 2024 Re]

Options:

A.

$I_0/16$

B.

$I_0/4$

C.

$I_0/2$

D.

$I_0/32$

Answer: A

Solution:

$$I_1 = \frac{I_0}{2}$$

$$I_B = (I_1)\cos^2 60^\circ$$

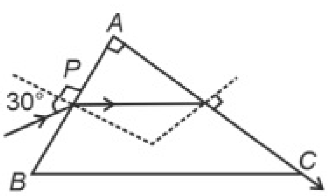
$$= \frac{I_0}{2}\left(\frac{1}{2}\right)^2 = \frac{I_0}{8}$$

$$I_C = I_B \cos^2 45^\circ$$

$$= \frac{I_0}{8} \times \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{16}$$

Question3

A light ray enters through a right angled prism at point P with the angle of incidence 30∘ as shown in figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is



[NEET 2024]

Options:

A.

$\sqrt{5}/4$

B.

$\sqrt{5}/2$

C.

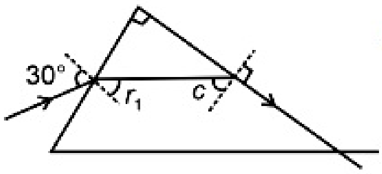
$\sqrt{3}/4$

D.

$\sqrt{3}/2$

Answer: B

Solution:



$A = 90°$

In prism, $r_1 + c = A$

$r_1 = 90^\circ - c$ ....(1)

$sin\ c = \frac{1}{\mu} \Rightarrow \cos c = \frac{\sqrt{\mu^2 - 1}}{\mu}$

$\Rightarrow$ Apply Snell's law, on incidence surface

$1 \cdot sin\ 30^\circ = \mu sin\ (r_1) \Rightarrow 1 \times \frac{1}{2} = \mu \times sin\ (90^\circ - c)$

$\frac{1}{2} = \mu \times \frac{\sqrt{\mu^2 - 1}}{\mu}$

On squaring $\frac{1}{4} = \mu^2 - 1$

$\Rightarrow \mu^2 = \frac{5}{4} \Rightarrow \mu = \frac{\sqrt{5}}{2}$

Question4

A small telescope has an objective of focal length 140cm and an eye piece of focal length 5.0 cm. The magnifying power of telescope for viewing a distant object is:

[NEET 2024]

Options:

A.

34

B.

28

C.

17

D.

32

Answer: B

Solution:

$f_0 = 140\ \text{cm}$ and $f_e = 5\ \text{cm}$

For distant object,

$$m = \frac{f_0}{f_e} = \frac{140}{5} = 28$$

Question5

If the monochromatic source in Young's double slit experiment is replaced by white light, then

[NEET 2024]

Options:

A.

Interference pattern will disappear

B.

There will be a central dark fringe surrounded by a few coloured fringes

C.

There will be a central bright white fringe surrounded by a few coloured fringes

D.

All bright fringes will be of equal width

Answer: C

Solution:

At central point on screen, path difference is zero for all wavelength. So, central bright fringe is white and other fringes depend on wavelength as $\beta = \lambda D/d$.

Therefore, other fringes will be coloured.

Question6

An unpolarised light beam strikes a glass surface at Brewster's angle. Then

[NEET 2024]

Options:

A.

The reflected light will be partially polarised.

B.

The refracted light will be completely polarised.

C.

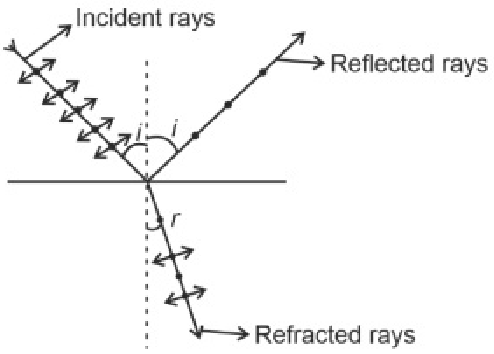
Both the reflected and refracted light will be completely polarised.

D.

The reflected light will be completely polarised but the refracted light will be partially polarised.

Answer: D

Solution:



According to Brewster's law, reflected rays are completely polarized and refracted rays are partially polarized.

Question7

Light travels a distance x in time t1 in air and 10x in time t2 in another denser medium. What is the critical angle for this medium?

[NEET 2023]

Options:

A.

$sin^{-1}\left(\frac{10t_2}{t_1}\right)$

B.

$sin^{-1}\left(\frac{t_1}{10t_2}\right)$

C.

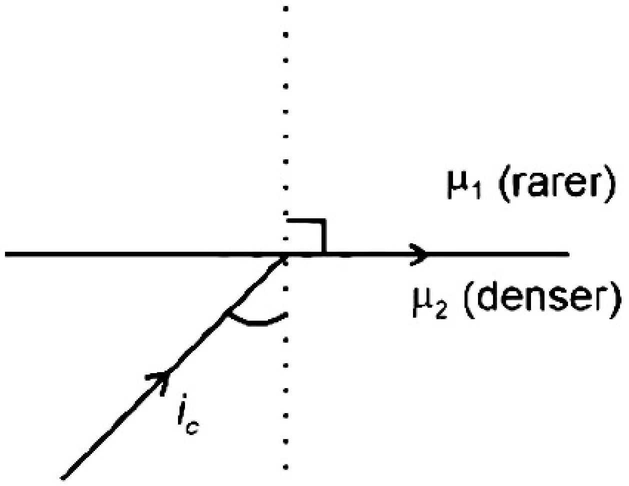
$sin^{-1}\left(\frac{10t_1}{t_2}\right)$

D.

$sin^{-1}\left(\frac{t_2}{t_1}\right)$

Answer: C

Solution:



$\mu_2 sin\ i_c = \mu_1$

$sin\ i_c = \frac{\mu_1}{\mu_2}$

$\mu = \frac{c}{V}$

So $sin\ i_c = \frac{\mu_1}{\mu_2} = \frac{V_2}{V_1}$

$sin\ i_c = \frac{10xt_1}{t_2x}$

$i_c = sin^{-1}\left(\frac{10t_1}{t_2}\right)$

Question8

Two thin lenses are of same focal lengths (f), but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be

[NEET 2023]

Options:

A.

f/4

B.

f/2

C.

Infinite

D.

Zero

Answer: C

Solution:

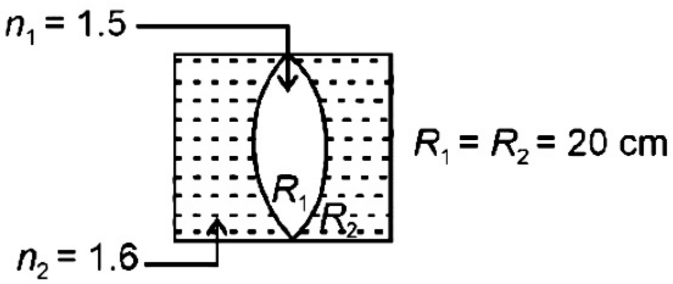
Convex lens $f_1 > 0$, concave lens $f_2 < 0$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f} - \frac{1}{f} = 0$$

$$f_{eq} = \infty$$

Question9

In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin)?



[NEET 2023]

Options:

A.

−40cm

B.

−100cm

C.

-50cm

D.

40cm

Answer: B

Solution:

Effective focal length $\Rightarrow f_{\text{eff}}$

$$\frac{1}{f_{\text{eff}}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

Also, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$$\frac{1}{f_1} = (1.6 - 1)\left(\frac{1}{\infty} - \frac{1}{20}\right) = \frac{-0.6}{20}$$

$$\frac{1}{f_2} = (1.5 - 1)\left(\frac{1}{20} - \frac{1}{-20}\right) = \frac{0.5}{10}$$

$$\frac{1}{f_3} = (1.6 - 1)\left(\frac{1}{-20} - \frac{1}{\infty}\right) = \frac{-0.6}{20}$$

$$\frac{1}{f_{\text{eff}}} = \frac{-0.6}{20} + \frac{0.5}{10} - \frac{0.6}{20}$$

$$\frac{1}{f_{\text{eff}}} = \frac{-0.6}{10} + \frac{0.5}{10} = \frac{-0.1}{10} = \frac{-1}{100}$$

$$\therefore f_{\text{eff}} = -100 \text{ cm}$$

Question10

For Young's double slit experiment, two statements are given below:

Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.
Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

In the light of the above statements, choose the correct answer from the options given below:

[NEET 2023]

Options:

A.

Both Statement I and Statement II are false.

B.

Statement I is true but Statement II is false.

C.

Statement I is false but Statement II is true.

D.

Both Statement I and Statement II are true.

Answer: B

Solution:

For YDSE, angular fringe width is given by $\alpha = \frac{\lambda}{d}$

It does not depend on the distance of screen from the slit, so statement I is correct.

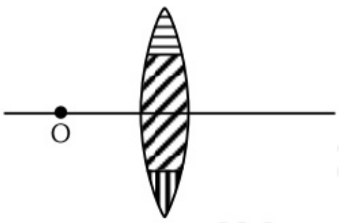
Angular fringe width $\propto \lambda$

If $\lambda \uparrow \rightarrow$ angular separation of fringes increases

So, statement I is true and statement II is false.

Question11

A lens is made up of 3 different transparent media as shown in figure. A point object O is placed on its axis beyond 2f. How many real images will be obtained on the other side?



[NEET 2023]

Options:

A.

2

B.

1

C.

5

D.

3

Answer: D

Solution:

Since lens is made of three materials so three μ and hence three images.

Question12

E_0 and μ_0 are the electric permittivity and magnetic permeability of free space respectively. If the corresponding quantities of a medium are $2E_0$ and $1.5\mu_0$ respectively, the refractive index of the medium will nearly be :

[NEET 2023 mpr]

Options:

A.

$\sqrt{2}$

B.

$\sqrt{3}$

C.

3

D.

2

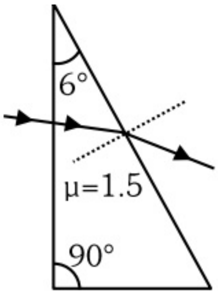
Answer: B

Solution:

$$\mu = \frac{C}{v} = \frac{\frac{1}{\sqrt{\mu_0 E_0}}}{\frac{1}{\sqrt{1.5\mu_0 \times 2E_0}}} = \sqrt{3}$$

Question13

A horizontal ray of light is incident on the right angled prism with prism angle 6∘. If the refractive index of the material of the prism is 1.5 , then the angle of emergence will be:



[NEET 2023 mpr]

Options:

A.

9°

B.

10°

C.

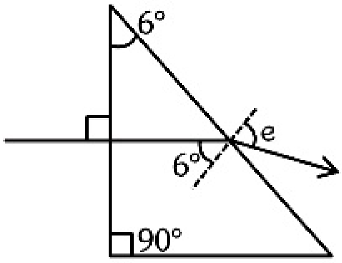
4°

D.

6°

Answer: A

Solution:



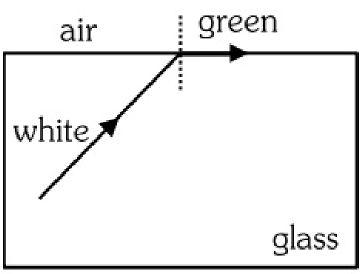
$A = r_1 + r_2 = 6^{\circ}$

$\mu = 1.5\ \frac{\sin e}{\sin r_2} = \frac{\sin e}{\sin 6}$

$\sin e\ = 1.5 \times 6^{\circ}$

$e \simeq 9^{\circ}$

Question14



Which set of colours will come out in air for a situation shown in figure?

[NEET 2023 mpr]

Options:

A.

Yellow, Orange and Red

B.

All

C.

Orange, Red and Violet

D.

Blue, Green and Yellow

Answer: A

Solution:

$$\mathrm{Sin}\, i_c = \frac{1}{\mu} \propto \lambda$$

$$i_c \propto \lambda$$

Yellow, orange, red emerge from air.

Question15

An object is mounted on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex lens placed between these walls. The lens is kept at distance x in front of the second wall. The required focal length of the lens will be :

[NEET 2023 mpr]

Options:

A.

less than x/4

B.

more than x/4 but less than x/2

C.

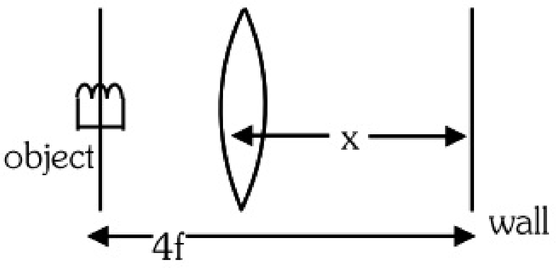
x/2

D.

x/4

Answer: C

Solution:



$x = 2f$

$f = x/2$

Question16

During a cloudy day, a primary and a secondary rainbow may be created, then the :
[NEET Re-2022]

Options:

A. secondary rainbow is due to single reflection and is formed above the primary one.

B. primary rainbow is due to double internal reflection and is formed above the secondary one,

C. primary rainbow is due to double internal reflection and is formed below the secondary one.

D. secondary rainbow is due to double internal reflection and is formed above the primary one.

Answer: D

Solution:

Solution:

Primary rainbow is formed due to 1st TIR while secondary rainbow is formed after 2nd TIR.

Secondary rainbow form above the primary rainbow

Question17

An astronomical refracting telescope is being used by an observer to observe planets in normal adjustment. The focal lengths of the objective and eye piece used in the construction of the telescope are 20 m and 2 cm respectively. Consider the following

statements about the telescope :
(a) The distance between the objective and eyepiece is 20.02 m
(b) The magnification of the telescope is (–) 1000
(c) The image of the planet is erect and diminished
(d) The aperture of eye piece is smaller than that of objective The correct statements are :
[NEET Re-2022]

Options:

A. (a), (b) and (d)

B. (a), (b) and (c)

C. (b), (c) and (d)

D. (c), (d) and (a)

Answer: A

Solution:

In normal adjustment of Astronomical Telescope final image is formed at infinity \& inverted image is formed.

$$m=-\frac{-f_0}{f_e}=-\frac{20}{2\times10^{-2}}=-1000$$

$$L=f_o+f_e=20+0.02=20.02$$

Aperture of eye piece is smaller than that of objective.

So, statement (a), (b) \& (d) are correct.

Question18

If the screen is moved away from the plane of the slits in a Young's double slit experiment, then the :
[NEET Re-2022]

Options:

A. linear separation of the fringes decreases

B. angular separation of the fringes increases

C. angular separation of the fringes decreases

D. linear separation of the fringes increases

Answer: D

Solution:

We know fringe width

$$B = \frac{\lambda D}{d}.$$

As D increases B increases.

i.e., Linear separation of fringes increases.

Question19

After passing through a polariser a linearly polarised light of intensity I is incident on an analyser making an angle of 30° with that of the polariser. The intensity of light emitted from the analyser will be: [NEET Re-2022]

Options:

A. $\frac{2I}{3}$

B. $\frac{I}{2}$

C. $\frac{I}{3}$

D. $\frac{3I}{4}$

Answer: D

Solution:

By law of Malus, Intensity after analyser

$$I' = I\cos^2 30^\circ = I \times \frac{3}{4}$$

$$I' = \frac{3I}{4}$$

Question20

A biconvex lens has radii of curvature, 20cm each. If the refractive index

of the material of the lens is 1.5, the power of the lens is
[NEET-2022]

Options:

A. +2 D

B. +20 D

C. +5D

D. Infinity

Answer: C

Solution:

Power of lens is given by

$$P = \frac{1}{f(m)}$$

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left\{\frac{3}{2} - 1\right\}\left(\frac{1}{20} + \frac{1}{20}\right)$$

$$f = 20cm$$

$$P = \frac{1}{20 \times 10^{-2}}$$

$$= 5D$$

Question21

In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of 600nm wavelength is used. If the wavelength of light is changed to 400nm, then the number of fringes he would observe in the same region of the screen is
[NEET-2022]

Options:

A. 6

B. 8

C. 9

D. 12

Answer: D

Solution:

$$\beta = \frac{\lambda D}{d}$$

Let length of segment of screen $= 1$

$$\Rightarrow I = 8\beta_1 = \frac{8\lambda_1 D}{d} \ldots (1)$$

and $I = n\beta_2 = \dfrac{n\lambda_2 D}{d} \ldots (2)$

from (1) and (2)

$$8\lambda_1 = n\lambda_2$$

$$8(600nm) = n(400nm)$$

$$n = 12$$

Question22

A light ray falls on a glass surface of refractive index $\sqrt{3}$, at an angle 60°. The angle between the refracted and reflected rays would be [NEET-2022]

Options:

A. 30°

B. 60°

C. 90°

D. 120°

Answer: C

Solution:

Given $i = 60^\circ$ and $\mu = \sqrt{3}$

$\Rightarrow$ Here, angle of incidence $\Rightarrow i = \tan^{-1}(\mu)$

Hence, reflected and refracted rays would be perpendicular to each other.

Question23

Two transparent media A and B are separated by a plane boundary. The

speed of light in those media are 1.5×10^8m / s and 2.0×10^8m / s, respectively. The critical angle for a ray of light for these two media is [NEET-2022]

Options:

A. $\sin^{-1}(0.500)$

B. $\tan^{-1}(0.500)$

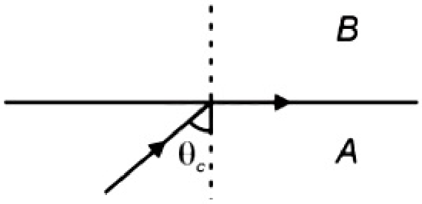
C. $\sin^{-1}(0.750)$

D. $\tan^{-1}(0.750)$

Answer: C

Solution:

Solution:



$$\mu_A = \frac{3 \times 10^8}{1.5 \times 10^8} = 2$$

$$\mu_B = \frac{3 \times 10^8}{2 \times 10^8} = 1.5$$

For TIR, ray of light should travel from denser to rarer medium

$$\mu_A \sin \theta_C = \mu_B \sin 90^\circ$$

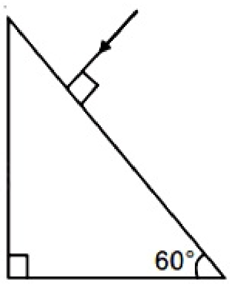
$$2 \sin \theta_C = 1.5 \sin 90^\circ$$

$$\sin \theta_C = 0.75$$

$$\theta_C = \sin^{-1}(0.75)$$

Question24

Find the value of the angle of emergence from the prism. Refractive index of the glass is $\sqrt{3}$.
[NEET 2021]



Options:

A. 60°

B. 30°

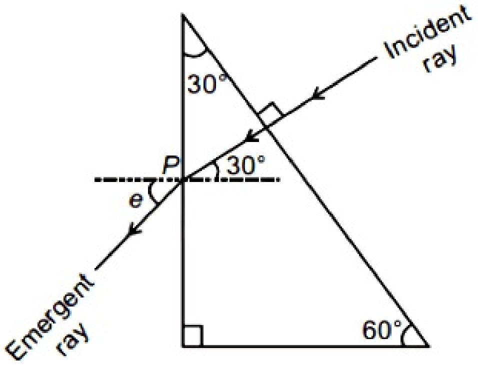
C. 45°

D. 90°

Answer: A

Solution:

Solution:
From the ray diagram shown in the figure.
At point P, from Snell's law



$$\frac{\sin i}{\sin r} = \frac{\mu_{air}}{\mu_{Prism}}$$

$$\Rightarrow \frac{\sin 30°}{\sin e} = \frac{1}{\sqrt{3}}$$ ($\angle r = \angle\theta$ emergent angle)

$$\Rightarrow \sin e = \sqrt{3} \cdot \frac{1}{2}$$

$$\Rightarrow \angle e = 60°$$

Question25

A convex lens 'A' of focal length 20 cm and a concave lens 'B' of focal length 5 cm are kept along the same axis with a distance 'd' between them. If a parallel beam of light falling on 'A' leaves 'B' as a parallel beam, then the distance 'd' in cm will be [NEET 2021]

Options:

A. 25

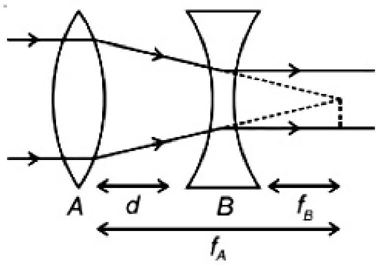
B. 15

C. 50

D. 30

Answer: B

Solution:



Parallel beam of light after refraction from convex lens converge at the focus of convex lens. In question it is given light after refraction pass through concave lens becomes parallel. Therefore light refracted from convex lens virtually meet at focus of concave lens.
According to above ray diagram $d = f_A - f_B$
$= 20 - 5 = 15 \text{ cm}$

Question26

A lens of large focal length and large aperture is best suited as an objective of an astronomical telescope since
[NEET 2021]

Options:

A. A large aperture contributes to the quality and visibility of the images.

B. A large area of the objective ensures better light gathering power.

C. A large aperture provides a better resolution.

D. All of the above

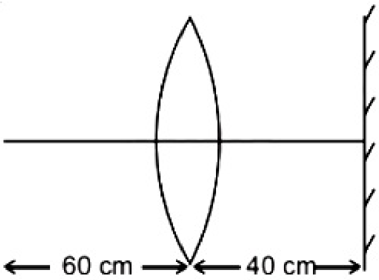
Answer: D

Solution:

Solution:
With larger aperture of objective lens, the light gathering power in telescope is high.
Also, the resolving power or the ability to observe two objects distinctly also depends on the diameter of the objective.
Thus objective of large diameter is preferred.
Also, with large diameters fainter objects can be observed. Hence it also contributes to the better quality and visibility of images.
Hence, all options are correct.

Question27

A point object is placed at a distance of 60 cm from a convex lens of focal length 30 cm. If a plane mirror were put perpendicular to the principal axis of the lens and at a distance of 40 cm from it, the final image would be formed at a distance of
[NEET 2021]



Options:

A. 20 cm from the lens, it would be a real image

B. 30 cm from the lens, it would be a real image

C. 30 cm from the plane mirror, it would be a virtual image

D. 20 cm from the plane mirror, it would be a virtual image

Answer: D

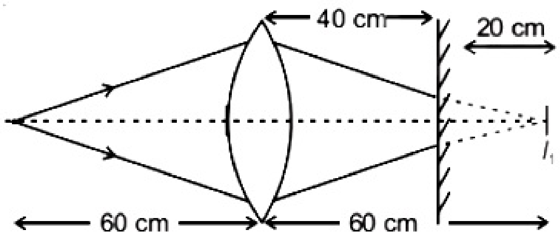
Solution:

Solution:
Using lens formula for first refraction from convex lens

$\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f}$

$v_1 = ?, u = -60 \text{ cm}, f = 30 \text{ cm}$

$\Rightarrow \frac{1}{v_1} + \frac{1}{60} = \frac{1}{30} \Rightarrow v_1 = 60 \text{ cm}$



I_1 here is first image by lens
The plane mirror will produce an image at distance 20 cm to left of it.
For second refraction from convex lens,
u = –20 cm, v = ? , f = 30 cm

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{20} = \frac{1}{30}$

$\Rightarrow \frac{1}{v} = \frac{1}{30} - \frac{1}{20} \Rightarrow v = -60\text{cm}$

Thus the final image is virtual and at a distance, 60 – 40 = 20 cm from plane mirro

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Question28

In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent sources is doubled, then the fringe width becomes :
[2020]

Options:

A. half

B. four times

C. one-fourth

D. double

Answer: B

Solution:

Solution:

(b) Fringe width $\beta = \frac{\lambda D}{d}$

Here, $\lambda =$ wavelength of light from coherent sources, $D =$ distance of screen from the coherent sources, $d =$ separation between coherent sources

When, $d' = \frac{d}{2}$ and $D' = 2D$

New Fringe width, $\beta' = \frac{\lambda(2D)}{d/2} = \frac{4\lambda D}{d}$

$\Rightarrow \beta' = 4\beta$

Fringe width becomes 4 times.

Question29

The Brewsters angle i_b for an interface should be (2020)

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Options:

A. $30^\circ < i_b < 45^\circ$

B. $45^\circ < i_b < 90^\circ$

C. $i_b = 90^\circ$

D. $0^\circ < i_b < 30^\circ$

Answer: B

Solution:

Solution:

(b) According to Brewster's law, when a beam of unpolarised light is reflected from a transparent medium of refractive index (μ_2),

the reflected light is completely polarised at certain angle of incidence called the angle of polarisation (i_b).

$\tan i_b = \frac{\mu_2}{\mu_1}$

For air, $\mu_1 = 1$

$\therefore \tan i_b = \mu_2 > 1$

$\Rightarrow \tan i_b > 1 \Rightarrow 90^\circ > i_b > 45^\circ$

Question30

Assume that light of wavelength 600nm is coming from a star. The limit of resolution of telescope whose objective has a diameter of 2m is: (2020)

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Options:

A. 1.83×10^{-7}rad

B. 7.32×10^{-7}rad

C. 6.00×10^{-7}rad

D. 3.66×10^{-7}rad

Answer: D

Solution:

(d) Given:
Wavelength, $\lambda = 600\text{nm} = 600 \times 10^{-9}\text{m}$
and diameter of objective, $d = 2\text{m}$
Limit of resolution of telescope,

$$\theta = \frac{1.22\lambda}{d} = \frac{1.22 \times 600 \times 10^{-9}}{2} = 3.66 \times 10^{-7}\text{rad}$$

Question31

A ray is incident at an angle of incidence i on one surface of a small angle prism (with angle of prism A) and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, then the angle of incidence is nearly equal to :
[2020]

Options:

A. $\frac{2A}{\mu}$

B. μA

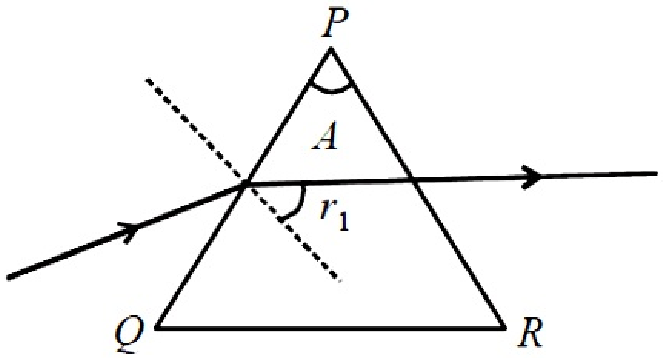
C. $\frac{\mu A}{2}$

D. $\frac{A}{2\mu}$

Answer: B

Solution:

(b) Light ray emerges normally from another surface, hence, e (angle of emergence) = 0
$\therefore r_2 = 0 \quad r_1 + r_2 = A \Rightarrow r_1 = A$
$\mu_1 \cdot \sin i = \mu_2 \cdot \sin r$



Applying Snell's law on first surface PQ
$\Rightarrow \mu_1 \cdot \sin i = \mu_2 \cdot \sin r_1 \Rightarrow \sin i = \mu \sin A$
For small angles $(\sin\theta \approx \theta)$
$\therefore i = \mu A$

Question32

Pick the wrong answer in the context with rainbow. (NEET 2019)

Options:

A. Rainbow is a combined effect of dispersion, refraction and reflection of sunlight.

B. When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.

C. The order of colours is reversed in the secondary rainbow.

D. An observer can see a rainbow when his front is towards the sun.

Answer: D

Solution:

Solution:
An observer can see a rainbow only when his back is towards the sun.

Question33

Which colour of the light has the longest wavelength? (NEET 2019)

Options:

A. violet

B. red

C. blue

D. green

Answer: B

Solution:

Solution:
Red light of the visible spectrum is having a maximum wavelength of about 650 nm

----

Question34

In total internal reflection when the angle of incidence is equal to the critical angle for the pair of media in contact, what will be angle of refraction? (NEET 2019)

Options:

A. 90°

B. 180°

C. 0°

D. equal to angle of incidence

Answer: A

Solution:

Solution:
When the angle of refraction is equal to 90°, the angle of incidence is called the critical angle.

Question35

Two similar thin equi-convex lenses, of focal length f each, are kept coaxially in contact with each other such that the focal length of the combination is F_1. When the space between the two lenses is filled with glycerin (which has the same refractive index ($\mu = 1.5$) as that of glass) then the equivalent focal length is F_2. The ratio $F_1 : F_2$ will be (NEET 2019)

Options:

A. 3: 4

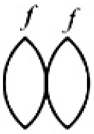
B. 2: 1

C. 1: 2

D. 2: 3 .

Answer: C

Solution:



According to lens maker's formula

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - 1 - R\right) = (1.5 - 1)\left(\frac{2}{R}\right) = \frac{1}{R}$

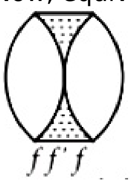
Two similar equi-convex lenses of focal length f each are held in contact with each other.
The focal length F_1 of the combination is given by

$\frac{1}{F_1} = \frac{1}{f} + \frac{1}{f} = \frac{2}{f}; F_1 = \frac{f}{2} = \frac{R}{2}$ .....(i)

For glycerin in between lenses, there are three lenses, one concave and two convex.
Focal length of the concave lens is given by

$\frac{1}{f'} = (1.5 - 1)\left(\frac{-2}{R}\right) = -\frac{1}{R}$

Now, equivalent focal length of the combination is,



$\frac{1}{F_2} = \frac{1}{f} + \frac{1}{f'} + \frac{1}{f}; \frac{1}{F_2} = \frac{1}{R} - \frac{1}{R} + \frac{1}{R} = \frac{1}{R}$

$F_2 = R$ .....(ii)

Dividing equation(i) by (ii), we get $\frac{F_1}{F_2} = \frac{1}{2}$

Question36

In a double slit experiment, when light of wavelength 400nm was used, the angular width of the first minima formed on a screen placed 1m away, was found to be 0.2°. What will be the angular width of the first minima, if the entire experimental apparatus is immersed in water? ($\mu_{water} = 4 / 3$) (NEET 2019)

Options:

A. 0.1°

B. 0.266°

C. 0.15°

D. 0.05°

Answer: C

Solution:

Angular width for first minima in Young's double slit experiment, $\theta = \frac{\lambda}{a}$

For given value of a, $\theta \propto \lambda$

$\frac{\theta}{\theta_w} = \frac{\lambda}{\lambda_w} = \frac{\lambda}{\frac{\lambda}{\mu}} = \mu \Rightarrow \theta_w = \frac{\theta}{\mu} = \frac{0.2^{\circ}}{\frac{4}{3}} = 0.15^{\circ}$

Question37

An equiconvex lens has power P. It is cut into two symmetrical halves by a plane containing the principal axis. The power of one part will be (OD NEET 2019)

Options:

A. 0

B. $\frac{P}{2}$

C. $\frac{P}{4}$

D. P

Answer: D

Solution:

When an equiconvex lens is cut into two symmetrical halves along the principal axis, then there will be no change in focal length of the lens.

$\therefore$ Power of lens, $P = \frac{1}{f}$

So, the power of each part will be P.

Question38

In a Young' double slit experiment if there is no initial phase difference between the light from the two slits, a point on the screen corresponding to the fifth minimum has path difference. (OD NEET 2019)

Options:

A. $5\frac{\lambda}{2}$

B. $10\frac{\lambda}{2}$

C. $9\frac{\lambda}{2}$

D. $11\frac{\lambda}{2}$

Answer: C

Solution:

Given, there is no initial phase difference.
∴ Initial phase $= \delta = 0$
Again, phase difference $= \frac{2\pi}{\lambda} \times$ path difference
$\Rightarrow \delta' = \frac{2\pi}{\lambda} \times \Delta x \Rightarrow \Delta x = \frac{\lambda}{2\pi} \times \delta'$
Now, for the fifth minima we will consider $n = 4$ as initial phase difference is zero.
∴ For fifth minimum, $\delta = (8 + 1)\pi = 9\pi$
∴ Path difference, $\Delta x = \frac{\lambda}{2\pi} \times 9\pi = \frac{9\lambda}{2}$

Question39

The refractive index of the material of a prism is $\sqrt{2}$ and the angle of the prism is 30°. One of the two refracting surfaces of the prism is made a mirror inwards, by silver coating. A beam of monochromatic light entering the prism from the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is
(NEET 2018)

Options:

A. 60°

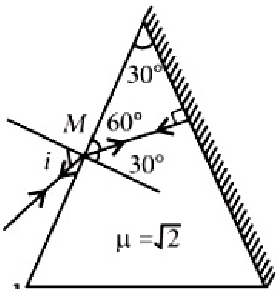
B. 45°

C. 30°

D. zero.

Answer: B

Solution:



For retracing the path shown in figure, light ray should be incident normally on the silvered face. Applying Snell's law at point M ,

$$\frac{\sin i}{\sin 30°} = \frac{\sqrt{2}}{1} \Rightarrow \sin i = \sqrt{2} \times \frac{1}{2}$$

$\sin i = \frac{1}{\sqrt{2}} i.e., i = 45°$

Question40

An object is placed at a distance of 40cm from a concave mirror of focal length 15cm. If the object is displaced through a distance of 20cm towards the mirror, the displacement of the image will be (NEET 2018)

Options:

A. 30cm away from the mirror

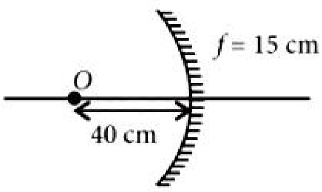
B. 36cm away from the mirror

C. 30cm towards the mirror

D. 36cm towards the mirror.

Answer: B

Solution:



Using mirror formula,

$$\frac{1}{f} = \frac{1}{v_1} + \frac{1}{u_1}; -\frac{1}{15} = \frac{1}{v_1} - \frac{1}{40} \Rightarrow \frac{1}{v_1} = \frac{1}{-15} + \frac{1}{40}$$

$v_1 = -24cm$When object is displaced by 20cm towards mirror. Now, $u_2 = -20cm$

$$\frac{1}{f} = \frac{1}{v_2} + \frac{1}{u_2}; \frac{1}{-15} = \frac{1}{v_2} - \frac{1}{20} \Rightarrow \frac{1}{v_2} = \frac{1}{20} - \frac{1}{15};$$

$v_2 = -60$ cm

So, the image will be shift away from mirror by $(60 - 24)$ cm $= 36$ cm

----

Question41

Unpolarised light is incident from air on a plane surface of a material of

refractive index μ. At a particular angle of incidence i it is found that the reflected and refracted rays are perpendicular to each other. Which of the following options is correct for this situation?
(NEET 2018)

Options:

A. Reflected light is polarised with its electric vector parallel to the plane of incidence

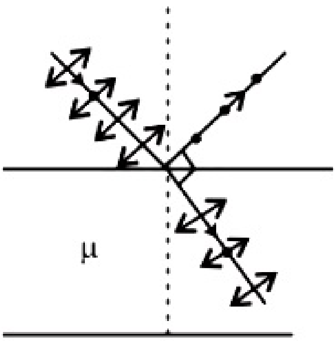
B. Reflected light is polarised with its electric vector perpendicular to the plane of incidence

C. $i = \sin^{-1}\left(\frac{1}{\mu}\right)$

D. $i = \tan^{-1}\left(\frac{1}{\mu}\right)$

Answer: B

Solution:



When reflected light and refracted light are perpendicular, reflected light is polarised with electric field vector perpendicular to the plane of incidence. Also, $\tan i = \mu$(Brewster angle)

Question42

In Young's double slit experiment the separation d between the slits is 2mm the wavelength λ of the light used is 5896 AA and distance D between the screen and slits is 100cm. It is found that the angular width of the fringes is 0.20°. To increase the fringe angular width to 0.21° (with same λ and D) the separation between the slits needs to be changed to
(NEET 2018)

Options:

A. 1.8mm

B. 1.9mm

C. 2.1mm

D. 1.7mm.

Answer: B

Solution:

Angular width $= \frac{\lambda}{d}$

$0.20° = \frac{\lambda}{2mm}$ and $0.21° = \frac{\lambda}{d}$

Dividing we get, $\frac{0.20}{0.21} = \frac{d}{2mm}$

$\therefore d = 1.9mm$

Question43

An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of
(NEET 2018)

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Options:

A. small focal length and large diameter

B. large focal length and small diameter

C. large focal length and large diameter

D. small focal length and small diameter.

Answer: C

Solution:

Solution:

For telescope, angular magnification $= \frac{f_0}{f_e}$

Angular resolution $= \frac{D}{1.22\lambda}$ should be large.

So, objective lens should have large focal length (f_0) and large diameter D for large angular magnification and high angular resolution.

Question44

The ratio of resolving powers of an optical microscope for two wavelengths $\lambda_1 = 4000Å$ and $\lambda_2 = 6000Å$ is
(2017 NEET)

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Options:

A. 9 : 4

B. 3 : 2

C. 16 : 81

D. 8 : 27

Answer: B

Solution:

The resolving power of an optical microscope,
$RP = \frac{2\mu\sin\theta}{\lambda}; \therefore \frac{RP_1}{RP_2} = \frac{6000}{4000} = \frac{3}{2}$

Question45

Young’s double slit experiment is first performed in air and then in a medium other than air. It is found that 8th bright fringe in the medium lies where 5th dark fringe lies in air. The refractive index of the medium is nearly
(2017 NEET)

Options:

A. 1.59

B. 1.69

C. 1.78

D. 1.25

Answer: C

Solution:

Position of 8th bright fringe in medium,
$x = \frac{8\lambda_m D}{d}$
Position of 5th dark fringe in air,
$x' = \frac{\left(5 - \frac{1}{2}\right)\lambda_{air} D}{d} = \frac{4.5\lambda_{air} D}{d}$
Given $x = x'$
$\therefore \frac{8\lambda_m D}{d} = \frac{4.5\lambda_{air} D}{d}$
$\mu_m = \frac{\lambda_{air}}{\lambda_m} = \frac{8}{4.5} \approx 1.78$

Question46

A beam of light from a source L is incident normally on a plane mirror fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source L. When the mirror is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is
(2017 NEET)

Options:

A. $\frac{y}{x}$

B. $\frac{x}{2y}$

C. $\frac{x}{y}$

D. $\frac{y}{2x}$

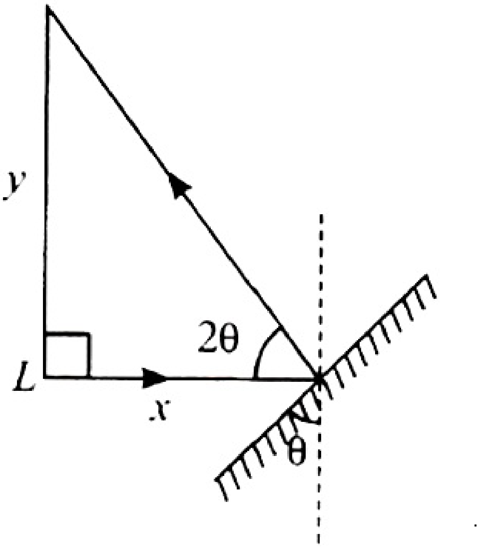
Answer: D

Solution:

Solution:
When mirror is rotated by θ angle reflected ray will be rotated by 2θ

For small angle θ,$\tan 2\theta \approx 2\theta = \frac{y}{x}$

$\therefore \theta = \frac{y}{2x}$



Question47

A thin prism having refracting angle 10° is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be
(2017 NEET)

Options:

A. 6°

B. 8°

C. 10

D. 4°

Answer: A

Solution:

The condition for dispersion without deviation is
given as $(\mu - 1)A = (\mu' - 1)A'$
Given $\mu = 1.42$, $A = 10°$, $\mu' = 1.7$, $A' = ?$
$\therefore (1.42 - 1) \times 10 = (1.7 - 1)A'$
$(0.42) \times 10 = 0.7 \times A'$
or, $A' = \frac{0.42 \times 10}{0.7} = 6°$

Question48

Two polaroid's P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1.A third polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45° with that of P_1. The intensity of transmitted light through P_2 is
(2017 NEET)

Options:

A. $\frac{I_0}{4}$

B. $\frac{I_0}{8}$

C. $\frac{I_0}{16}$

D. $\frac{I_0}{2}$

Answer: B

Solution:

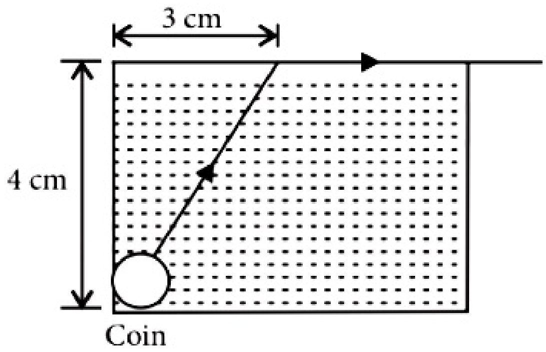
The intensity of transmitted light through P_1

$I_1 = \frac{I_0}{2}$
The intensity of transmitted light through P_3
$I_2 = I_1 \cos^2 45° = \frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{2} \cdot \frac{1}{2} = \frac{I_0}{4}$

Angle between polaroids P_3 and $P_2 = (90° - 45°) = 45°$
∴ Intensity of transm itted light through P_2
$I_3 = I_2 \cos^2 45° = \frac{I_0}{4}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{8}$

Question49

A small coin is resting on the bottom of a beaker filled with liquid. A ray of light from the coin travels upto the surface of the liquid and moves along its surface. How fast is the light travelling in the liquid? (2007)



Options:

A. 2.4×10^8 m / s

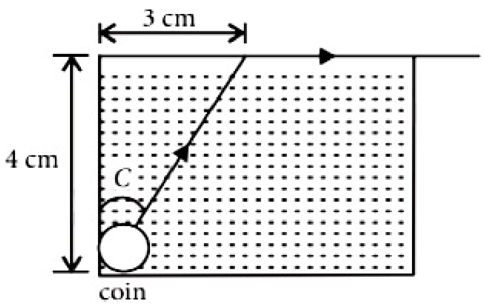
B. 3.0×10^8 m / s

C. 1.2×10^8 m / s

D. 1.8×10^8 m / s

Answer: D

Solution:



From figure, $\sin C = \frac{3}{\sqrt{(4)^2 + (3)^2}} = \frac{3}{5}$
where C is the critical angle. Also, $\sin C = {}^1\mu_a$

$\sin C = 1a_{\mu_l}$ [since $l_{\mu_a} = \frac{1}{a_{\mu_l}}$]

Also $a\mu_l = \frac{\text{velocity of light in air (c)}}{\text{velocity of light in liquid (v)}}$

$\therefore \sin C = \frac{v}{c} = \frac{v}{3 \times 10^8}$

or, $v = 3 \times 10^8 \times \frac{3}{5} = 1.8 \times 10^8 ms^{-1}$

Question50

Match the corresponding entries of column 1 with column 2. [Where m is the magnification produced by the mirror]

Column 1	Column 2
(A) $m = -2$	(p) Convex mirror
(B) $m = -\frac{1}{2}$	(q) Concave mirror
(C) $m = +2$	(r) Real image
(D) $m = +\frac{1}{2}$	(s) Virtual image

(2016 NEET Phase-I)

Options:

A. A→ p and s; B → q and r; C → q and s; D → q and r

B. A → r and s; B → q and s; C → q and r; D → p and s

C. A → q and r; B → q and r; C → q and s; D → p and s

D. A → p and r; B → p and s; C → p and q; D → r and s

Answer: C

Solution:

Solution:

Magnification in the mirror, $m = -\frac{v}{u}$

$m = -2 \Rightarrow v = 2u$

As v and u have same signs so the mirror is concave and image formed is real.

$m = -\frac{1}{2} \Rightarrow v = \frac{u}{2} \Rightarrow$

Concave mirror and real image

$m = +2 \Rightarrow v = -2u$

As v and u have different signs but magnification is 2 so the mirror is concave and image formed is virtual.

$m = +\frac{1}{2} \Rightarrow v = -\frac{u}{2}$

As v and u have different signs with magnification $\left(\frac{1}{2}\right)$ so the mirror is convex and image formed is virtual.

Question51

In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of (2016 NEET Phase-I)

Options:

A. $\sin^{-1}\left(\frac{1}{2}\right)$

B. $\sin^{-1}\left(\frac{3}{4}\right)$

C. $\sin^{-1}\left(\frac{1}{4}\right)$

D. $\sin^{-1}\left(\frac{2}{3}\right)$

Answer: B

Solution:

For first minimum, the path difference between extreme waves, $a\sin\theta = \lambda$

Here, $\theta = 30° \Rightarrow \sin\theta = \frac{1}{2}$

$\therefore a = 2\lambda$........(i)

For first secondary maximum, the path difference between extreme waves

$a\sin\theta' = \frac{3}{2}\lambda$ or $(2\lambda)\sin\theta' = \frac{3}{2}\lambda$ [Using eqn. (i)]

or $\sin\theta' = \frac{3}{4} \therefore \theta' = \sin^{-1}\left(\frac{3}{4}\right)$

Question52

The intensity at the maximum in a Young's double slit experiment is I_0. Distance between two slits is d = 5λ., where λ. is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance D = 10d ? (2016 NEET Phase-I)

Options:

A. $\frac{3}{4}I_0$

B. $\frac{I_0}{2}$

C. I_0

D. $\frac{I_0}{4}$

Answer: B

Solution:

Solution:
Here, $d = 5\lambda$, $D = 10d$, $y = \frac{d}{2}$.
Resultant Intensity at $y = \frac{d}{2}$, $I_y = ?$
The path difference between two waves at
$y = \frac{d}{2}$

$$\Delta x = d\tan\theta = d \times \frac{y}{D} = \frac{d \times \frac{d}{2}}{10d} = \frac{d}{20} = \frac{5\lambda}{20} = \frac{\lambda}{4}$$

Corresponding phase difference,$\phi = \frac{2\pi}{\lambda}\Delta x = \frac{\pi}{2}$
Now, maximum intensity in Young's double slit experiment,
$I_{max} = I_1 + I_2 + 2I_1 I_2$
$I_0 = 4I \quad (\because I_1 = I_1 = I)$
$\therefore I = \frac{I_0}{4}$
Required intensity $I_y = I_1 + I_2 + 2I_1 I_2 \cos\frac{\pi}{2} = 2I = \frac{I_0}{2}$

Question53

A astronomical telescope has objective and eyepiece of focal lengths 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance (2016 NEET Phase-I)

Options:

A. 50.0 cm

B. 54.0 cm

C. 37.3 cm

D. 46.0 cm

Answer: B

Solution:

Here, $f_0 = 40cm$, $f_e = 4cm$
Tube length(l = Distance between lenses $= v_o + f_e$
For objective lens,

$u_0 = -200\text{cm}, v_0 = ?$

$\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_o}$ or $\frac{1}{v_o} - \frac{1}{-200} = \frac{1}{40}$

or $\frac{1}{v_o} = \frac{1}{40} - \frac{1}{200} = \frac{4}{200} \therefore v_o = 50\text{cm}$

$\therefore l = 50 + 4 = 54\text{cm}$

Question54

The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are (2016 NEET Phase-I)

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Options:

A. $45°, \sqrt{2}$

B. $30°, \frac{1}{\sqrt{2}}$

C. $45°, \frac{1}{\sqrt{2}}$

D. $30°, \sqrt{2}$

Answer: D

Solution:

Given $i = 45°, A = 60°$
Since the ray undergoes minimum deviation, therefore, angle of emergence from second face,$e = i = 45°$
$\therefore \delta_m = i + e - A = 45° + 45° - 60° = 30°$

$$\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{60° + 30°}{2}\right)}{\sin\left(\frac{60°}{2}\right)}$$

$$= \frac{\sin 45°}{\sin 30°} = \frac{1}{\sqrt{2}} \times \frac{2}{1} = \sqrt{2}$$

Question55

Two identical glass $\left(\mu_g = \frac{3}{2}\right)$ equiconvex lenses of focal length l each are kept in contact. The space between the two lenses is filled with water $\left(\mu_w = \frac{4}{3}\right)$. The focal length of the combination is (2016 NEET Phase-II)

Options:

A. $\frac{f}{3}$

B. f

C. $\frac{4f}{3}$

D. $\frac{3f}{4}$

Answer: D

Solution:

Solution:

Here, $\mu_g = \frac{3}{2}, \mu_w = \frac{4}{3}$

Focal length (f) of glass convex lens is given by

$\frac{1}{f} = (\mu_g - 1)\left(\frac{2}{R}\right)$

or $\frac{1}{f} = \left(\frac{3}{2} - 1\right)\frac{2}{R} = \frac{1}{R}$ or $f = R$..........(i)

Focal length (f') of water filled concave lens is given by

$\frac{1}{f'} = (\mu_w - 1)\left(-\frac{2}{R}\right)$

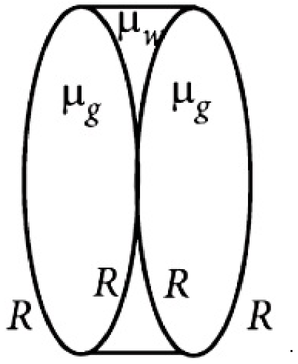
or $\frac{1}{f'} = \left(\frac{4}{3} - 1\right)\left(-\frac{2}{R}\right)$

$= -\frac{2}{3R} = -\frac{2}{3f}$ [Using eqn. (i)]

Equivalent focal length (f_{eq}) of lens system

$\frac{1}{f_{eq}} = \frac{1}{f} - \frac{2}{3f} + \frac{1}{f} = \frac{3 - 2 + 3}{3f} = \frac{4}{3f}$

$\therefore f_{eq} = \frac{3f}{4}$



Question56

An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is (2016 NEET Phase-II)

Options:

A. 8

B. 10

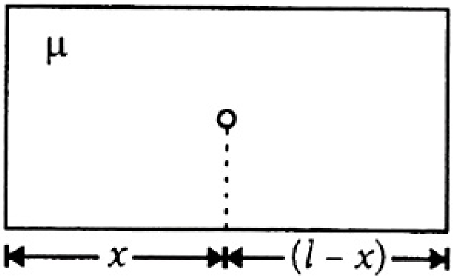
C. 12

D. 16

Answer: C

Solution:

Solution:



Here $\mu = 1..5$
l = length of the slab
x = position of air bubble fro one side
As per question, total apparent length of slab $= 5 + 3$
or $\frac{x}{\mu} + \frac{(1 - x)}{\mu} = 8$
or $\frac{l}{\mu} = 8 \quad \therefore l = 8\mu = 8 \times 1.5 = 12\text{cm}$

Question57

The interference pattern is obtained with two coherent light sources of intensity ratio n. In the interference pattern the ratio $\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ will be (2016 NEET Phase-II)

Options:

A. $\frac{\sqrt{n}}{n + 1}$

B. $\frac{2\sqrt{n}}{n + 1}$

C. $\frac{\sqrt{n}}{(n + 1)^2}$

D. $\frac{2\sqrt{n}}{(n + 1)^2}$

Answer: B

Solution:

Here, $\frac{I_1}{I_2} = n$

$$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right)^2 = \left(\frac{\sqrt{I_1/I_2} + 1}{\sqrt{I_1/I_2} - 1}\right)^2 = \left(\frac{\sqrt{n} + 1}{\sqrt{n} - 1}\right)^2$$

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}} = \frac{\frac{I_{max}}{I_{min}} - 1}{\frac{I_{max}}{I_{min}} + 1}$$

$$\frac{\left(\frac{\sqrt{n}+1}{\sqrt{n}-1}\right)^2 - 1}{\left(\frac{\sqrt{n}+1}{\sqrt{n}-1}\right)^2 + 1} = \frac{(\sqrt{n}+1)^2 - (\sqrt{n}-1)^2}{(\sqrt{n}+1)^2 - (\sqrt{n}-1)^2}$$

$$= \frac{4\sqrt{n}}{2(n+1)} = \frac{2\sqrt{n}}{n+1}$$

Question58

A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be
(2016 NEET Phase-II)

Options:

A. convex, +2.25 diopter

B. concave, -0.25 diopter

C. concave, -0.2 diopter

D. convex,+0.15 diopter

Answer: B

Solution:

Here, $u = 400\text{cm} = 4\text{m}, v = \infty, f = ?$

Using lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

or $\frac{1}{\infty} - \frac{1}{4} = \frac{1}{f}$ or $f = -4\text{m}$

Lens should be concave.

Power of lens $= \frac{1}{f} = \frac{1}{-4} = -0.25\text{D}$

Question59

A linear aperture whose width is 0.02 cm is placed immediately in front

of a lens of focal length 60 cm.The aperture is illuminated normally by a parallel beam of wavelength 5×10^{-5}cm.The distance of the first dark band of the diffraction pattern from the centre of the screen is
(2016 NEET Phase-II)

Options:

A. 0.10 cm

B. 0.25 cm

C. 0.20 cm

D. 0.15 cm

Answer: D

Solution:

Here, $a = 0.02\text{cm} = 2 \times 10^{-4}\text{m}$
$\lambda = 5 \times 10^{-5}\text{cm} = 5 \times 10^{-7}\text{m}$
$D = 60\text{cm} = 0.6\text{m}$
Position of first minima on the diffraction pattern,
$$y_1 = \frac{D\lambda}{a} = \frac{0.6 \times 5 \times 10^{-7}}{2 \times 10^{-4}} = 0.15\text{cm}$$

Question60

For a parallel beam of monochromatic light of wavelength $'\lambda'$, diffraction is produced by a single slit whose width $'a'$ is of the order of the wave length of the light.If 'D' is the distance of the screen from the slit, the width of the central maxima will be
(2015 Cancelled)

Options:

A. $\frac{Da}{\lambda}$

B. $\frac{2Da}{\lambda}$

C. $\frac{2D\lambda}{a}$

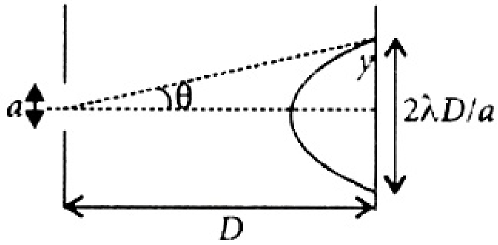
D. $\frac{D\lambda}{a}$

Answer: C

Solution:

Given situation is shown in the figure. For central maxima,

$\sin\theta = \frac{\lambda}{a}$
Also,θ is very-very small so
$\sin\theta = \tan\theta = \frac{y}{D}$
$\therefore \frac{y}{D} = \frac{\lambda}{a}, y = \frac{\lambda D}{a}$
Width of central maxima $= 2y = \frac{2\lambda D}{a}$.



Question61

Two identical thin plano-convex glass lenses (refractive index 1.5) each having radius of curvature of 20 cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is (2015 Cancelled)

Options:

A. -50 cm

B. 50 cm

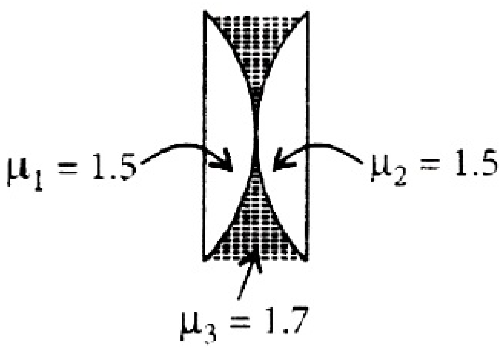
C. -20 cm

D. -25 cm

Answer: A

Solution:

Solution:



Given combination is equivalent to three lenses. In which two are plano-convex with refractive index 1.5 and one is concave lens of refractive index 1.7
Using lens maker formula,
$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
For plano-convex lens
$R_1 = \infty, R_2 = -20\text{cm}$

$\therefore \frac{1}{f_1} = \frac{1}{f_2} = (1.5 - 1)\left(\frac{1}{\infty} - \frac{1}{-20}\right) = \frac{0.5}{20} = \frac{1}{40}$

So, $f_1 = f_2 = 40cm$
For concave lens,
$\mu = 1.7, R_1 = -20cm, R_2 = 20cm$
$\therefore \frac{1}{f_3} = (1.7 - 1)\left(\frac{1}{-20} - \frac{1}{20}\right)$
$= 0.7 \times \left(\frac{-2}{20}\right) = -\frac{7}{100}$
So, $f_3 = -\frac{100}{7}cm$
Equivalent focal length (f_{eq}) of the system is given by
$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_3} + \frac{1}{f_2} = \frac{1}{40} + \frac{1}{-100/7} + \frac{1}{40}$

$= \frac{1}{20} - \frac{7}{100} = -\frac{2}{100} = -\frac{1}{50}$
$\therefore f_{eq} = -50cm$

Question62

In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit pattern within the central maxima of single slit pattern? (2015 Cancelled)

Options:

A. 0.5 mm

B. 0.02 mm

C. 0.2 mm

D. 0.1 mm

Answer: C

Solution:

Solution:
For double slit experiment,
$d = 1mm = 1 \times 10^{-3}, D = 1m, \lambda = 500 \times 10^{-9}m$

Fringe width $\beta = \frac{D\lambda}{d}$
Width of central maxima in a single slit $= \frac{2\lambda D}{a}$
As per question,
width of central maxima of single slit pattern = width of 10 maxima of double slit pattern
$\frac{2\lambda D}{a} = 10\left(\frac{\lambda D}{d}\right)$
$\Rightarrow a = \frac{2d}{10} = \frac{2 \times 10^{-3}}{10} = 0.2 \times 10^{-3}m = 0.2mm$

Question63

The refracting angle of a prism is A, and refractive index of the material of the prism is cot (A/2). The angle of minimum deviation is (2015 Cancelled)

Options:

A. $90° - A$

B. $180° + 2A$

C. $180° - 3A$

D. $180° - 2A$

Answer: D

Solution:

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

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

$$\frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\frac{A}{2}}$$

$$\sin\left(\frac{\pi}{2} - \frac{A}{2}\right) = \sin\left(\frac{A + D_m}{2}\right)$$

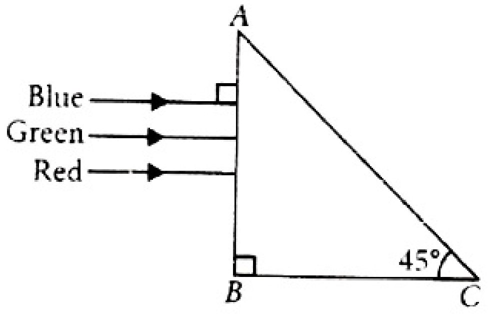
$$\Rightarrow \frac{\pi}{2} - \frac{A}{2} = \frac{A}{2} + \frac{D_m}{2}$$

$$D_m = \pi - 2A$$

$$D_3 = 180^{\circ} - 2A$$

Question64

A beam of light consisting of red, green and blue colours is incident on a right angled prism. The refractive index of the material of the prism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The prism will



(2015)

Options:

A. not separate the three colours at all

B. separate the red colour part from the green and blue colours

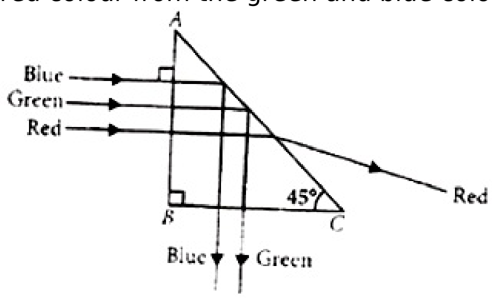
C. separate the blue colour part from the red and green colours

D. separate all the three colours from one another

Answer: B

Solution:

As beam of light is incident normally on the face AB of the right angled prism ABC, so no refraction occurs at face AB and it passes straight and strikes the face AC at an angle of incidence $i = 45°$.
For total reflection to take place at face AC,
$i > i_c$ or $\sin i > \sin i_c$
where i_c is the critical angle
But as here $i = 45°$ and $\sin i_c = \frac{1}{\mu}$
$\therefore \sin 45° > \frac{1}{\mu}$ or $\frac{1}{\sqrt{2}} > \frac{1}{\mu}$ or $\mu > \sqrt{2} = 1.414$
As $\mu_{red}(= 1.39) < \mu(= 1.414)$ while $\mu_{green}(= 1.44)$ and $\mu_{blue}(= 1.47) > \mu(= 1.414)$, so only red colour will be transmitted through face AC while green and blue colours will suffer total internal reflection. So the prism will separate red colour from the green and blue colours as shown in the following figure.



Question65

At the first minimum adjacent to the central maximum of a single-slit diffraction pattern, the phase difference between the Huygen's wavelet from the edge of the slit and the wavelet from the midpoint of the slit is (2015)

Options:

A. π radian

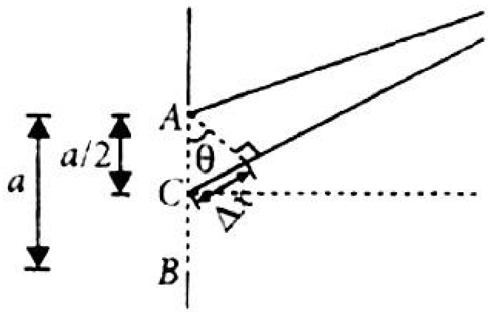
B. $\frac{\pi}{8}$ radian

C. $\frac{\pi}{4}$ radian

D. $\frac{\pi}{2}$ radian

Answer: A

Solution:



The situation is shown in the figure.
In figure A and B represent the edges of the slit AB of width a and C represents the midpoint of the slit.
For the first minimum at P,
$a\sin\theta = \lambda$..........(i)
where λ is the wavelength of light.
The path difference between the wavelets from A to C is
$\Delta x = \frac{a}{2}\sin\theta = \frac{1}{2}(a\sin\theta) = \frac{\lambda}{2}$ (Using (i))
The corresponding phase difference $\Delta\phi$ is
$\Delta\phi = \frac{2\pi}{\lambda}\Delta x = \frac{2\pi}{\lambda} \times \frac{\lambda}{2} = \pi$

Question66

In an astronomical telescope in normal adjustment a straight black line of length L is drawn on inside part of objective lens. The eye-piece forms a real image of this line. The length of this image is /. The magnification of the telescope is
(2015)

Options:

A. $\frac{L+I}{L-I}$

B. $\frac{L}{I}$

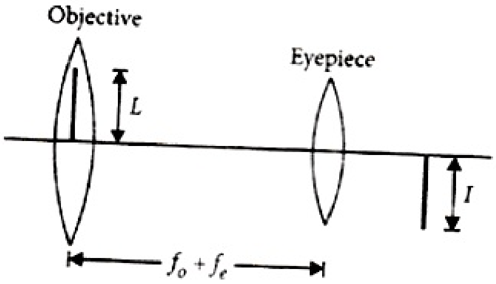
C. $\frac{L}{I} + 1$

D. $\frac{L}{I} - 1$

Answer: B

Solution:

The situation is shown in the figure.



Let f_o and f_e be the focal lengths of the objective and eyepiece respectively.
For normal adjustment distance of the objective from the eyepiece (tube length) $= f_o + f_e$
Treating the line on the objective as the object and eyepiece as the lens
$\therefore u = -(f_o + f_e)$ and $f = f_3$

As $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ $\therefore \frac{1}{v} - \frac{1}{-(f_o + f_e)} = \frac{1}{f_e}$

$$\frac{1}{v} = \frac{1}{f_e} - \frac{1}{f_o + f_e} = \frac{f_o + f_e - f_e}{f_e(f_o + f_e)} = \frac{f_o}{f_e(f_o + f_e)}$$

or $v = \frac{f_e(f_o + f_e)}{f_o}$

Thus, $\frac{I}{L} = \frac{v}{|u|} = \frac{\frac{f_e(f_o + f_e)}{f_e}}{(f_o + f_e)} = \frac{f_e}{f_o}$ or $\frac{f_o}{f_e} = \frac{L}{I}$..........(i)

$\therefore$The magnification of the telescope in normal adjustment is

$m = \frac{f_o}{f_e} = \frac{L}{I}$ (Using (i))

Question67

Two slits in Youngs experiment have widths in the ratio 1:25. The ratio of intensity at the maxima and minima in the interference pattern, $\frac{I_{max}}{I_{min}}$ is (2015)

Options:

A. $\frac{49}{121}$

B. $\frac{4}{9}$

C. $\frac{9}{4}$

D. $\frac{121}{9}$

Answer: C

Solution:

As, intensity $I \propto$ width of slit W
Also,intensity $I \propto$ square of amplitude A

$$\therefore \frac{I_1}{I_2} = \frac{W_1}{W_2} = \frac{A_1^2}{A_2^2}$$

But $\frac{W_1}{W_2} = \frac{1}{25}$ (given)

$$\therefore \frac{A_1^2}{A_2^2} = \frac{1}{25} \text{ or } \frac{A_1}{A_2} = \sqrt{\frac{1}{25}} = \frac{1}{5}$$

$$\therefore \frac{I_{max}}{I_{min}} = \frac{(A_1 + A_2)^2}{(A_1 - A_2)^2} = \frac{\left(\frac{A_1}{A_2} + 1\right)^2}{\left(\frac{A_1}{A_2} - 1\right)^2}$$

$$= \frac{\left(\frac{1}{5} + 1\right)^2}{\left(\frac{1}{5} - 1\right)^2} = \frac{\left(\frac{6}{5}\right)^2}{\left(-\frac{4}{5}\right)^2} = \frac{36}{16} = \frac{9}{4}$$

Question68

A beam of light of λ = 600nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between first dark fringes on either side of the central bright fringe is
(2014)

Options:

A. 1.2 cm

B. 1.2 mm

C. 2.4 cm

D. 2.4 mm

Answer: D

Solution:

Solution:
Here, $\lambda = 600\text{nm} = 600 \times 10^{-9}\text{m}$
$a = 1\text{mm} = 10^{-3}$. $D = 2\text{m}$
Distance between the first dark fringes on either side of the central bright fringe is also the width of central maximum.
Width of central maximum $= \frac{2\lambda D}{a}$

$$= \frac{2 \times 600 \times 10^{-9}\text{m} \times 2\text{m}}{10^{-3}\text{m}}$$

$24 \times 10^{-4}\text{m} = 2.4 \times 10^{-3}\text{m} = 2.4\text{mm}$

Question69

In the Young's double slit experiment, the intensity of light at a point on the screen where the path difference λ is K,(λ being the wavelength of

light used). The intensity at a point where the path difference is $\frac{\lambda}{4}$ will be
(2014)

Options:

A. K

B. $\frac{K}{4}$

C. $\frac{K}{2}$

D. zero

Answer: C

Solution:

Solution:
Intensity at any point on the screen is
$I = 4I_0 \cos^2\frac{\phi}{2}$
where I_0 0 is the intensity of either wave and ϕ is the phase difference between two waves.
Phase difference, $\phi = \frac{2\pi}{\lambda} \times$ Path difference
When path difference is λ, then
$\phi = \frac{2\pi}{\lambda} \times \lambda = 2\pi$
$\therefore I = 4I_0 \cos^2\left(\frac{2\pi}{2}\right) = 4I_0 \cos^2(\pi) = 4I_0 = K$ ....(i)

When path difference is $\frac{\lambda}{4}$, then
$\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2}$
$\therefore I = 4I_0 cs^2\left(\frac{\pi}{4}\right) = 2I_0 = \frac{K}{2}$ [Using (i)]

Question70

If the focal length of objective lens is increased then magnifying power of
(2014)

Options:

A. microscope will increase but that of telescope decrease.

B. microscope and telescope both will increase.

C. microscope and telescope both will decrease.

D. microscope will decrease but that of telescope will increase.

Answer: D

Solution:

Solution:
Magnifying power of a microscope,
$m = \left(\frac{L}{f_o}\right)\left(\frac{D}{f_o}\right)$
where f_o and f_e are the focal lengths of the objective and eyepiece respectively and L is the distance between their focal points and
D is the least distance of distinct vision.
If f_o increases, then m will decrease.
Magnifying power of a telescope, $m = \frac{f_0}{f_e}$
where f_o and f_e are the focal lengths of the objective and eyepiece respectively.
IIf f_o increases, then m will increase.

Question71

The angle of a prism is A. One of its refracting surfaces is silvered. Light rays falling at an angle of incidence 2A on the first surface returns back through the same path after suffering reflection at the silvered surface. The refractive index μ, of the prism is (2014)

Options:

A. 2 sinA

B. 2 cosA

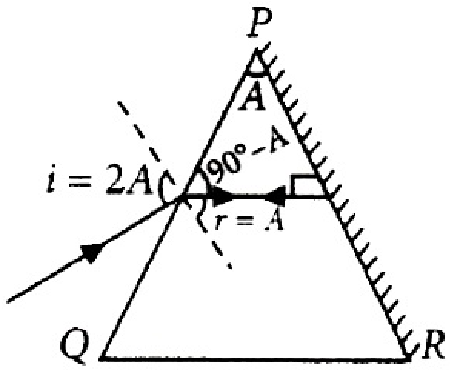
C. $\frac{1}{2}$ cosA

D. tanA

Answer: B

Solution:

Solution:



On reflection from the silvered surface, the incident ray will retrace its path, if it falls normally on the surface.
By geometry, $r = A$
Applying Snell's law at surface PQ,
$1\sin i = \mu \sin r$

$\mu = \frac{\sin i}{\sin r} = \frac{\sin 2A}{\sin A} = \frac{2\sin A\cos A}{\sin A} = 2\cos A$

Question72

A piano convex lens fits exactly into a piano concave lens. Their plane surfaces are parallel to each other. If lenses are made of different materials of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then the focal length of the combination is (2013 NEET)

Options:

A. $\frac{R}{(\mu_1 - \mu_2)}$

B. $\frac{2R}{(\mu_2 - \mu_1)}$

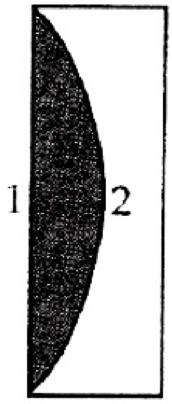
C. $\frac{R}{2(\mu_1 + \mu_2)}$

D. $\frac{R}{2(\mu_1 - \mu_2)}$

Answer: A

Solution:

Solution:
The combination of two lenses 1 and 2 is as shown in figure



According to Lens maker formula, we have, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

For Plano-convex lens, $R_1 = \infty$

$R_2 = -R$

Therefore, $\frac{1}{f_1} = (\mu_1 - 1)\left(\frac{1}{\infty} - \frac{1}{(-R)}\right)$

$\frac{1}{f_1} = \frac{\mu_1 - 1}{R}$

For Plano-concave lens, $R_1 = -R$

$R_2 = \infty$

Therefore, $\frac{1}{f_2} = (\mu_2 - 1)\left(\frac{1}{-R} - \frac{1}{\infty}\right)$

$\frac{1}{f_2} = \frac{1 - \mu_2}{R}$

Thus, focal length of the combination, $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

Putting the values, $\frac{1}{F} = \frac{\mu_1 - 1}{R} + \frac{1 - \mu_2}{R}$

$F = \frac{R}{\mu_1 - \mu_2}$

Focal length of combination of Plano-convex lens and Plano-concave lens is $\frac{R}{\mu_1 - \mu_2}$.

Question73

In Young's double slit experiment, the slits are 2 mm apart and are illuminated by photons of two wavelengths λ_1 = 12000Å and λ_2 = 10000Å.At what minimum distance from the common central bright fringe on the screen 2 m from the sHt will a bright fringe from one interference pattern coincide with a bright fringe from the other ? (2013 NEET)

Options:

A. 4 mm

B. 3 m

C. 8 mm

D. 6 mm

Answer: D

Solution:

Solution:

Let n_1 bright fringe of λ_1 coincides with n_2 bright fringe of λ_2.Then

$\frac{n_1\lambda_1 D}{d} = \frac{n_2\lambda_2 D}{d}$

or $n_1\lambda_1 = n_2\lambda_2$

$\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} = \frac{10000}{12000} = \frac{5}{6}$

Let x be given distance.

$\therefore x = \frac{n_1\lambda_1 D}{d}$

Here,

$n_1 = 5$, $D = 2m$, $d = 2mm = 2 \times 10^{-3}m$

$\lambda_1 = 12000Å = 12000 \times 10^{-10} = 12 \times 10^{-7}m$

$x = \frac{5 \times 12 \times 10^{-7}m \times 2m}{2 \times 10^{-3}m} = 6 \times 10^{-3}m = 6mm$

Question74

For a normal eye, the cornea of eye provides a converging power of 40 D

and the least converging power of the eye lens behind the cornea is 20 D. Using this information, the distance between the retina and the cornea-eye lens can be estimated to be
(2013 NEET)

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Options:

A. 1.67 cm

B. 1.5 cm

C. 5 cm

D. 2.5 cm

Answer: A

Solution:

Solution:
Converging power of cornea, $P_c = +40D$
Least converging power of eye lens, $P_e = +20D$
Power of the eye-lens, $P = P_c + P_e = 40D + 20D = 60D$
Power of the eye lens
$P = \frac{1}{\text{Focal length of the eye lens}(f)}$
$= \frac{1}{60D} = \frac{1}{60}m = \frac{100}{60}cm = \frac{5}{3}cm$
Distance between the retina and cornea-eye lens = Focal length of the eye lens
$= \frac{5}{3}cm = 1.67cm$

Question75

A parallel beam of fast moving electrons is incident normally on a narrow slit. A fluorescent screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statements is correct?
(2013 NEET)

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Options:

A. The angular width of the central maximum will decrease

B. The angular width of the central maximum will be unaffected.

C. Diffraction pattern is not observed on the screen in the case of electrons.

D. The angular width of the central maximum of the diffraction pattern will increase

Answer: A

Solution:

We know that $\lambda = \frac{h}{mv}$

Also for angular width $\omega = \frac{2\lambda}{d}$

So we can say $\omega \propto \lambda \propto \frac{1}{v}$

So if the velocity increases, the angular width of the central maximum will decrease.

Question76

In Young's double slit experiment the distance between the slits and the screen is doubled. The separation between the slits is reduced to half. As a result the fringe width
(KN NEET 2013)

Options:

A. is halved

B. becomes four times

C. remains unchanged

D. is doubled.

Answer: B

Solution:

Solution:

Fringe width, $\beta = \frac{\lambda D}{d}$

where D is the distance between slits and screenand d is the distance between the slits.
When D is doubled and d is reduced to half, then fringe width becomes

$$\beta' = \frac{\lambda(2D)}{\left(\frac{d}{2}\right)} = \frac{4\lambda D}{d} = 4\beta$$

Question77

A parallel beam of light of wavelength λ is incident normally on a narrow slit. A diffraction pattern formed on a screen placed perpendicular to the direction of the incident beam. At the second minimum of the diffraction pattern, the phase difference between the rays coming from the two edges of slit is
(KN NEET 2013)

Options:

A. 2π

B. 3π

C. 4π

D. πλ.

Answer: C

Solution:

Solution:
For the second minimum,
Path difference $= 2\lambda$
Therefore, corresponding value of phase difference is
$\Delta\phi = \frac{2\pi}{\lambda} \times$ Path difference
$\therefore \Delta\phi = \frac{2\pi}{\lambda} \times 2\lambda = 4\pi$

Question78

The reddish appearance of the sun at sunrise and sunset is due to (KN NEET 2013)

Options:

A. the scattering of light

B. the polarisation of light

C. the colour of the sun

D. the colour of the sky.

Answer: A

Solution:

Solution:
The reddish appearance of the sun at sunrise and sunset is due to the scattering of light.

Question79

Two plane mirrors are inclined at 70° . A ray incident on one mirror at angle, θ after reflection falls on second mirror and is reflected from there parallel to first mirror. The value of θ is (KN NEET 2013)

Options:

A. 45°

B. 30°

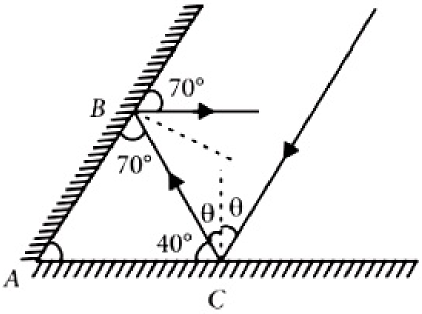
C. 55°

D. 50°.

Answer: D

Solution:

Solution:
Different angles as shown in the figure.



$\theta + 40° = 90°$
$\therefore \theta = 90° - 40° = 50°$

Question80

When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index
(2012)

©

Options:

A. equal to that of glass

B. less than one

C. greater than that of glass

D. less than that of glass

Answer: A

Solution:

Solution:
According to lens maker's formula
$\frac{1}{f} = \left(\frac{\mu_g}{\mu_L} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
where μ_g is the refractive index of the material of the lens and μ_L is the refractive index of the liquid in which lens is dipped. As the biconvex lens dipped in a liquid acts as a plane sheet ofglass, therefore
$f = \infty \Rightarrow \frac{1}{f} = 0, \therefore \frac{\mu_g}{\mu_L} - 1 = 0$ or $\mu_g = \mu_L$

Question81

A ray of light is incident at an angle of incidence i, on one face of a prism of angle A (assumed to be small) and emerges normally from the opposite face. If the refractive index of the prism is ft, the angle of incidence i, is nearly equal to
(2012)

Options:

A. μA

B. $\frac{\mu A}{2}$

C. $\frac{A}{\mu}$

D. $\frac{A}{2\mu}$

Answer: A

Question82

A concave mirror of focal length f_1 is placed at a distance of d from a convex lens of focal length f_2 A beam of light coming from infinity and falling on this convexlens - concave mirror combination returns to infinity. The distance d must equal
(2012)

Options:

A. $f_1 + f_2$

B. $-f_1 + f_2$

C. $2f_1 + f_2$

D. $-2f_1 + f_2$

Answer: C

Question83

The magnifying power of a telescope is 9. When it is adjusted for parallel rays the distance between the objective and eyepiece is 20 cm. The focal length of lenses are (2012)

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Options:

A. 10 cm, 10 cm

B. 15 cm, 5 cm

C. 18 cm,2 cm

D. 11 cm, 9 cm

Answer: C

Solution:

Solution:

Magnifying power, $m = \frac{f_o}{f_e} = 9$.....(i)

where f_o and f_e are the focal lengths of the objective and eyepiece respectively

Also, $f_o + f_e = 20cm$........(ii)

On solving (i) and (ii), we get $f_o = 18cm$, $f_e = 2cm$

Question84

For the angle of minimum deviation of a prism to be equal to its refracting angle, the prism must be made of a material whose refractive index (2012 Mains)

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Options:

A. lies between $\sqrt{2}$ and 1

B. lies between 2 and $\sqrt{2}$

C. is less than 1

D. is greater than 2

Answer: B

Solution:

As $\mu = \dfrac{\sin\left(\dfrac{A+\delta_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

$\mu = \dfrac{\sin\left(\dfrac{A+A}{2}\right)}{\sin\left(\dfrac{A}{2}\right)} = \dfrac{\sin A}{\sin\left(\dfrac{A}{2}\right)}$ ($\because \delta_m = A$(Given))

$= \dfrac{2\sin\left(\dfrac{A}{2}\right)\cos\left(\dfrac{A}{2}\right)}{\sin\left(\dfrac{A}{2}\right)} = 2\cos\left(\dfrac{A}{2}\right)$

As $\delta = i + e - A$

At minimum deviation, $\delta = \delta_m$, $i = e$

$\therefore \delta_m = 2i - A$

$2i = \delta_m + A$

$i = \dfrac{\delta_m + A}{2} = \dfrac{A+A}{2} = A$ ($\because \delta_m = A$(given))

$i_{min} = 0° \Rightarrow A_{min} = 0°$

Then, $\mu_{max} = 2\cos 0° = 2$

$\because i_{max} = \dfrac{\pi}{2} \Rightarrow A_{max} = \dfrac{\pi}{2}$

Then, $\mu_{min} = 2\cos 45° = 2 \times \dfrac{1}{\sqrt{2}} = \sqrt{2}$

So refractive index lies between 2 and $\sqrt{2}$.

Question85

A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is
(2012 Mains)

Options:

A. 10 cm

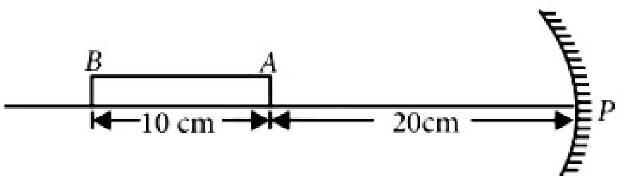
B. 15 cm

C. 2.5 cm

D. 5 cm

Answer: D

Solution:



-10 cm

Here, $f = -10$cm

For end A, $u_A = -20cm$
Image position of end A,
$$\frac{1}{v_A} + \frac{1}{u_A} = \frac{1}{f}$$
$$\frac{1}{v_A} + \frac{1}{(-20)} = \frac{1}{(-10)} \text{ or } \frac{1}{v_A} = \frac{1}{-10} + \frac{1}{20} = -\frac{1}{20}$$
$v_A = -20cm$
For end B, $u_B = -30cm$
Image position of end B,
$$\frac{1}{v_B} + \frac{1}{u_B} = \frac{1}{f}$$
$$\frac{1}{v_B} + \frac{1}{(-30)} = \frac{1}{(-10)} \text{ or } \frac{1}{v_B} = \frac{1}{-10} + \frac{1}{30} = -\frac{2}{30}$$
$v_B = -15cm$
Length of the image
$= | v_A | - | v_B | = 20cm - 15cm = 5cm$

Question86

Which of the following is not due to total internal reflection? (2011)

Options:

A. Working of optical fibre

B. Difference between apparent and real depth of a pond

C. Mirage on hot summer days

D. Brilliance of diamond

Answer: B

Solution:

Solution:
Difference between apparent and real depth of a pond is due to refraction. Other three are due to total internal reflection.

Question87

A biconvex lens has a radius of curvature of magnitude 20 cm. Which one of the following options describe best the image formed of an object of height 2 cm placed 30 cm from the lens? (2011)

Options:

A. Virtual, upright, height = 1 cm

B. Virtual, upright, height = 0.5 cm

C. Real, inverted, height = 4 cm

D. Real, inverted, height = 1 cm

Answer: C

Solution:

Radius of curvature, R = 20cm
Height of object, $h_0 = 2$
Object distance, u = 30cm
We have, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
$= \left(\frac{3}{2} - 1\right)\left[\frac{1}{20} - \left(-\frac{1}{20}\right)\right]$
$\Rightarrow \frac{1}{f} = \left(\frac{3}{2} - 1\right) \times \frac{2}{20}$
$\therefore f = 20cm$
$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$
$\Rightarrow \frac{1}{20} = \frac{1}{v} + \frac{1}{30}$
$\frac{1}{v} = \frac{1}{20} - \frac{1}{30}$
$= \frac{10}{600}$
v = 60cm
$m = \frac{h_i}{h_0} = \frac{v}{u}$
$\Rightarrow h_i = \frac{v}{u} \times h_0$
$= \frac{60}{30} \times 2 = -4cm$
so, image is inverted.

Question88

A thin prism of angle 15° made of glass of refractive index μ_1 = 1.5 is combined with another prism of glass of refractive index μ_2 = 1.75. The combination of the prisms produces dispersion without deviation. The angle of the second prism should be
(2011 Mains)

Options:

A. 5°

B. 7°

C. 10°

D. 12

Answer: C

Solution:

For dispersion without deviation
$\delta_1 + \delta_2 = 0$
$(\mu_1 - 1)A_1 + (\mu_2 - 1)A_2 = 0$
$A_2 = \frac{(\mu_1 - 1)A_1}{(\mu_2 - 1)}$
Substituting the given values, we get
$A_2 = -\frac{(1.5 - 1)15°}{(1.75 - 1)} = -10°$
-ve sign shows that two prisms must be joined in opposition.

Question89

A converging beam of rays is incident on a diverging lens. Having passed through the lens, the rays intersect at a point 15 cm from the lens on the opposite side. If the lens is removed, the point where the rays meet will move 5 cm closer to the lens. The focal length of the lens is
(2011 Mains)

Options:

A. 5 cm

B. -10 cm

C. 20 cm

D. -30 cm

Answer: D

Solution:

Here, $v = +15\text{cm}, u + (15 - 5) = +10\text{cm}$
According to lens formula
$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{15} - \frac{1}{10} = \frac{1}{f} \Rightarrow f = -30\text{cm}$

Question90

A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45°. For which of the following value of ft, the ray can undergo total internal reflection?
(2010)

Options:

A. $\mu = 1.33$

B. $\mu = 1.40$

C. $\mu = 1.50$

D. $\mu = 1.25$

Answer: C

Solution:

For total internal reflection, sini > sinC
where,
i = angle of incidence
C = cirtical angle
But, $\sin C = \frac{1}{\mu}$ $\therefore \sin i > \frac{1}{\mu}$ or $\mu > \frac{1}{\sin i}$
$\mu > \frac{1}{\sin 45°}$ (i = 45°(Given))
$\mu > \sqrt{2}$
Hence, option (c) is correct.

Question91

A lens having focal length f and aperture of diameter d forms an image of intensity I .Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively
(2010)

Options:

A. f and $\frac{I}{4}$

B. $\frac{3f}{4}$ and $\frac{I}{2}$

C. f and $\frac{3I}{4}$

D. $\frac{f}{2}$ and $\frac{I}{2}$

Answer: C

Solution:

Focal length of the lens remains same.
Intensity of image formed by lens is proportional to area exposed to incident light from object.
i.e., Intensity ∝ area
or $\frac{I_2}{I_1} = \frac{A_2}{A_1}$

Initial area, $A_1 = \pi \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$

After blocking, exposed area,

$$A_2 = \frac{\pi d^2}{4} - \frac{\pi \left(\frac{d}{2}\right)^2}{4} = \frac{\pi d^2}{4} - \frac{\pi d^2}{16} = \frac{3\pi d^2}{16}$$

$$\therefore \frac{I_2}{I_1} = \frac{A_2}{A_1} = \frac{\frac{3\pi d^2}{16}}{\frac{\pi d^2}{4}} = \frac{3}{4}$$

or $I_2 = \frac{3}{4} I_1 = \frac{3}{4} I \; (\because I_1 = I)$

Hence, focal length of a lens $= f$, intensity of the image $= \frac{3I}{4}$

Question92

The speed of light in media M_1 and M_2 are $1.5 \times 10^8 \frac{m}{s}$ and $2.0 \times 10^8 \frac{m}{s}$ respectively. A ray of light enters from medium M_1 to M_2 at an incidence angle i. If the ray suffers total internal reflection, the value of i is
(2010 Mains)

Options:

A. Equal to $\sin^{-1}\left(\frac{2}{3}\right)$

B. Equal to or less than $\sin^{-1}\left(\frac{3}{5}\right)$

C. Equal to or greater than $\sin^{-1}\left(\frac{3}{4}\right)$

D. Less than $\sin^{-1}\left(\frac{2}{3}\right)$

Answer: C

Solution:

Refractive index for medium M_1 is

$$\mu_1 = \frac{c}{v_1} = \frac{3 \times 10^8}{1.5} \times 10^8 = 2$$

Refractive index for medium M_2 is

$$\mu_2 = \frac{c}{v_2} = \frac{3 \times 10^8}{2.0 \times 10^8} = \frac{3}{2}$$

For total internal reflection

$\sin i \geq \sin C$

Where

i = angle of incidence

C = critical angle

But $\sin C = \frac{\mu_2}{\mu_1}$

$\sin i \geq \frac{\mu_2}{\mu_1} \geq \frac{\frac{3}{2}}{2} \Rightarrow i \geq \sin^{-1}\left(\frac{3}{4}\right)$

Question93

A ray of light is incident on a 60° prism at the minimum deviation position. The angle of refraction at the first face (i.e., incident face) of the prism is
(2010 Mains)

Options:

A. zero

B. 30°

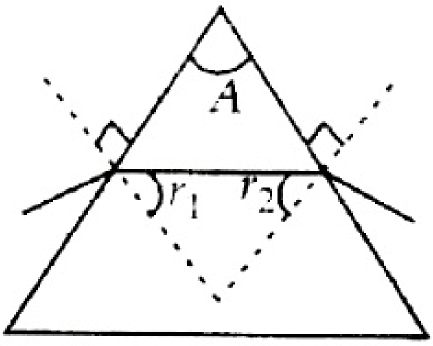
C. 45°

D. 60°

Answer: B

Solution:

Angle of prism, $A = r_1 + r_2$
For minimum deviation
$r_1 = r_2 = r \quad \therefore A = 2r$
Given, $A = 60°$
Hence, $r = \frac{A}{2} = \frac{60°}{2} = 30°$



Question94

A boy is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length 10 cm. The diameter of the sun is 1.39×10^9 m and its mean distance from the earth is 1.5×10^{11}m. What is the diameter of the sun's image on the paper?
(2008)

Options:

A. 6.5×10^{-5}m

B. 12.4×10^{-4} m

C. 9.2×10^{-4} m

D. 6.5×10^{-4} m

Answer: C

Solution:

Solution:

frac $\frac{\text{size of image}}{\text{size of object}} = \left|\frac{v}{u}\right|$

$\Rightarrow$ size of the image $= \frac{1.39 \times 10^{9} \times 10^{-1}}{1.5 \times 10^{11}}$

$= 0.92 \times 10^{-3}$ m

size of the image $= 9.2 \times 10^{-4}$ m

Question95

Two thin lenses of focal lengths f_1 and f_2 are in contact and coaxial. The power of the combination is (2008)

Options:

A. $\frac{f_1 + f_2}{2}$

B. $\frac{f_1 + f_2}{f_1 f_2}$

C. $\sqrt{\frac{f_1}{f_2}}$

D. $\sqrt{\frac{f_2}{f_1}}$

Answer: B

Solution:

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\therefore \text{Power, } P = \frac{1}{f} = \frac{f_1 + f_2}{f_1 f_2}$$

Question96

The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000Å The refractive index of material will be (2007)

Options:

A. 1.50

B. 3.00

C. 1.33

D. 1.40 .

Answer: B

Solution:

$$\mu = \frac{\text{velocity of light in vacuum(c)}}{\text{velocity of light in medium (v)}}$$
$\therefore v = \nu\lambda = 2 \times 10^{14} \times 5000 \times 10^{-10}$

In the medium, $v = 10^{8} \mathrm{m / s}$

$$\therefore \mu = \frac{c}{v_{med}} = \frac{3 \times 10^{8}}{10^{8}} = 3$$

Question97

A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again? (2006)

Options:

A. 2 cm upward

B. 1 cm upward

C. 4.5 cm downward

D. 1 cm downward.

Answer: B

Solution:

Apparent depth $= \frac{\text{real depth}}{\mu} = \frac{3}{1.5}$
$= 2$ cm
As image appears to be raised by 1 cm, therefore, microscope must be moved upwards by 1 cm.

Question98

A convex lens and a concave lens, each having same focal length of 25 cm, are put in contact to form a combination of lenses. The power in diopters of the combination is
(2006)

Options:

A. zero

B. 25

C. 50

D. infinite.

Answer: A

Solution:

Solution:
Focal length of convex lens $f_1 = 25$ cm
Focal length of concave lens $f_2 = -25$ cm
Power of combination in dioptres,
$P = P_1 + P_2 = \frac{100}{f_1} + \frac{100}{f_2} = \frac{100}{25} - \frac{100}{25} = 0$

Question99

The angular resolution of a 10 cm diameter telescope at a wavelength of 5000Å is of the order of
(2005)

Options:

A. 10^6 rad

B. 10^{-2} rad

C. 10^{-4} rad

D. 10^{-6} rad.

Answer: D

Solution:

Two point sources are regarded as just resolved when the principal diffraction maximum of one image coincides with the first minimum of the other.
If one considers diffraction through a circular aperture, this translates into the expression

$\theta = 1.22\,\frac{\lambda}{d} = 1.22 \times \frac{5000 \times 10^{-8}}{10} = 1.22 \times 5 \times 10^{-6} = 6 \times 10^{-6}\text{rad}$

Hence, the closest option is 10^{-6} rad

Question100

A telescope has an objective lens of 10 cm diameter and is situated at a distance of onekilometre from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000Å , is of the order of (2004)

Options:

A. 0.5 m

B. 5 m

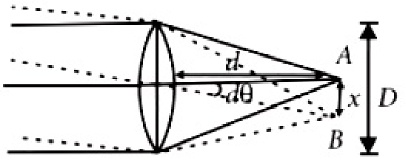
C. 5 mm

D. 5 cm.

Answer: C

Solution:

Resolution of telescope



$d\,\theta = 1.22\frac{\lambda}{D} = 1.22 \times \frac{5000 \times 10^{-8}}{10}$

$x = d\,\theta \times d$

$= \frac{1.22 \times 5000 \times 10^{-8} \times 10^{5}}{10}\ [d\ = 10^{5}\text{cm}] \simeq 5\text{mm}$

Question101

The refractive index of the material of a prism is $\sqrt{2}$ and its refracting angle is 30°. One of the refracting surfaces of the prism is made a mirror inwards. A beam of monochromatic light entering the prism from the other face will retrace its path after reflection from the mirrored surface if its angle of incidence on the prism is

(2004)

Options:

A. 45°

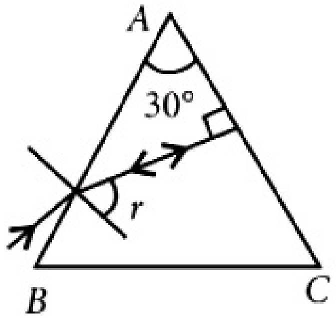
B. 60°

C. 0

D. 30°

Answer: A

Solution:



$\angle r = 30°$ (using law of triangle)

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

$\Rightarrow \sqrt{2} \times \sin 30° = \sin i$

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

Question102

A beam of light composed of red and green ray is incident obliquely at a point on the face of rectangular glass slab. When coming out on the opposite parallel face, the red and green ray emerge from (2004)

Options:

A. Two points propagating in two different non parallel directions

B. Two points propagating in two different parallel directions.

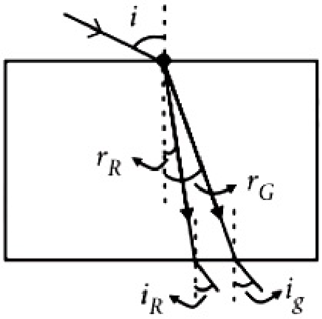
C. One point propagating in two different directions.

D. One point propagating in the same directions.

Answer: B

Solution:

The velocities of different colours is different in a given medium. Red and green are refracted at different angle of refraction.



$\frac{\sin i}{\sin r_R} = \mu$ ......(i)

$\frac{\sin i}{\sin r_G} = \mu$ ....(ii)

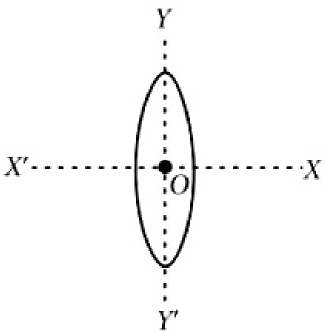
$\frac{\sin r_p}{\sin i_p} = \mu$ ......(iii)

From equations (i), (ii) and (iii), we get

$i = i_R = i_G$

Thus two point propagation in two different parallel direction.

Question103



An equiconvex lens is cut into two halves along(i) XOX' and(ii) YOY' as shown in the figure. Let f, f', f'' be the focal lengths of the complete lens, of each half in case (i), and of each half in case (ii), respectively. Choose the correct statement from the following
(2003)

Options:

A. $f' = f$, $f'' = 2f$

B. $f' = 2f$, $f'' = f$

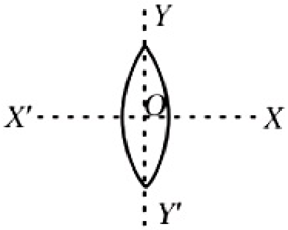
C. $f' = f$, $f'' = f$

D. $f' = 2f$, $f'' = 2f$

Answer: A

Solution:

Solution:
since the lens is equiconvex, the radius of curvature of each half is same, say R. We know from Lens maker's formula



$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

(considering the lens to be placed in air).

Here $R_1 = R$

$R_2 = -R$ by convention

$\therefore \frac{1}{f} = (\mu - 1)\frac{2}{R} \Rightarrow (\mu - 1)\,\frac{1}{R} = \frac{1}{2f}$ ......(i)

If we cut the lens along $X\,OX^{\text{prime}}$ then the two halves of the lens will be having the same radii of curvature and so, focal length $f' = f$

But when we cut it along $Y\,OY'$ then, we will have

$R_1 = R\,\text{but}\,R_2 = \infty$

$\therefore \frac{1}{f''} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right) = (\mu - 1)\frac{1}{R} = \frac{1}{2f}$

$\Rightarrow f'' = 2f$

Question104

A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will (2003)

Options:

A. become zero

B. become infinite

C. become small, but non-zero

D. remain unchanged.

Answer: B

Solution:

Solution:

When refractive index of lens is equal to the refractive index of liquid, the lens behave like a plane surface with focal length infinity.

Question105

A bulb is located on a wall. Its image is to be obtained on a parallel wall with the help of convex lens. The lens is placed at a distance d ahead of second wall, then required focal length will be (2002)

Options:

A. only $\frac{d}{4}$

B. only $\frac{d}{2}$

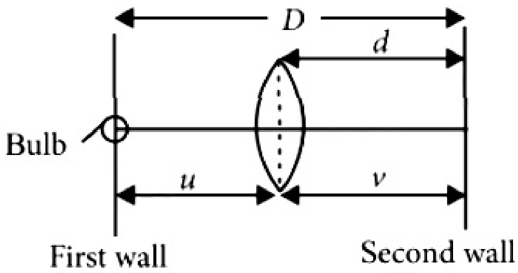
C. more than $\frac{d}{4}$ but less than $\frac{d}{2}$

D. less than $\frac{d}{4}$.

Answer: B

Solution:

Solution:
A real image is to be formed on the 2^{nd} wall of the bulb placed on the first wall by the convex lens. The lens is placed at a distance of d from the 2^{nd} wall.



Now, we know that to form a real image of an object on a screen by a convex lens, the distance between the source and the screen (D) should be equal to $4f$, where f is the focal length of the lens.
In that case, $u = v = \frac{D}{2} = d$.
$\therefore f = \frac{D}{4} = \frac{d}{2}$

Question106

Diameter of human eye lens is 2 mm. What will be the minimum distance between two points to resolve them, which are situated at a distance of 50 meter from eye. The wavelength of light is 5000Å (2002)

Options:

A. 2.32 m

B. 4.28 mm

C. 1.25 cm

D. 12.48 cm

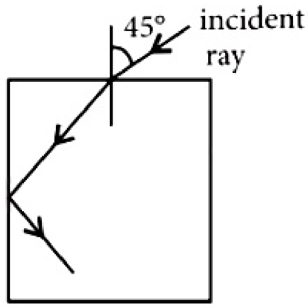
Answer: C

Solution:

Resolving power of eye lens $= \frac{\mathrm{d}}{\lambda} = \frac{2 \times 10^{-1}}{5000 \times 10^{-8}} = \frac{1}{\mathrm{d}\,\theta}$

left[right. Given d = diameter of lens $= 2\mathrm{mm} = 2 \times 10^{-1}$ cm.
$\lambda = 5000\text{Å} = 5000 \times 10^{-8}\mathrm{cm}$].
Let S be the minimum distance between two points so that it may be resolved.
$\therefore$ S $= \mathrm{r}\ \mathrm{d}\,\theta$. Here $\mathrm{r} = 50\ \mathrm{m} = 5000\ \mathrm{cm}$.
$\therefore \mathrm{S} = 5000 \times \frac{5000 \times 10^{-8}}{2 \times 10^{-1}} = 1.25$ cm.

Question107



For the given incident ray as shown in figure, the condition of total internal reflection of this ray the required refractive index of prism will be (2002)

Options:

A. $\frac{\sqrt{3}+1}{2}$

B. $\frac{\sqrt{2}+1}{2}$

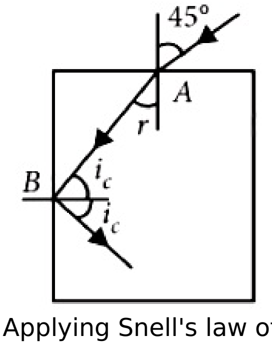
C. $\sqrt{\frac{3}{2}}$

D. $\sqrt{\frac{7}{6}}$.

Answer: C

Solution:

Solution:



Applying Snell's law of refraction at A, we get

$\mu = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin r}$

$\therefore \sin r = \frac{1}{\sqrt{2}\mu}$

$\therefore r = \sin^{-1}\left(\frac{1}{\sqrt{2}\mu}\right)$ ....(i)

Applying the condition of total internal reflection at B, we get

$i_c = \sin^{-1}\left(\frac{1}{\mu}\right)$ ......(ii)

where i_c is the critical angle.

Now, $r + i_c = 90° = \frac{\pi}{2}$

$\therefore \sin^{-1}\frac{1}{\sqrt{2}\mu} = \frac{\pi}{2} - \sin^{-1}\frac{1}{\mu}$

or, $\sin^{-1}\frac{1}{\sqrt{2}\mu} = \cos^{-1}\frac{1}{\mu}$

$\therefore \frac{1}{\sqrt{2}\mu} = \frac{\sqrt{\mu^2 - 1}}{\mu}$ or $\frac{1}{2} = \mu^2 - 1$

$\therefore \mu = \sqrt{\frac{3}{2}}$

Question108

Optical fibre are based on (2001)

Options:

A. total internal reflection

B. less scattering

C. refraction

D. less absorption coefficient.

Answer: A

Question109

A ray of light travelling in air have wavelength λ, frequency n, velocity v and intensity I . If this ray enters into water then these parameters are λ′, n′, v′ and I ′ respectively. Which relation is correct from following? (2001)

Options:

A. λ = λ′

B. n = n′

C. v = v′

D. I = I ′

Answer: B

Solution:

Frequency remains same.

Question110

A disc is placed on a surface of pond which has refractive index $\frac{5}{3}$. A source of light is placed 4 m below the surface of liquid. The minimum radius of disc needed so thatlight is not coming out is,
(2001)

Options:

A. ∞

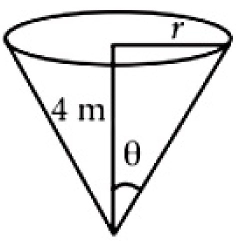
B. 3 m

C. 6 m

D. 4 m.

Answer: B

Solution:



θ is the critical angle.
$\therefore \theta = \sin^{-1}\left(\frac{1}{\mu}\right) = \sin^{-1}\left(\frac{3}{5}\right)$
or, $\sin\theta = \frac{3}{5}$
$\therefore \tan\theta = \frac{3}{4} = \frac{r}{4}$
or, r = 3 m.

Question111

A bubble in glass slab ($\mu = 1.5$) when viewed from one side appears at 5 cm and 2 cm from other side, then thickness of slab is (2000)

Options:

A. 3.75 cm

B. 3 cm

C. 10.5 cm

D. 2.5 cm

Answer: C

Solution:

Total apparent depth,
$y = y_1 + y_2 = 5 + 2 = 7$ cm
If x is real depth = thickness of slab, then as
$\mu = \frac{\text{real depth}}{\text{apparent depth}} = \frac{x}{y}$
or, $x = \mu y = 1.5 \times 7 = 10.5$ cm.

Question112

A tall man of height 6 feet, want to see his full image. Then required minimum length of the mirror will be (2000)

Options:

A. 12 feet

B. 3 feet

C. 6 feet

D. any length.

Answer: B

Solution:

Solution:
The minimum mirror length should be half of the height of man.

Question113

For a plano convex lens ($\mu = 1.5$) has radius of curvature 10 cm. It is silvered on its plane surface. Find focal length after silvering.
(2000)

Options:

A. 10 cm

B. 20 cm

C. 15 cm

D. 25 cm.

Answer: A

Solution:

$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$= (1.5 - 1)\left[\frac{1}{\infty} - \frac{1}{(-10)}\right] = 0.5\left[\frac{1}{10}\right] \Rightarrow f = 20 \text{ cm}$$

When plane surface is silvered,

$$F = \frac{f}{2} = \frac{20}{2} = 10 \text{ cm}$$

Question114

Rainbow is formed due to
(2000)

Options:

A. scattering and refraction

B. internal reflection and dispersion

C. reflection only

D. diffraction and dispersion.

Answer: B

Solution:

Solution:
The rainbow is an example of the dispersion of sunlight by the water drops in the atmosphere. This is a phenomenon due to a combination of the refraction of sunlight by spherical water droplets and of internal (not total) reflection.

Question115

A plano convex lens is made of refractive index 1.6. The radius of curvature of the curved surface is 60 cm. The focal length of the lens is (1999)

Options:

A. 200 cm

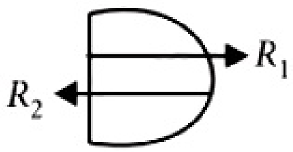
B. 100 cm

C. 50 cm

D. 400 cm

Answer: B

Solution:



$R_1 = +\infty$
$R_2 = -60$ cm
$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
$\frac{1}{f} = (1.6 - 1)\left(\frac{1}{\infty} - \frac{1}{-60}\right)$ or $f = 100$ cm

----

Question116

Colours appear on a thin soap film and on soap bubbles due to the phenomenon of
(1999)

Options:

A. interference

B. dispersion

C. refraction

D. diffraction.

Answer: A

Question117

If the refractive index of a material of equilateral prism is $\sqrt{3}$, then angle of minimum deviation of the prism is
(1999)

Options:

A. 60°

B. 45°

C. 30°

D. 75°.

Answer: A

Solution:

$A = 60°, \mu = \sqrt{3}, \delta_m = ?$

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}} \therefore \delta_m = 60°$$

Question118

A luminous object is placed at a distance of 30 cm from the convex lens of focal length 20 cm. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature 10 cm be placed in order to have an upright image of the object coincident with it?
(1998)

Options:

A. 50 cm

B. 30 cm

C. 12 cm

D. 60 cm

Answer: A

Solution:

For lens, $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$
$u=-30$, $f=20$, $v=60$ cm
To have an upright image of the object, coincide with it, image should tend to form at centre of curvature of convex mirror. Therefore, the distance of convex mirror from the lens
$=60-10=50$ cm

Question119

Light enters at an angle of incidence in a transparent rod of refractive index n. For what value of the refractive index of the material of the rod the light once entered into it will not leave it through its lateral face whatsoever be the value of angle of incidence?
(1998)

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Options:

A. $n=1.1$

B. $n=1$

C. $n>\sqrt{2}$

D. $n=1.3$

Answer: C

Solution:

$$n>\frac{\sin r}{\sin i}$$
i.e., $n>\frac{\sin 90^{\circ}}{\sin 45^{\circ}} \Rightarrow n>\sqrt{2}$

Question120

An astronomical telescope of tenfold angular magnification has a length of 44 cm. The focal length of the objective is
(1997)

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Options:

A. 44 cm

B. 440 cm

C. 4 cm

D. 40 cm

Answer: D

Solution:

Solution:
Length of astronomical telescope $(f_o + f_e) = 44$ cm and ratio of focal length of the objective lens to that of the eye piece
$\frac{f_o}{f_e} = 10$
From the given ratio, we find that $f_o = 10f_e$.
Therefore $10f_e + f_e = 44$ or $f_e = 4$ cm
and focal length of the objective (f_o)
$= 44 - f_e = 44 - 4 = 40$ cm

Question121

The focal length of converging lens is measured for violet, green and red colours. It is respectively f_v, f_g, f_r. We will get (1997)

Options:

A. $f_v < f_r$

B. $f_g > f_r$

C. $f_v = f_g$

D. $f_g < f_r$

Answer: A

Solution:

Solution:
$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
since the refractive index of violet colour (μ_v) is greater than the refractive index of red colour (μ_r), therefore focal length of violet colour is less than the focal length of red colour or in other words, $f_{v}

Question122

An electromagnetic radiation of frequencyn, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive indexμ. The frequency, wavelength and velocity of light in the glass slab will be respectively (1997)

Options:

A. n, 2λ and $\frac{v}{\mu}$

B. $\frac{2n}{\mu}$, $\frac{\lambda}{\mu}$ and v

C. $\frac{n}{\mu}$, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

D. n, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

Answer: D

Solution:

Solution:
Frequency $= n$; Wavelength $= \lambda$ Velocity of light in air $= v$ and refractive index of glass slab $= \mu$
Frequency of light remains the same, when it changes the medium. Refractive index is the ratio of wavelengths in vacuum and in the given medium. Similarly refractive index is also the ratio of velocities in vacuum and in the given medium.

Question123

If a convex lens of focal length 80 cm and a concave lens of focal length 50 cm are combined together, what will be their resulting power? (1996)

Options:

A. +7.5D

B. −0.75 D

C. +6.5 D

D. -6.5 D.

Answer: B

Solution:

Solution:
Focal length $(f_1) = 80\text{cm}$ and$(f_2) = -50\text{cm}$ (Minus sign due to concave lens)
Power of the combination (P)

$$= P_1 + P_2 = \frac{100}{f_1} + \frac{100}{f_2} = \frac{100}{80} - \frac{100}{50} = -0.75\text{D}$$

Question124

The refractive index of water is 1.33. What will be the speed of light in

water?
(1996)

Options:

A. 4×10^{8} m / s

B. 1.33×10^{8} m / s

C. 3×10^{8} m / s

D. 2.25×10^{8} m / s

Answer: D

Solution:

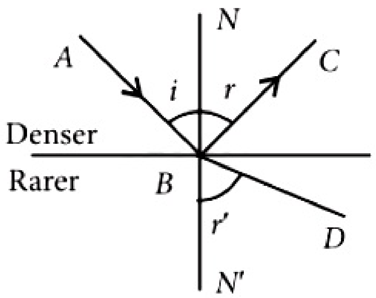
Solution:
(d) : Refractive index of water $(\mu_2) = 1.33$.

$$\frac{v_2}{v_1} = \frac{\mu_1}{\mu_2} = \frac{1}{1.33}$$

Therefore $v_2 = \frac{v_1}{1.33} = \frac{3 \times 10^{8}}{1.33} = 2.25 \times 10^{8} \text{m / s}$

Question125

A ray of light from a denser medium strikes aware medium as shown in figure. The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are r and r′. The critical angle would be
(1996)



Options:

A. $\sin^{-1}(\tan r)$

B. $\sin^{-1}(\sin r)$

C. $\cos^{-1}(\tan r)$

D. $\tan^{-1}(\sin r)$.

Answer: A

Solution:

According to Snell's law,

$\mu = \frac{\sin i}{\sin r'} = \frac{\sin i}{\sin(90° - r)} = \frac{\sin i}{\cos r}$

From law of reflection, $i = r$

$\therefore \mu = \frac{\sin r}{\cos r} = \tan r$

Critical angle $= \sin^{-1}(\mu) = \sin^{-1}(\tan r)$

Question126

If f_V and f_R are the focal lengths of a convex lens for violet and red light respectively and F_V and F_R are the focal lengths of a concave lens for violet and red light respectively, then we must have
(1996)

Options:

A. $f_V > f_R$ and $F_V > F_R$

B. $f_V < f_R$ and $F_V > F_R$

C. $f_V > f_R$ and $F_V < F_R$

D. $f_V < f_R$ and $F_V < F_R$

Answer: B

Solution:

Solution:
For a convex lens, $f_R > f_V$ or $f_V < f_R$. For a concave lens, focal length is negative.
$\therefore$ $|F_V| < |F_R|$ or $F_V > F_R$ as the smaller negative value is bigger.

Question127

Light travels through a glass plate of thickness t and having a refractive index μ. If c is the velocity of light in vacuum, the time taken by light to travel this thickness of glass is
(1996)

Options:

A. $\frac{t}{\mu c}$

B. $\frac{\mu t}{c}$

C. tμc

D. $\frac{tc}{\mu}$.

Answer: B

Solution:

$$\text{Time} = \frac{\text{distance}}{\text{velocity}} = \frac{t}{v} = \frac{t}{c / \mu} = \frac{\mu t}{c}$$

Question128

A lens is placed between a source of light and a wall. It forms images of area A_1 and A_2 on the wall, for its two different positions. The area of the source of light is
(1995)

Options:

A. $\frac{A_1 - A_2}{2}$

B. $\frac{1}{A_1} + \frac{1}{A_2}$

C. $\sqrt{A_1 A_2}$

D. $\frac{A_1 + A_2}{2}$.

Answer: C

Solution:

Solution:
By displacement method, size of object (O) = $\sqrt{I_1 \times I_2}$.
Therefore area of source of light (A) = $\sqrt{A_1 A_2}$

Question129

Exposure time of camera lens at $\frac{f}{2.8}$ setting is $\frac{1}{200}$ second. The correct time of exposure at $\frac{f}{5.6}$ is
(1995)

Options:

A. 0.20 second

B. 0.40 second

C. 0.02 second

D. 0.04 second.

Answer: C

Solution:

Time of exposure $t \propto (\text{f} - \text{number})^2$
$\therefore t\left(\frac{1}{200}\right) = \left(\frac{5.6}{2.8}\right)^2 = 4$ or $t = 0.02$ s

----

Question130

In a Fresnel biprism experiment, the two positions of lens give separation between the slits as 16 cm and 9 cm respectively. What is the actual distance of separation?
(1995)

Options:

A. 13 cm

B. 14 cm

C. 12.5 cm

D. 12 cm.

Answer: D

Solution:

Separations between the slits
$(d_1) = 16$ cm. and $(d_2) = 9$ cm
Actual distance of separation
$(d) = \sqrt{d_1 d_2} = \sqrt{16 \times 9} = 12$ cm

Question131

Four lenses of focal length ±15 cm and ±150 cm are available for

making a telescope. To produce the largest magnification, the focal length of the eyepiece should be
(1994)

Options:

A. +15 cm

B. +150 cm

C. −150 cm

D. −15 cm.

Answer: A

Solution:

Solution:
Magnifying power of telescope,
$M = \frac{f_o}{f_e}$
To produce largest magnifications $f_o > f_e$ and f_o and f_e both should be positive (convex lens).
Therefore $f_e = +15$ cm

Question132

The blue colour of the sky is due to the phenomenon of
(1994)

Options:

A. scattering

B. dispersion

C. reflection

D. refraction.

Answer: A

Solution:

Solution:
According to Rayleigh, the amount of scattering is inversely proportional to the fourth power of the wavelength.

Question133

Ray optics is valid, when characteristic dimensions are (1994, 1989)

Options:

A. much smaller than the wavelength of light

B. of the same order as the wavelength of light

C. of the order of one millimetre

D. much larger than the wavelength of light.

Answer: D

Question134

A small source of light is 4 m below the surface of water of refractive index $\frac{5}{3}$. In order to cut off all the light, coming out of water surface, minimum diameter of the disc placed on the surface of water is (1994)

Options:

A. 6 m

B. ∞

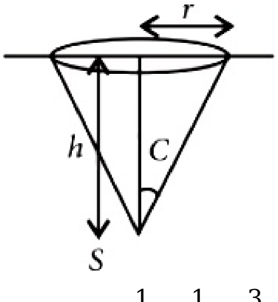
C. 3 m

D. 4 m.

Answer: A

Solution:

Solution:
In order to cut off all the light coming out of water surface, angle C should be equal to critical angle.



i.e. $\sin C = \frac{1}{\mu} = \frac{1}{\frac{5}{3}} = \frac{3}{5}$

$\therefore\ \tan C = \frac{3}{4}$

Now, $\tan C = \frac{r}{h}$;

$r = h \tan C = 4 \times \frac{3}{4} = 3$ m

Diameter of disc $= 2r = 6$ m.

Question135

A parallel beam of monochromatic light of wavelength 5000Å A is incident normally on a single narrow slit of width 0.001 mm. The light is focussed by a convex lens on a screen placed in focal plane. The first minimum will be formed for the angle of diffraction equal to
(1993)

Options:

A. 0°

B. 15°

C. 30°

D. 50°.

Answer: C

Solution:

For first minimum, $a \sin \theta = n\lambda = 1\lambda$

$$\sin \theta = \frac{\lambda}{a} = \frac{5000 \times 10^{-10}}{0.001 \times 10^{-3}} = 0.5 \text{ or } \theta = 30°.$$

Question136

Interference was observed in interference chamber where air was present, now the chamber is evacuated, and if the same light is used, a careful observer will see
(1993)

Options:

A. no interference

B. interference with brighter bands

C. interference with dark bands

D. interference with larger width.

Answer: D

Solution:

Solution:
In vacuum, λ increases very slightly compared to that in air. As $\beta \propto \lambda$, therefore, width of interference fringe increases slightly.

Question137

Time taken by sunlight to pass through a window of thickness 4 mm whose refractive index is $\frac{3}{2}$ is (1993)

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Options:

A. 2×10^{-4} s

B. 2×10^{8} s

C. 2×10^{-11} s

D. 2×10^{11} s

Answer: C

Solution:

$$v_g = \frac{c}{\mu} = \frac{3 \times 10^8}{\frac{3}{2}} = 2 \times 10^8 \text{ m / s}$$

$$t = \frac{x}{v_g} = \frac{4 \times 10^{-3}}{2 \times 10^8} = 2 \times 10^{-11} \text{ s}$$

Question138

There is a prism with refractive index equal to $\sqrt{2}$ and the refractive angle equal to 30°. One of the refractive surface of the prism is polished. A beam of monochromatic light will be retrace its path if its angle of incidence over the refracting surface of the prism is (1992)

Options:

A. 0°

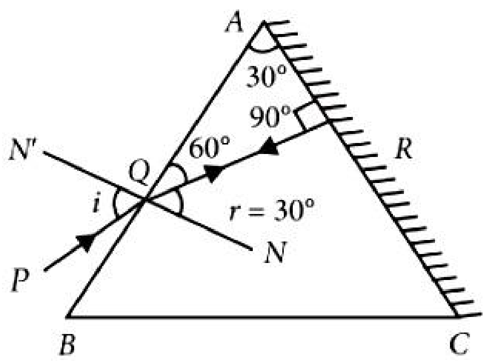
B. 30°

C. 45°

D. 60°.

Answer: C

Solution:



The ray will retrace the path when the refracted ray QR is incident normally on the polished surface AC. Thus angle of refraction r = 30°

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

$\therefore \sin i = \mu \times \sin r = \sqrt{2} \times \sin 30°$

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

Question139

If yellow light emitted by sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity (1992)

Options:

A. fringe width will decrease

B. fringe width will increase

C. fringe width will remain unchanged

D. fringes will becomes less intense

Answer: A

Solution:

Solution:

As $\beta = \frac{\lambda D}{d}$ and $\lambda_b < \lambda_y$,

$\therefore$ Fringe width β will decrease

Question140

In Young's double slit experiment carried out with light of wavelength (λ) = 5000Å , the distance between the slits is 0.2 mm and the screen is at 200 cm from the slits. The central maximum is at x = 0. The third maximum (taking the central maximum as zeroth maximum) will be at x equal to
(1992)

Options:

A. 1.67 cm

B. 1.5 cm

C. 0.5 cm

D. 5.0 cm

Answer: B

Solution:

Solution:

$x = (n)\lambda\frac{D}{d} = 3 \times 5000 \times 10^{-10} \times \frac{2}{0.2 \times 10^{-3}}$

$= 1.5 \times 10^{-2}m = 1.5cm$

Question141

A beam of monochromatic light is refracted from vacuum into a medium of refractive index 1.5. The wavelength of refracted light will be
(1992, 1991)

Options:

A. depend on intensity of refracted light

B. same

C. smaller

D. larger.

Answer: C

Solution:

λ' of refracted light is smaller, because $\lambda' = \frac{\lambda}{\mu}$

Question142

Green light of wavelength 5460Å is incident on an air-glass interface. If the refractive index of glass is 1.5, the wavelength of light in glass would be ($c = 3 \times 10^8\ ms^{-1}$)
(1991)

Options:

A. 3640Å

B. 5460Å

C. 4861Å

D. none of these.

Answer: A

Solution:

Solution:

$\lambda_g = \frac{\lambda_a}{\mu} = \frac{5460}{1.5} = 3640\text{Å}$

Question143

Ratio of intensities of two waves are given by 4 : 1. Then ratio of the amplitudes of the two waves is
(1991)

Options:

A. 2: 1

B. 1: 2

C. 4: 1

D. 1: 4 .

Answer: A

Solution:

$\frac{I_1}{I_2} = \frac{a^2}{b^2} = \frac{4}{1}$

$\therefore \frac{a}{b} = \frac{2}{1}$

Question144

In Young's experiment, two coherent sources are placed 0.90 mm apart and fringes are observed one metre away. If it produces second dark fringe at a distance of 1 mm from central fringe, the wavelength of monochromatic light is used would be
(1991)

Options:

A. 60×10^{-4} cm

B. 10×10^{-4} cm

C. 10×10^{-5} cm

D. 6×10^{-5} cm.

Answer: D

Solution:

Solution:

For dark fringe, $x = (2n-1)\frac{\lambda D}{2d}$

$\lambda = \frac{2xd}{(2n-1)D} = \frac{2 \times 10^{-3} \times 0.9 \times 10^{-3}}{(2 \times 2 - 1) \times 1}$

$\lambda = 0.6 \times 10^{-6}$ m $= 6 \times 10^{-5}$ cm

Question145

In Young's double slit experiment, the fringes width is found to be 0.4 mm. If the whole apparatus is immersed in water of refractive index $\frac{4}{3}$, without disturbing the geometrical arrangement, the new fringe width will be
(1990)

Options:

A. 0.30 mm

B. 0.40 mm

C. 0.53 mm

D. 450 microns.

Answer: A

Solution:

$$\beta' = \frac{\beta}{\mu} = \frac{0.4}{4/3} = 0.3\text{mm}$$

Question146

The Young's double slit experiment is performed with blue and with green5460 Å respectively. If x is the distance of 4^{th} maxima from the central one, then
(1990)

Options:

A. x (blue) = x (green)

B. x (blue) >x (green)

C. x (blue) <x (green)

D. $\frac{x\text{ (blue)}}{x\text{ (green)}} = \frac{5460}{4360}$.

Answer: C

Solution:

Distance of n^{th} maxima $x = n\lambda\frac{D}{d} \propto \lambda$

As $\lambda_b < \lambda_g$

$\therefore$ x(blue $)

Question147

Interference is possible in
(1989)

Options:

A. light waves only

B. sound waves only

C. both light and sound waves

D. neither light nor sound waves.

Answer: C

Solution:

Solution:
Interference is a wave phenomenon shown by both the light waves and sound waves.

Question148

Which of the phenomenon is not common to sound and light waves? (1988)

Options:

A. Interference

B. Diffraction

C. Coherence

D. Polarisation

Answer: D

Solution:

Solution:
Sound waves can not be polarised as they are longitudinal. Light waves can be polarised as they are transverse.

Question149

Which one of the following phenomena is not explained by Huygen's construction of wavefront?
(1988)

Options:

A. Refraction

B. Reflection

C. Diffraction

D. Origin of spectra

Answer: D

Solution:

Solution:
Huygen's construction of wavefront does not apply to origin of spectra which is explained by quantum theory.

Question150

Focal length of a convex lens of refractive index 1.5 is 2 cm. Focal length of lens when immersed in a liquid of refractive index of 1.25 will be
(1988)

Options:

A. 10 cm

B. 2.5 cm

C. 5 cm

D. 7.5 cm.

Answer: C

Solution:

$$\frac{f_a}{f_e} = \frac{\left(\frac{\mu_g}{\mu_l} - 1\right)}{(\mu_g - 1)} = \frac{\left(\frac{1.5}{1.25} - 1\right)}{1.5 - 1} = \frac{1/5}{1/2} = \frac{2}{5}$$

$$f_e = \frac{5}{2} f_a = \frac{5}{2} \times 2 = 5 \text{ cm}$$
