Optics Important Questions With Answers

NEET Physics 2023

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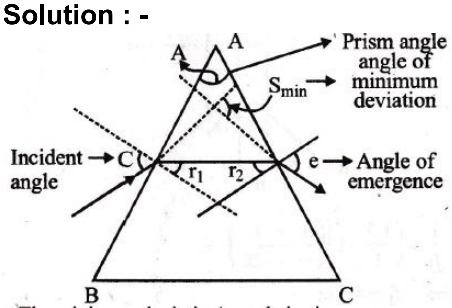
1. For the angle of minimum deviation of a prism to be equal to its refracting angle, the prism must be made of a material whose refractive index __________ .

   a) lies between $\sqrt{2}$ and 1   **b) lies between 2 and $\sqrt{2}$**   c) is less than 1   d) is greater than 2

   Solution : -

   The minimum deviation's angle is given as $\delta_{\min} = i + e - A$ for minimum
   $\delta_{\min} = A$ then
   $2A = i + e$
   in case of $\delta_{\min} i = e$
   $2A = 2i \quad \eta_1 = r_2 = \frac{A}{2}$
   $i = A = 90^\circ$
   By snell's law
   $1 \sin i = n \sin \eta$
   $\sin A = n \sin \frac{A}{2}$
   $2 \sin \frac{A}{2} \cos \frac{A}{2} = n \sin \frac{A}{2}$
   $2 \cos \frac{A}{2} = n$
   when $A = 90^\circ = i_{\min}$
   then $n_{\min} = \sqrt{2}$
   i=A=0
   $n_{\max} = 2$

2. The refractive index of glass is 1.5 for light waves of λ= 6000 $\mathring{A}$ in vacuum. Its wavelength in glass is

   a) 2000 $\mathring{A}$ **b) 4000 $\mathring{A}$**   c) 1000 $\mathring{A}$ d) 3000 $\mathring{A}$

3. In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent source is doubled, then the fringe width becomes____

   a) one-fourth   b) double   c) half   **d) four times**

   Solution : -

   Fringe width $\beta = \frac{\lambda D}{d}$
   $\beta' = \frac{\lambda D'}{d'}$
   New $d' = \frac{d}{2}$ and

$D' = 2D$
$\beta' = \frac{\lambda \times 2D}{d/2} = \frac{4\lambda D}{d}$
$\beta' = 4\beta$
Fringe width becomes 4 times.

4. The angle between pass axis of polarizer and analyser is 45°. The percentage of polarized light passing through analyser is

   a) 75% b) 25% **c) 50%** d) 100%

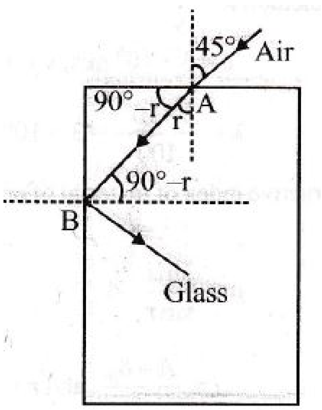
5. A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometre from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000 A°, is of the order of ___________ .

   a) 5 cm b) 0.5 m c) 5 m **d) 5 mm**

   Solution : -

   Here, $\frac{x}{1000} = \frac{1.22\lambda}{D}$
   or, $x = \frac{1.22 \times 5 \times 10^3 \times 10^{-10} \times 10^3}{10 \times 10^{-2}}$
   or, $x = 1.22 \times 5 \times 10^{-3}\ \mathrm{m} = 6.1\ \mathrm{mm}$
   therefore x is of the order of $5\ \mathrm{mm}$.

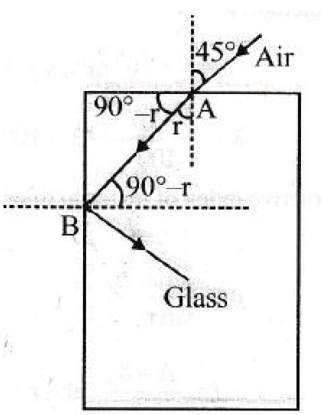
6. A light ray falls on a rectangular glass slab as shown. The index of refraction of the glass, if total intemal reflection is to occur at the vertical face, is__



   a) $\sqrt{3/2}$ b) $\frac{(\sqrt{3}+1)}{2}$ c) $\frac{(\sqrt{2}+1)}{2}$ d) $\sqrt{5}/2$

   Solution : -

   For point A, $a\mu_g = \frac{\sin 45^\circ}{\sin r}$
   $\Rightarrow \sin r = \frac{1}{\sqrt{2} a\mu_g}$
   For point $B, \sin(90^\circ - r) = {}_g\mu_a$ where $\left(90^\circ - \acute{r}\right)$ is critical angle.



   $\therefore \cos r =_g \mu_a - \frac{1}{_a\mu_g}$

$\Rightarrow {}_a\mu_g = \frac{1}{\cos r}$
$= \frac{1}{\sqrt{1-\sin^2 r}} = \frac{1}{\sqrt{1-\frac{1}{2_a\mu_g^2}}}$
$\Rightarrow a\mu_g{}^2 = \frac{1}{1-\frac{1}{2_a\mu_g^2}} = \frac{2_a\mu_g^2}{2_a\mu_g^2-1}$
$\Rightarrow 2_a\mu_g^2 - 1 = 2 \Rightarrow_a \mu_g = \sqrt{\frac{3}{2}}$

7. A beam of monochromatic light is refracted from vacuum into a medium of refractive index 1.5. The wavelength of refracted light will be___
   a) dependent on intensity of refracted light b) same **c) smaller** d) larger

   Solution : -
   Refractive index,
   $\mu = \frac{c}{v} = \frac{v\lambda_v}{v\lambda_w}$
   As, c = velocity of light in vacuum v = velocity of light in medium
   $v = i\lambda$ and n remains constant during refraction
   $\therefore \lambda_m = \frac{\lambda_e}{\mu}$
   $\Rightarrow \lambda_m < 1_v \quad (\mu = 1, given)$
   Hence, the wavelength decreases in second medium.

8. Out of the following statements which is not correct?
   a) When unpolarised light passes through a Nic prism, the emergent light is elliptically polarized
   b) Nicol's prism works on the principle of double refraction and total internal reflection
   c) Nicol's prism can be used to produce and analyze polarized lig
   d) Calcite and Quartz are both doubly refracting crystals

   Solution : -
   (a) Nicol prism is made from a double refracting calcite crystal which works on principle of double refraction and total internal reflection and is used to produce and analyze polarized light.
   Also, in Nicol prism there is no light on refraction so (a) is not correct.

9. In Young's double slit experiment the distance d between the slits S_1 and S_2 is 1mm. What should the width of each slit be so as to obtain 10^{th} maxima of the double slit pattern within the central maximum of the single slit pattern?
   a) 0.9mm b) 0.8mm **c) 0.2mm** d) 0.6mm

   Solution : -
   The angular separation between n bright fringes, $\theta_n = \frac{x_n}{D} = \frac{n\lambda}{d}$
   For 10 bright fringes, $\theta_{10} = \frac{10\lambda}{d}$
   The angular width of the central maximum diffraction pattern due to slit of width a is
   $2\theta_1 = \frac{2\lambda}{a}$
   $Now \quad \frac{10\lambda}{d} \leq \frac{2\lambda}{a} \; or \; a \leq \frac{d}{5} = \frac{1}{5}mm \; = 0.2 \; mm$

10. A laser beam is used for locating distant objects because
    a) it is monochromatic b) it is not chromatic c) it is not observed **d) it has small angular spread**

    Solution : -
    A laser beam is used for locating distant objects because it has small angular spread.

11. Polarised glass is used in sun glasses because
    a) It reduces the light intensity to half on account of polarisation b) It is fashionable
    c) It has good colou d) It is cheaper

Solution : -

In sun glasses, polarised glasses are applied so as to reduces the light intensity to half during polarisation

12. Two slits are made one millimetre apart and the screen is placed one metre away. The fringe separation when blue green light of wavelength 500 nm is used is

a) 5×10^{-4} m b) 2.5×10^{-3} m c) 2×10^{-4} m d) 10×10^{-4} m

Solution : -

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

Here, D = 1 m, d = 1×10^{-3} m, λ= 500 nm = 5×10^{-7} m

$\therefore \beta = \frac{1\times5\times10^{-7}}{1\times10^{-3}}$ = 5×10^{-4} m

13. In Young's double slit experiment the separation d between the slits is 2 mm, the wavelength I.. of the light used is 5896 Å and distance D between the screen and slits is 100 em. It is found that the angular width of the fringes is 0.20°. To increase the fringe angular width to 0.2r (with same λ.. and D) the separation between the slits needs to be changed to:

a) 2.1 mm **b) 1.9 mm** c) 1.8 mm d) 1.7 mm

Solution : -

Angular Width = AId = 0.20°= λ/2 mm

λ = 0.20° x 2

As λ/d = 0.21°,so using value of A, we have

d = (0.20°x 2 mm)/0.21° = 1.9mm

14. An astronomical telescope of ten-fold angular magnification has a length of 44 cm. The focal length of the objective is ____

a) 440 cm b) 44 cm **c) 40 cm** d) 4 cm

Solution : -

For an astronomical telescope, where magnification, $m = \frac{f_O}{f_e}$

f_0 = focal length of objective lens

f_e = focal length of eye piece lens

Length of telescope tube $L = f_o + f_e$ Given, $m = 10, L = 44 \text{ cm}$

$\therefore \frac{f_o}{f_e} = 10$ and $f_o + f_e = 44$

$\Rightarrow f_e = \frac{f_o}{10}$

So, $f_o + \frac{f_0}{10} = 44$

or $\frac{11 f_\theta}{10} = 44$ or $f_\theta = 44 \text{ cm}$

15. The transverse nature of light is shown by

a) Interference of light b) Refraction of light **c) Polarisation of light** d) Dispersion of light

Solution : -

Fact.

16. The critical angle of a certain medium is $\sin^{-1}\left(\frac{3}{5}\right)$. The polarizing angle of the medium is

a) $\sin^{-1}\left(\frac{4}{5}\right)$ **b)** $\tan^{-1}\left(\frac{5}{3}\right)$ c) $\tan^{-1}\left(\frac{3}{4}\right)$ d) $\tan^{-1}\left(\frac{4}{3}\right)$

Solution : -

Here, critical angle, $i_c = \sin^{-1}\left(\frac{3}{5}\right)$

$\therefore \quad \sin i_c = \frac{3}{5}$

$As \quad \mu = \frac{1}{\sin i_c} = \frac{5}{3}$

According to Brewster's law

$\tan i_p = \mu$

where i_p is the polarising angle

$\therefore \tan i_p = \frac{5}{3} \Rightarrow i_p = \tan^{-1}\left(\frac{5}{3}\right)$

17. In the case oflinearly polarized light, the magnitude of the electric field vector
    a) is parallel to the direction of propagation   b) does not change with time   c) increases linearly with time
    d) varies periodically with time

    Solution : -
    In the case of linearly polarised light the magnitude of the electric field vector varies periodically with time.

18. The human eye has an approximate angular resolution of ϕ= 5.8 X 10^{-4} rad and typical photoprinter prints a minimum of 300 dpi (dots per inch, 1 inch = 2.54 cm), At what minimal distance z should a printed page be held so that one does not see the individual dots?
    a) 14.5 cm   b) 20.5 cm   c) 29.5 cm   d) 28 cm

    Solution : -
    Here, angular resolution of human eye,
    ϕ= 5.8 X 10^{-4}rad
    The linear distance between two successive dots in a typical photo printer is$l = \frac{2.54}{300} cm$ = 0.84 x 10^{-2}cm.
    At a distance of z cm, the gap distance 1 will subtend an angle
    $\phi = \frac{1}{z} \quad \therefore \quad z = \frac{1}{\phi} = \frac{0.84 \times 10^{-2} cm}{5.8 \times 10^{-4}} = 14.5 \quad cm$

19. When the angle of incidence is 60° on the surface of a glass slab, it is found that the reflected ray is completely polarized. The velocity of light in glass is
    a) $\sqrt{2} \times 10^8 \quad ms^{-1}$ **b)** $\sqrt{3} \times 10^8 \quad ms^{-1}$ c) $2 \times 10^8 \quad ms^{-1}$ d) $3 \times 10^8 \quad ms^{-1}$

    Solution : -
    As reflected light is completely polarized, therefore, $i_p = 60^0$
    $\mu = \tan i_p = \tan 60^0 = \sqrt{3}$
    $As \quad \mu = \frac{c}{v} \quad \therefore v = \frac{c}{\mu} = \frac{3 \times 10^8}{\sqrt{3}} = \sqrt{3} \times 10^8 \quad ms^{-1}$

20. An unpolarized light beam is incident on a surface at an angle of incidence equal to Brewster's angle. Then,
    a) the reflected and the refracted beam are both partially polarized
    b)
    the reflected beam is partially polarized and the refracted beam is completely polarized and are at right angles to each other
    c)
    the reflected beam is completely polarized and the refracted beam is partially polarized and are at right angles to each other
    d) both the reflected and the refracted beams are completely polarized and are at right angles to each other.

21. If the focal length of objective lens is increased then magnifying power of____
    a) misrocene will inereace 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 increase

    Solution : -
    Microscope's magnifying power
    $= \frac{LD}{f_0 f_e} \propto \frac{1}{f_0}$
    Thus, with increase in f_0 magnifying power of microscope decreases.

Magnifying power of telescope $= \frac{f_0}{f_e} \propto f_0$

Thus, with increase in f_0, magnifying power of telescope increases.

22. The fringe width in a Young's double slit interference pattern is 2.4×10^{-4} m, when red light of wavelength 6400 $\mathring{A}$ is used. How much will it change, if blue light of wavelength 4000$\mathring{A}$ is used?

a) 9×10^{-4} m **b) 0.9×10^{-4} m** c) 4.5×10^{-4} m d) 0.45×10^{-4} m

Solution : -

$Here, \quad \beta_1 = 2.4 \times 10^{-4}\ m$

$\lambda_1 = 6400\mathring{A} \quad , \lambda_2 = 4000\mathring{A}$

$\because \frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1} = \frac{4000}{6000} = \frac{5}{8}$

$or \quad \beta_2 = \frac{5}{8}\beta_1 = \frac{5}{8} \times 2.4 \times 10^{-4} = 1.5 \times 10^{-4}\ m$

Decrease in fringe width

$\Delta\beta = \beta_1 - \beta_2 = (2.4 - 1.5) \times 10^{-4} = 0.9 \times 10^{-4}\ m$

23. 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 m the ray can undergo total internal reflection?

a) $\mu = 1.33$ b) $\mu = 1.40$ **c)** $\mu = 1.50$ d) $\mu = 1.25$

Solution : -

For total internal reflection,

$\mu \geq \frac{1}{\sin C} \geq \sqrt{2} \geq 1.414$

$\Rightarrow \mu = 1.50$

24. Which colour of the light has the longest wavelength?

a) Blue b) Green c) Violet **d) Red**

Solution : -

Red has the longest wavelength among the given options.

25. A polaroid is placed at 45° to an incoming light of intensity 10. Now the intensity of light passing through polaroid after polarization would be :

a) 1_0 **b) $I_0/2$** c) I_04 d) Zero

Solution : -

Now intensity $I = I_0\cos^2\theta$

$= 10\cos^2 45° = I_0/2$

26. Yellow light of wavelength 6000 $\mathring{A}$ produces fringes of width 0.8 mm in Young's double slit experiment. If the source is replaced by another monochromatic source of wavelength 7500$\mathring{A}$ and the separation between the slits is doubled then the fringe width becomes

a) 0.1mm **b) 0.5mm** c) 4.3mm d) 1mm

Solution : -

Fringe width in first case, $\beta_1 = \frac{D\lambda_1}{d} \quad \ldots \quad (i)$

Fringe width in second case, $\beta_2 = \frac{D\lambda_2}{2d} \quad \ldots \quad (ii)$

Divide equation (ii) by (i),

$\therefore \frac{\beta_2}{\beta_1} = \frac{D\lambda_2 \quad /2d}{D\lambda_1 \quad /d} = \frac{1}{2}.\frac{\lambda_2}{\lambda_1} \quad or \quad \beta_2 = \frac{1}{2}.\frac{\lambda_2}{\lambda_1}\beta_1$

$\therefore \beta_2 = \frac{1}{2} \times \frac{7500\mathring{A}}{6000 \quad \mathring{A}} \times 0.8 \quad mm = 0.5mm$

27. Two thin lenses of focal lengths f_1 and f_2 are in contact and coaxial. The power of the combination is____

a) $\sqrt{\frac{f_1}{f_2}}$ b) $\sqrt{\frac{f_2}{f_1}}$ c) $\frac{f_1+f_2}{2}$ **d)** $\frac{f_1+f_2}{f_1 f_2}$

Solution : -

The combination's focal length $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$

therefore Power of the combinations,

$P=\frac{f_1+f_2}{f_1 f_2} \quad \left(\therefore P=\frac{1}{f}\right)$

28. A beam of light consisting of two wavelengths, 650 nm and 520 nm is used to obtain interference fringes in a Young's double-slit experiment. What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide?

a) 1.77 mm   b) 2.52 mm   **c) 1.56 mm**   d) 3.14 mm

Solution : -

Let at linear distance 'y' from center of screen the bright fringes due to both wavelength coincides. Let n_1 number of bright fringe with wavelength λ_1 coincides with n_2 number of bright fringe with wavelength λ_2 We can write

$y=n_1\beta_1=n_2\beta_2$

$n_1\frac{\lambda_1 D}{d}=n_2\frac{D\lambda_2}{d} \quad or \quad n_1\lambda_1=n_2\lambda_2 \qquad ---(i)$

Also at first position of coincide, the n^{th} bright fringe of one will coincide with $(n+1)^{th}$ bright fringe of other.

$If \quad \lambda_2<\lambda_1$

$So, \quad then \quad n_2>n_1 \quad and \quad n_2=n_1+1 \qquad ---(ii)$

Using equation (ii) in equation (i)

$n_1\lambda_1=(n_1+1)\lambda_2$

$n_1(650)\times10^{-9}=(n_1+1)520\times10^{-9}$

$65n_1=52n_1+52 \quad or \quad 13n_1=52 \quad or \quad n_1=4$

$Thus, \quad y=n_1\beta_1=4\left[\frac{(6.5\times10^{-7})(1.2)}{2\times10^{-3}}\right]$

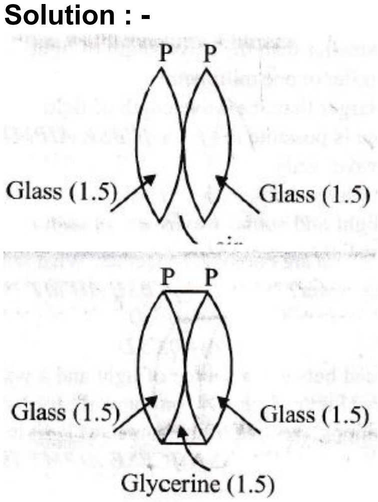
$=1.56\times10^{-3}m=1.56 \quad mm$

So, the fourth bright fringe of wavelength 520 nm coincides with 5^{th} bright fringe of wavelength 650 nm.

29. 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 glycerine (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_____

a) 1: 2   b) 2: 3   c) 3: 4   d) 2: 1

Solution : -



Equivalent focal length in air

$\frac{1}{F_1} = \frac{1}{f'} + \frac{1}{f'} = \frac{2}{f}$

When glycerine is filled inside, glycerine lens behaves like a diverging lens of focal length (-f)

$\frac{1}{F_2} = \frac{1}{f} + \frac{1}{f} = \frac{1}{f}$

$= \frac{1}{f}$

$\frac{F_1}{F_2} = \frac{1}{2} = 1:2$

30. A telescope is used to resolve two stars separated by 4.6 x 10^{-6} rad. If the wavelength of light used is 5460 $\mathring{A}$ what should be the aperture of the objective of the telescope?

a) 0.1488 m b) 0.567 m c) 1 m d) 2 m

Solution : -

Aperture of the telescope, D=$\frac{1.22\lambda}{d\theta}$

$$Here, \quad \lambda = 5460\mathring{A} = 5460 \times 10^{-10} m, d\theta = 4.6 \times 10^{-6} \quad rad,$$

$$\therefore D = \frac{1.22 \times 5460 \times 10^{-10}}{4.6 \times 10^{-6}} = 0.1488mm$$

31. When a light wave goes from air into water, the quality that remains unchanged is its :

a) Speed b) Amplitude **c) Frequency** d) Wavelength

Solution : -

If v' and λ' shows frequency and wavelength of light in a medium, v' = v/λ'

= (c/μ)/(λ/μ) = c/): = c/λ = v

32. Two towers on the top of two hills are 40 km apart. The line joining them passes 50 m above a hill halfway between the towers. The longest wavelength of radio waves which can be sent between the two towers without appreciable diffraction effects is

a) 1.25 m **b) 0.125 m** c) 2.50 m d) 0.250 m

Solution : -

Distance between one of the towers and hill half way = 40/2 km = 2 X 10^4km

$$\therefore \quad z_F = 2 \times 10^4 km$$

$$Using \quad z_F = \frac{a^2}{\lambda} \quad or \quad \lambda = \frac{a^2}{z_F}$$

$$\therefore \lambda = \frac{(50)^2}{2 \times 10^4} = 1250 \times 10^{-4} = 0.125 \quad m$$

33. The hypermetropia is a_____

a) short-sight defect **b) long-sight defect** c) bad vision due to old age d) None of the above

Solution : -

A hypermetropic person or a long sighted person can see clearly only those objects which are at long distances, as if near point of his eye has shifted to some distant point. This defect arises on account of contraction of eye ball or increase in focal length of eye lens. To correct this defect, the person has to wear spacè using a convex lens of suitable focal length given by

$\frac{1}{f} - \frac{1}{D} - \frac{1}{d}$

where d= actual distance of distinct vision of defective eyc, and

D= distance of distinct vision of normal eye.

Note

A myopic person can see clearly only those objects which are at short distances from the eye. This is as if far point of the eye has shifted to some nearby point.

Oldage vision defect is also called astigmatism. It arises becausc curvature of the comea plus eye lens refracting system is not the same in different planes. This defect is removed by using a cylindrical lens with its axis along the vertical.

34. A slit of width a is illuminated by white light. For red light (λ.= 6500Å), the first minima is obtained at θ= 30°. Then the value of a will :

a) 3250 Å b) 6.5 x 10^{-4} mm **c) 1.24 microns** d) 2.6 x 10^{-4}

Solution : -

For first minima

$$\theta = \lambda/a \Rightarrow a = \lambda/\theta \left(\therefore = \frac{\pi}{6} = 30^o\right)$$

Now a = 6500 x 10-8 x 6/π

= 1.24 x 10^{-4} cm = 1.24 microns

35. Through which character we can distinguish the light waves from sound waves

a) Interference b) Refraction **c) Polarisation** d) Reflection

Solution : -

Interference, Refraction and Reflection are shown by both light and sound waves while polarisation is shown by light wave only.

36. Spherical wavefronts, emanating from a point source, strike a plane reflecting surface. What will happen to these wave fronts, immediately after reflection?

a) They will remain spherical with the same curvature, both in magnitude and sign.

b) They will become plane wave fronts.

c) They will remain spherical, with the same curvature, but sign of curvature reversed.

d) They will remain spherical, but with different curvature, both in magnitude and sign.

37. Stars are twinkling due to

a) Diffraction b) Reflection **c) Refraction** d) Scattering

Solution : -

With the phenomena of refraction, stars twinkle due toue to variation in refractive index in the atmosphere.

38. In a Young's double slit experiment an electron beam is used to obtain interference pattern. If the speed of electron decreases then

a) distance between two consecutive fringes remains the same

b) distance between two consecutive fringes decreases

c) distance between two consecutive fringes increases d) none of these

Solution : -

Fringe width, $\beta = \frac{\lambda D}{d}; \quad Also, \quad \lambda = \frac{h}{mv}$

Here h is Planck's constant. This wavelength is inversely proportional to the velocity. Hence, the fringe width increases with decrease in electron speed.

39. Red light is generally used to observe diffraction pattern from single slit. If blue light is used instead of red light, then diffraction pattern :

a) Willbe clearer **b) Will contract** c) Will expanded d) Will not be visualiaes

Solution : -

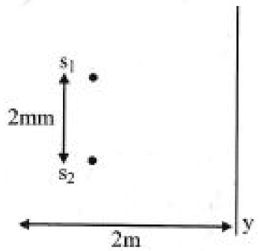
If $\lambda_{Blue} < \lambda_{Red}$' hence the fringe pattern will contract as fringe width ∝λ.

40. In Young's double slit experiment, the slits are 2 mm apart and are illuminated by photons of two wavelengths $\mathrm{l}_1 = 12000A^o$ and $\mathrm{I}_2 = 10000A^o$. At what minimum distance from the common central bright fringe on the screen 2m from the slit will a bright fringe from one interference pattern coincide with a bright fringe from the other?

a) 6 mm b) 4 mm c) 3 mm d) 8 mm

Solution : -

$\because y = \frac{n\lambda D}{d}$
$\therefore n_1\lambda_1 = n_2\lambda_2$
$\Rightarrow n_1 \times 12000 \times 10^{-10}$
$= n_2 \times 10000 \times 10^{-10}$
or, $n\left(12000 \times 10^{-10}\right) = (n+1)\left(10000 \times 10^{-10}\right) \Rightarrow n = 5$
$\left(\begin{array}{l}\because \lambda_1 = 12000 \times 10^{-10} \text{ m;} \\ \lambda_2 = 10000 \times 10^{-10} \text{ m}\end{array}\right)$



Thus, $y_{\text{common}} = \frac{n\lambda_1 D}{d}$
$= \frac{5\left(12000 \times 10^{-10}\right) \times 2}{2 \times 10^{-3}}$
$(\because d = 2 \text{ mm and } D = 2 \text{ m})$
$= 5 \times 12 \times 10^{-4} \text{ m}$
$= 60 \times 10^{-4} \text{ m}$
$= 6 \times 10^{-3} \text{ m} = 6 \text{ mm}$

41. Refractive index for a material for infrared light is
 a) equal to that of ultraviolet light **b) less than for ultraviolet light** c) equal to that for red colour of light
 d) greater than that for ultraviolet light

 Solution : -
 As μ ∝ 1/λ (∴ $\lambda_{uv} < \lambda_{IR}$)

42. Velocity of light in glass whose refractive index with respect to air is 1.5 is 2 x 108 m/s and in certain liquid the velocity of light found to be 2.5 x 108 m/s. The refractive index of the liquid with respect to air is :
 a) 0.64 b) 0.80 **c) 1.20** d) 1.44

 Solution : -
 Velocity of light in glass = 2 x 10^8 m/s
 refractive index = 1.5
 Now μα1/v
 μ_l/ = μ_g/'v_l
 So μ_l/1.5 = 2 x 10^8/2.5 x 10^8
 μ_l= 1.2

43. The reddish appearance of the sun at sunrise and sunset is due to___
 a) the colour of the sky **b) the scattering of light** c) the polarisation of light d) the colour of the sun

 Solution : -
 It is because of scattering of light. Scattering $\propto \frac{1}{\lambda^4}$.
 As λ for red light is maximum, it reaches us unscattered.

44. A parallel beam of light of wavelength lis incident normally on a narrow slit. A diffraction pattern is 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_____
 a) πl b) 2π c) 3π **d)** 4π

 Solution : -

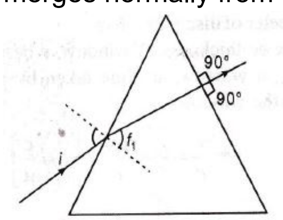
Conditions for diffraction minima are Path diff. $\Delta x = n\lambda$, and phase diff. $\delta\phi = 2n\pi$
Path diff: $= n\lambda = 2\lambda$
Phase diff, $= 2m\pi = 4\pi \; (\because n = 2)$

45. A ray is incident at angle of incidence i on one surface of a prism of small angle. A and emerge normally from opposite surface. If the refractive index of the material of prism is μ, the angle of incidence i is nearly equal to____

a) $\frac{A}{\mu}$ b) $\frac{A}{2\mu}$ **c) μA** d) $\frac{\mu A}{2}$

Solution : -

Angle of prism is given by $A = r_1 + r_2$
where, r_1 is refraction angle on incident face and r_2 is angle oi incidence of 2 nd face of prism. As refracted ray merges normally from opposite surface, r_2 =0.



$\therefore A = r_1$
Now, $\mathrm{m} - \frac{\sin i}{\sin r_1}$
If $\angle i_1$ and $\angle i_2$ are very small then, $\sin i \approx i$, $\sin r_1 \approx r_1$
$\therefore \mu = \frac{i}{r_1} = \frac{i}{A}$
$\therefore i = \mu A$

46. Light waves can be polarised as they are

a) Transverse b) of high frequency c) Longitudinal d) Reflected

Solution : -

It is observed that only transverse waves can be polarised.

47. 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_____

a) infinite **b) 0** c) 25 d) 50

Solution : -

On the basis of formula,
$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{25} - \frac{1}{25} = 0$
Power of combination $= \frac{1}{f} = 0$

48. A paper, with two marks having separation d, is held normal to the line of sight of an observer at a distance of 50m. The diameter of the eye-lens of the observer is 2 mm, Which of the following is the least value of d, so that the marks can be seen as separate? The mean wavelength of visible light may be taken as $5000\ \mathrm{A}^{\circ}$____

a) 1.25 cm b) 2.5 mm c) 1.25 m **d) 12.5 cm**

Solution : -

Angular limit of eye's resolution, $\theta = \frac{\lambda}{d}$,
where, d is diameter of eye lens.
Further, if y is the minimum separation between two objects at distance D from eye then
$\theta = \frac{y}{D}$
$\Rightarrow \frac{y}{D} = \frac{\lambda}{d} \Rightarrow y = \frac{\lambda D}{d}$
Here, wavelength $\mathrm{I} = 5000 A^o = 5 \times 10^{-7}\ \mathrm{m} D = 50\ \mathrm{m}$
Diameter of eye lens $= 2\ \mathrm{mm} = 2 \times 10^{-3}\ \mathrm{m}$

From eq. (i), minimum separation is

$$y = \frac{5\times10^{-7}\times50}{2\times10^{-3}} = 12.5 \times 10^{-3}\ \mathrm{m}$$

=12.5 cm

49. Two slits in Young's double slit experiment have widths in the ratio 81 : 1. The ratio of the amplitudes of light waves is

a) 3:1 b) 3:2 **c) 9:1** d) 6:1

Solution : -

$$Width\ ratio,\ \frac{\beta_1}{\beta_2} = \frac{I_1}{I_2} = \frac{81}{1}$$

$$\therefore\ Amplitude\ ratio,\ \frac{A_1}{A_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{81}{1}} = 9:1$$

50. To observe diffraction the size of an obstacle

a) Should be of the same order as wavelength b) Should be much larger than the wavelength

c) Have no relation to wave d) Should be exactly λ/2

Solution : -

To have diffraction, it is observed that the size of an obstacle should be of similar order as that of wavelength.