Exercise-1

✍ **Marked Questions can be used as Revision Questions.**

OBJECTIVE QUESTIONS

Section (A) : Principle of superposition, path difference, Wavefronts, and coherence

A 1.✍ Ratio of intensities of two light waves is given by 4 : 1. The ratio of the amplitudes of the waves is :
(1) 2 : 1 (2) 1 : 2 (3) 4 : 1 (4) 1 : 4

A 2. Two coherent monochromatic light beams of intensities I and 4I are superposed; the maximum and minimum possible intensities in the resulting beam are :
(1) 5I and I (2) 5I and 3I (3) 9I and I (4) 9I and 3I

A 3.✍ Two sources of waves are called coherent if:-
(1) Both have the same amplitude of vibrations
(2) Both produce waves of the same wavelength
(3) Both produce waves of the same wavelength having constant phase difference
(4) Both produce waves having the same velocity

A 4. The meaning of wave front is:-
(1) All the particles on its surface vibrate in same phase
(2) All the particles on its surface vibrate in opposite phase
(3) Some particles vibrate in same phase and some in opposite phase
(4) None of the above

Section (B) : YDSE with Monochromatic light

B 1. The contrast in the fringes in any interference pattern depends on :
(1) Fringe width (2) Wavelength
(3) Intensity ratio of the sources (4) Distance between the sources

B 2.✍ Yellow light emitted by sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity :
(1) fringe width will decrease. (2) fringe width will increase.
(3) fringe width will remain unchanged. (4) fringes will become less intense.

B 3. For constructive interference to take place between two monochromatic light waves of wavelength λ, the path difference should be:-
(1) $[2n - 1]\lambda/4$ (2) $[2n - 1]\lambda/2$ (3) $n\lambda$ (4) $[2n + 1]\lambda/2$

B 4. Young's experiment is performed in air and then performed in water, the fringe width:-
(1) Will remain same (2) Will decrease
(3) Will increase (4) All the above types of waves

B 5. In Young's double slit experiment, the phase difference between the light waves reaching third bright fringe from the central fringe will be [λ = 6000 A_0]:-
(1) Zero (2) 2π (3) 4π (4) 6π

B 6. The phenomenon of interference light was studied first by:-
(1) Newton (2) Young (3) Fresnel (4) Huygen

B 7. In double slits experiment, for light of which colour the fringe width will be minimum:-
(1) Violet (2) Red (3) Green (4) Yellow

B 8. Two coherent sources of light produce destructive interference when phase difference between them is:
(1) 2π (2) π (3) $\pi/2$ (4) 0

B 9. Young's experiment establishes that :-
(1) Light consist of waves
(2) Light consist of particles
(3) Light consists of neither particles nor waves
(4) Light consists of both particles and waves

B 10. If two line slits are illuminated by a wavelength 5×10^{-7} m and the distance between two bright fringes is 0.005 m on a screen 1 m away, then the distance between the slits is:-
(1) 10 cm (2) 1 cm (3) 10^{-1} cm (4) 10^{-2} cm

B 11. The fringe width in the Young's double slit experiment is 2×10^{-4} m. If the distance between the slits is halved and the slit screen distance is double, then the new fringe width will be:-
(1) 2×10^{-4} m (2) 1×10^{-4} m (3) 0.5×10^{-4} m (4) 8×10^{-4} m

B 12. By a monochromatic wave, we mean:-
(1) A single ray (2) A single ray of a single colour
(3) Wave having a single wavelength (4) Many rays of a single colour

B 13. Fringe width observed in the Young's double slit experiment is β. If the frequency of the source is doubled, the fringe width will :
(1) become 2β (2) become $\frac{3\beta}{2}$ (3) remain as β (4) become $\frac{\beta}{2}$

B 14. In a Young's double slit experiment, the central point on the screen is:-
(1) Bright (2) Dark
(3) First bright and then dark (4) First dark and then bright

B 15. The distance between two slits in a double slit experiment is 1 mm. The distance between the slits and the screen is 1 m. If the distance of 10th fringe from the central fringe is 5 mm, then the wavelength of light is:-
(1) 5000 A^0 (2) 6000 A^0 (3) 7000 A^0 (4) 8000 A^0

B 16. If the slit separation in Young's double slit experiment is reduced to $\frac{1}{3}$rd, the fringe width becomes n times. The value of n is:
(1) 3 (2) 1/3 (3) 9 (4) 1/9

B-17. In a Young’s double slit experiment the intensity at a point I where the corresponding path difference is one sixth of the wavelength of light used. If I_0 denotes the maximum intensity, the ratio $\frac{I}{I_0}$ is equal to
(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{\sqrt{3}}{2}$ (4) $\frac{3}{4}$

B-18 Initially interference is observed with the entire experimental set up inside a chamber filled with air, Now the chamber is evacuated. With the same source of light used, a careful observer will find that
(1) The interference pattern is almost absent as it is very much diffused
(2) There is no change in the interference pattern
(3) The fringe width is slightly decreased
(4) The fringe width is slightly increased

Section (C) : YDSE with polychromatic light

C-1. A Young's double slit experiment is performed with white light, then which option is incorrect.
(1) The maxima next to the central will be red.
(2) The central maxima will be white

(3) The maxima next to the central will be violet
(4) There will not be a completely dark fringe.

Section (D) : YDSE with glass slab, Optical path

D 1. In Young's experiment, light wavelength 4000 A_0 is used, and fringes are formed at 2 metre distance and has a fringe width of 0.6 mm. If whole of the experiment is performed in a liquid of refractive index 1.5, then width of fringe will be:-
(1) 0.2 mm (2) 0.3 mm (3) 0.4 mm (4) 1.2 mm

D 2. The slits in a Young's double slit experment have equal widths and the source is placed symmetrically relative to the slits. The intensity at the central fringe is I_0. If one of the slits is closed, the intensity at this ponit will be:
(1) I_0 (2) $I_0/4$ (3) $I_0/2$ (4) $4I_0$

Section (E) : Thin film interference

E 1. Colours of thin films results from:-
(1) Dispersion of light (2) Interference if light
(3) Absorption of light (4) Scattering of light

Section (F) : differaction of light

F 1. In Fresnel's biprism, coherent sources are obtained by:-
(1) Division of wavefront (2) Division of amplitude
(3) Division of wavelength (4) None of the above

F 2. 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?
(1) 10.5 cm (2) 12 cm (3) 13 cm (4) 14 cm

F 3. In biprism experiment the light source is -
(1) extended (2) narrow (3) polychromatic (4) all of above

F 4. In Fresnel's biprism experiment the coherent sources are obtained by -
(1) interference (2) reflection (3) refraction (4) total internal reflection

F 5. What is effect on frenal biprism experiment when the white light is used:-
(1) Fringe are effected
(2) Diffraction pattern is spreaded more
(3) Central fringes are white and all others are coloured
(4) None of these

Section (G) : Polarisation and Resolving power

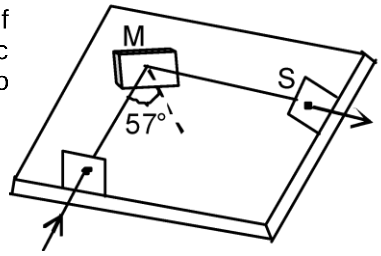
G-1. The diameter of objective of a telescope is 1*m*. Its resolving limit for the light of wave length 4538 Å, will be
(1) 5.54×10^{-7} rad (2) 2.54×10^{-4} rad (3) 6.54×10^{-7} rad (4) None of these

G-2. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is :
(1) $\frac{1}{2}I_0$ (2) $\frac{1}{4}I_0$ (3) zero (4) I_0

G-3. A single slit diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue light?
(1) There is no change in the diffraction pattern
(2) Diffraction fringes become narrower and crowded together

(3) Diffraction fringes become boarder and crowded together
(4) The diffraction pattern disappears

G-4. Shows a glass plate placed vertically on a horizontal table with a beam of unpolarised light falling on its surface at 57° with the normal. The electric vectors in the reflected light on the screen S will vibrate with respect to the plane of incidence :



(1) in a vertical plane
(2) in a horizontal plane
(3) in a plane making an angle of 45° with the vertical
(4) in a plane making an angle of 57° with the horizontal

G-5. Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. Approximately, what is the maximum distance at which these dots can be resolved by the eye?
[Take wavelength of light = 500 nm]
(1) 6m (2) 3m (3) 5m (4) 1m

G-6. Visible light passing through a circular hole form a diffraction disc of radius 0.1 mm on a screen. If X-ray is passed through the same set-up, the radius of the diffraction disc will be :
(1) zero (2) < 0.1 mm (3) 0.1 mm (4) > 0.1 mm

Exercise-2

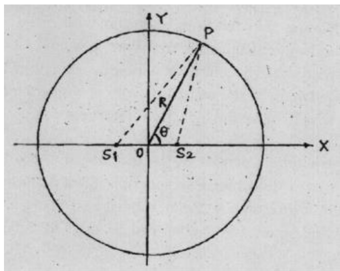
✍ Marked Questions can be used as Revision Questions.

PART - I : OBJECTIVE QUESTIONS

1. In Franuhoffer diffraction the centre diffraction image is:-
(1) Always bright
(2) Always dark
(3) Sometimes bright and sometimes dark
(4) Bright for large wavelength and dark for low wavelength

2. Diffraction and interference of light suggest is:-
(1) Nature of electro magnetic (2) Wave nature
(3) Nature is quantum (4) Nature of light is tranverse

3. Two coherent sources of light S_1 and S_2, equidistant from the origin, are separated by a distance 2λ as shown. They emit light of wavelength λ. Interference is observed on a screen placed along the circle of large radius R. Point is seen to be a point of constructive interference. Then angle θ (other than 0° and 90°) is

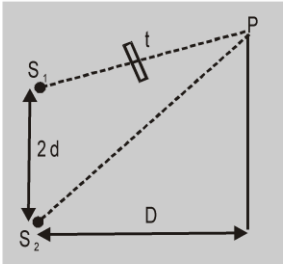


(1) 45°
(2) 30°
(3) 60°
(4) Not possible in the first quandrant

4.✍ In an experiment the two slits are 0.5 mm apart and the fringes are observed to 100 cm from the plane of the slits. The distance of the 11th bright fringe from the Ist bright fringe is 9.72 mm. Calculate the wavelength-
(1) 4.86×10^{-5} cm (2) 4.86×10^{-8} cm (3) 4.86×10^{-6} cm (4) 4.86×10^{-7} cm

5.✍ In the Young's double slit experiment, a mica slip of thickness t and refractive index μ is introduced in the ray from the first source S_1. By how much distance, the fringe pattern will be displaced-
[d = separation between slits]
(1) $\frac{d}{D}(\mu-1)\ t$ (2) $\frac{D}{d}(\mu-1)\ t$ (3) $\frac{d}{(\mu-1)\ D}$ (4) $\frac{D}{d}(\mu-1)$

6. If a thin mica sheet of thickness t and refractive index $\mu = [5/3]$ is placed in the path of one of the interfering beams as shown in fig. then the displacement of the fringe system is-



(1) $\frac{Dt}{3d}$ (2) $\frac{Dt}{5d}$

(3) $\frac{Dt}{4d}$ (4) $\frac{2Dt}{5d}$

7. The Young's double slit experiment is performed with blue and with green light of wavelengths 4360 Å and 5460 Å respectively. If X is the distance of 4th maximum from the central one, then :

(1) X(blue) = X(green) (2) X(blue) > X(green)

(3) X(blue) < X(green) (4) $\frac{X(blue)}{X(green)} = \frac{5460}{4360}$

8. In Young's double slit experiment when wavelength used 6000 A_0 and the screen is 40 cm from the slits, the fringes are 0.012 cm apart. what is the distance between the slits:–

(1) 0.024 cm (2) 2.4 cm (3) 0.24 cm (4) 0.2 cm

9. The two slits at a distance of 1 mm are illuminated by the light of wavelength 6.5×10^{-7} m. The interference fringes are observed on a screen placed at a distance of 1 m. The distance between third dark fringe and fifth bright fringe will be:-

(1) 0.65 mm (2) 1.63 mm (3) 3.25 mm (4) 4.88 mm

10. A two slit Young's interference experiment is done with monochromatic light of wavelength 6000 Å. The slits are 2 mm apart. The fringes are observed on a screen placed 10 cm away from the slits. Now a transparent plate of thickness 0.5 mm is placed in front of one of the slits and it is found that the interference pattern shifts by 5 mm. The refractive index of the transparent plate is :

(1) 1.2 (2) 0.6 (3) 2.4 (4) 1.5

11. In the Young's experiment, using light of $\lambda = 5893$ A_0, 62 fringes are observed in the field of view. how many fringes will be formed in the field of view for wavelength of 5461 A_0:-

(1) 62 (2) 66 (3) 60 (4) 68

12. In two separate set-ups of the Young's double-slit experiment, fringes of equal width are observed when lights of wavelengths in the ratio 1 : 2 are used. If the ratio of the slit separation in the two cases is 2 : 1, the ratio of the distances between the plane of the slits and the screen in the two set-ups is:-

(1) 4 : 1 (2) 1 : 1 (3) 1 : 4 (4) 2 : 1

13. White light is incident normally on a glass plate (in air) of thickness 500 nm and refractive index of 1.5. The wavelength (in nm) in the visible region (400 nm - 700nm) that is strongly reflected by the plate is:

(1) 450 (2) 600 (3) 400 (4) 500

14. A slit of size 0.15 cm is placed at 2.1 m from a screen. On illuminated it by a light of wavelength 5×10^{-5} cm. The width of diffraction pattern will be:-

(1) 70 mm (2) 0.14 mm (3) 1.4 cm (4) 0.14 cm

15. The distance of n^{th} bright fringe to the $(n+1)^{th}$ dark fringe in Young's experiment is equal to:

(1) $\frac{n\lambda D}{d}$ (2) $\frac{n\lambda D}{2d}$ (3) $\frac{\lambda D}{2d}$ (4) $\frac{\lambda D}{d}$

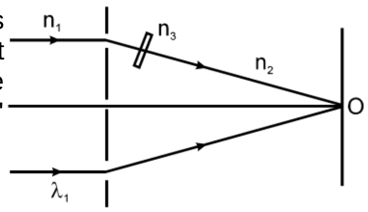
16. In a Young's double slit experiment, d = 1 mm, λ = 6000 Å and D = 1 m (where d, λ and D have usual meaning). Each of slit individually produces same intensity on the screen. The minimum distance between two points on the screen having 75 % intensity of the maximum intensity is:

(1) 0.45 mm (2) 0.40 mm (3) 0.30 mm (4) 0.20mm

17. Let S_1 and S_2 be the two slits in Young's double slit experiment. If central maxima is observed at P and angle $\angle S_1PS_2 = \theta$, then the fringe width for the light of wavelength λ will be. (Assume θ to be a small angle)

(1) λ/θ (2) $\lambda\theta$ (3) $2\lambda/\theta$ (4) $\lambda/2\theta$

18. In the figure shown in a YDSE, a parallel beam of light is incident on the slits from a medium of refractive index n_1. The wavelength of light in this medium is l_1. A transparent slab of thickness ' t' and refractive index is put infront of one slit. The medium between the screen and the plane of the slits is n_2. The phase difference between the light waves reaching point ' O ' (symmetrical, relative to the slits) is:



(1) $\frac{2\pi}{n_1\lambda_1}(n_3 - n_2)t$ (2) $\frac{2\pi}{\lambda_1}(n_3 - n_2)t$ (3) $\frac{2\pi n_1}{n_2\lambda_1}\left(\frac{n_3}{n_2} - 1\right)t$ (4) $\frac{2\pi n_1}{\lambda_1}(n_3 - n_2)\ t$

PART - II : MISCELLANEOUS QUESTIONS

Section (A) : Assertion/Reasoning

A-1. **STATEMENT-1 :** Two coherent point sources of light having nonzero phase difference are seperated by small distance. Then on the perpendicular bisector of line segment joining both the point sources, constructive interference cannot be obtained.

STATEMENT-2 : For two waves from coherent point sources to interfere constructively at a point, the magnitude of their phase difference at that point must be $2m\pi$ (where m is a nonnegative integer) .

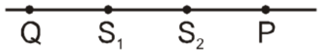
(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1
(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True.

A-2. **STATEMENT-1 :** Thin films such as soap bubble or a thin layer of oil on water show beautiful colours when illuminated by white light.

STATEMENT-2 : It happens due to the interference of light reflected from the upper surface of the thin film.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1
(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True.

A-3. **STATEMENT-1 :** Two point coherent sources of light S_1 and S_2 are placed on a line as shown. P and Q are two points on that line. If at point P maximum intensity is observed then maximum intensity should also be observed at Q.

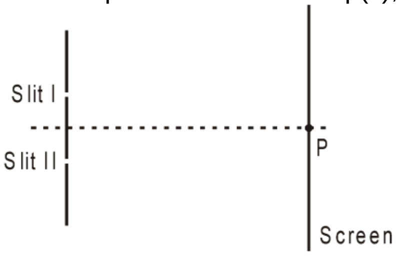


STATEMENT-2 : In the figure of statment 1, the distance $|S_1P - S_2P|$ is equal to distance $|S_2Q - S_1Q|$.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1
(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True.

Section (B) : Match the column

B-1. A double slit interference pattern is produced on a screen, as shown in the figure, using monochromatic light of wavelength 500 nm. Point P is the location of the central bright fringe, that is produced when light waves arrive in phase without any path difference. A choice of three strips A, B and C of transparent materials with different thicknesses and refractive indices is available, as shown in the table. These are placed over one or both of the slits, singularly or in conjunction, causing the interference pattern to be shifted across the screen from the original pattern. In the column-I, how the strips have been placed, is mentioned whereas in the column-II, order of the fringe at point P on the screen that will be produced due to the placement of the strip(s), is shown. Correctly match both the column.



Film	A	B	C
Thickness (in μm)	5	1.5	0.25
Refractive Index	1.5	2.5	2

Column - I	Column - II
(1) Only strip B is placed over slit-I	(p) First Bright
(2) Strip A is placed over slit-I and strip C is placed over slit-II	(q) Fourth Dark
(3) Strip A is placed over the slit-I and strip B and strip C are placed over the slit-II in conjunction.	(r) Fifth Dark
(4) Strip A and strip C are placed over slit-I (in conjuction) and strip B is placed over slit-II.	(s) Central Bright

Section (C) : One or More Than One Options Correct

C-1. White light is used to illuminate the two silts in a Young's double slit experiment. The separation between the slits is b and the screen is at a distance d (> > b) from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing. Some of these missing wavelengths are :

(1) $\lambda = \frac{b^2}{d}$ (2) $\lambda = \frac{2b^2}{d}$ (3) $\lambda = \frac{b^2}{3d}$ (4) $\lambda = \frac{2b^2}{3d}$

C-2. In Young's double slit experiment, the interference pattern is found to have an intensity ratio between bright and dark fringes as 9. This implies :
(1) the intensities at the screen due to the two slits are 5 and 4 units
(2) the intensities at the screen due to the two slits are 4 and 1 units
(3) the amplitude ratio of the individual waves is 3
(4) the amplitude ratio of the individual waves is 2

C-3. If one of the slits of a standard Young's double slit experiment is covered by a thin parallel sided glass slab so that it transmits only one half the light intensity of the other, then:
(1) The fringe pattern will get shifted towards the covered slit
(2) The fringe pattern will get shifted away from the covered slit
(3) The bright fringes will become less bright and the dark ones will become more bright
(4) The fringe width will remain unchanged

Exercise-3

✍ **Marked Questions can be used as Revision Questions.**
*** Marked Questions may have more than one correct option.**

PART - I : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Wavelength of light used in an optical instrument are λ_1= 4000 Å and λ_2= 5000 Å, then ratio of their respective resolving powers (corresponding to λ1 ανδ λ_2) is - **[AIEEE 2002; 3/225, –1]**
(1) 16 : 25 (2) 9 : 1 (3) 4 : 5 (4) 5 : 4

2. Electromagnetic waves are transverse in nature is evident by **[AIEEE 2002; 3/225, –1]**
(1) polarization (2) interference (3) reflection (4) diffraction

3. Wavelength of light used in an optical instrument are λ_1 = 4000 Å and λ_2 = 5000 Å, then ratio of their respective resolving powers (corresponding to λ_1 and λ_2) is **[AIEEE 2002; 3/225, –1]**
(1) 16 : 25 (2) 9 : 1 (3) 4 : 5 (4) 5 : 4

4. To demonstrate the phenomenon of interference we require two sources which emit radiation of **[AIEEE 2003; 3/225, –1]**

(1) nearly the same frequency
(2) the same frequency
(3) different wavelength
(4) the same frequency and having a definite phase relationship

5. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength in Young's double-slit experiment is **[AIEEE 2004; 3/225, –1]**

(1) infinite (2) five (3) three (4) zero

6. The angle of incidence at which reflected light in totally polarized for reflection from air to glass (refractive index n), is **[AIEEE 2004; 3/225, –1]**

(1) $\sin^{-1}(n)$ (2) $\sin^{-1}(1/n)$ (3) $\tan^{-1}(1/n)$ (4) $\tan^{-1}(n)$

7. A young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen. **[AIEEE 2005; 3/225, –1]**

(1) Straight line (2) Parabola (3) Hyperbola (4) Circle

8. If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled ? **[AIEEE 2005; 3/225, –1]**

(1) I_0 (2) $I_0/2$ (3) $2I_0$ (4) $4I_0$

9. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is **[AIEEE 2005; 3/225, –1]**

(1) zero (2) I_0 (3) $\frac{1}{2} I_0$ (4) $\frac{1}{4} I_0$

10. In a Young's double slit experiment the intensity at a point where the path difference is $\frac{\lambda}{6}$ (λ being the wavelength of the light used) is I. If I0 denotes the maximum intensity, I/I0 is equal to **[AIEEE 2007; 3/120, –1]**

(1) $\frac{1}{\sqrt{2}}$ (2) $\frac{\sqrt{3}}{2}$ (3) $\frac{1}{2}$ (4) $\frac{3}{4}$

11. At two points P and Q on a screen in Young's double slit experiment, waves from slits S_1 and S_2 have a path difference of 0 and $\frac{\lambda}{4}$ respectively. The ratio of intensities at P and Q will be **[AIEEE 2011, 11 May; 4/120, –1]**

(1) 2 : 1 (2) $\sqrt{2}$: 1 (3) 4 : 1 (4) 3 : 2

12. In a Young's double slit experiment, the two slits act as coherent sources of waves of equal amplitude A and wavelength λ. In another experiment with the same arrangement the two slits are made to act as incoherent sources of waves of same amplitude and wavelength. If the intensity at the middle point of the screen in the first case is I_1 and in the second case is I_2, then the ratio $\frac{I_1}{I_2}$ is : **[AIEEE 2011, 11 May; 4/120, –1]**

(1) 2 (2) 1 (3) 0.5 (4) 4

13. **Statement - 1 :**
On viewing the clear blue portion of the sky through a Calcite Crystal, the intensity of transmitted light varies as the crystal is rotated.
Statement - 2:
The light coming from the sky is polarized due to scattering of sun light by particles in the atmosphere. The scattering is largest for blue light **[AIEEE 2011, 11 May; 4/120, –1]**

(1) Statement-1 is true, statement-2 is false.
(2) Statement-1 is true, statement-2 is true, statement-2 is the correct explanation of statment-1

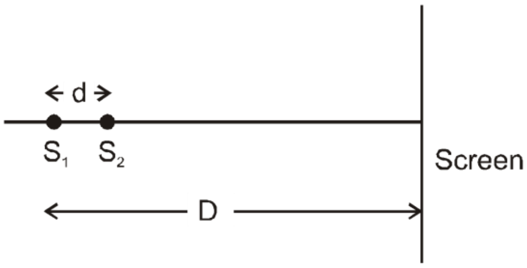
(3) Statement-1 is true, statement-2 is true, statement-2 is not the correct explanation of statement-1
(4) Statement-1 is false, statement-2 is true.

14. In Young's double slit experiment, one of the slit is wider than other, so that amplitude of the light from one slit is double of that from other slit. If I_m be the maximum intensity, the resultant intensity I when they interfere at phase difference φ is given by : **[AIEEE 2012; 4/120, –1]**

(1) $\frac{I_m}{9}(4 + 5\cos\varphi)$ (2) $\frac{I_m}{3}\left(1+2\cos^2\frac{\phi}{2}\right)$ (3) $\frac{I_m}{5}\left(1+4\cos^2\frac{\phi}{2}\right)$ (4) $\frac{I_m}{9}\left(1+8\cos^2\frac{\phi}{2}\right)$

15. This equation has statement 1 and Statement 2. Of the four choices given the Statements, choose the one that describes the two statements. **[AIEEE 2012; 4/120, –1]**
Statement 1 : Davisson-Germer experiment established the wave nature of electrons.
Statement 2 : If electrons have wave nature, they can interfere and show diffraction.
(1) Statement 1 is false, Statement 2 is true.
(2) Statement 1 is true, Statement 2 is false
(3) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation for statement 1
(4) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1

16. Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown. The fringes obtained on the screen will be : **[JEE-Main 2013; 4/120, –1]**



(1) points (2) straight lines (3) semi-circles (4) concentric circles

17. Tow beams, A and B, of plane polarized light with mutually perpendicular planes of polarization are seen through a polaroid. From the position when the beam A has maximum intensity (and beam B has zero intensity), a rotation of polaroid through 30º makes the two beams appear equally bright. If the initial intensities of the two beams are I_A and I_B respectively, then $\frac{I_A}{I_B}$ equals
[JEE(Main) 2014; 4/120, –1]

(1) 3 (2) $\frac{3}{2}$ (3) 1 (4) $\frac{1}{3}$

18. On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam : **[JEE(Main)-2015; 4/120, –1]**
(1) becomes narrower (2) goes horizontally without any deflection
(3) bends downwards (4) bends upwards

19. Assuming human pupil to have a radius of 0.25 cm and a comfortable viewing distance of 25 cm, the minimum separation between two objects that human eye can resolve at 500 nm wavelength is :
[JEE(Main)-2015; 4/120, –1]
(1) 1 μm (2) 30 μm (3) 100 μm (4) 300 μm

20. The box of a pin hole camera, of length L, has hole of radius a. it is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say b_{min}) when : **[JEE(Main)-2016; 4/120, –1]**

(1) $a = \sqrt{\lambda L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$ (2) $a = \sqrt{\lambda L}$ and $b_{min} = \sqrt{4\lambda L}$

(3) $a = \frac{\lambda^2}{L}$ and $b_{min} = \sqrt{4\lambda L}$ (4) $a = \left(\frac{\lambda^2}{L}\right)$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$

21. In a Young's double slit experiment, slits are separated by 0.5 mm, and the screen is placed 150 cm away. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes on the screen. The least distance from the common central maximum to the point where the bright fringes due to both the wavelengths coincide is : **[JEE(Main) 2017; 4/120, –1]**

(1) 15.6 mm (2) 1.56 mm (3) 7.8 mm (4) 9.75 mm

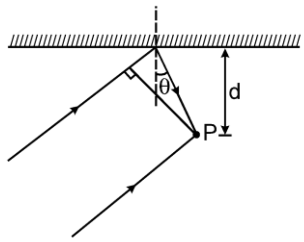
PART - II : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. In the ideal double-slit experiment, when a glass-plate (refractive index 1.5) of thickness t is introduced in the path of one of the interfering beams (wavelength λ), the intensity at the position where the central maximum occurred previously remains unchanged. The minimum thickness of the glass-plate is:

[JEE 2002 Screening, 3/90]

(A) 2λ (B) $2\lambda/3$ (C) $\lambda/3$ (D) λ

2. A parallel beam of light of wavelength λ is incident on a plane mirror at an angle θ as shown in the figure. With maximum intensity at point P, which of the following relation is correct. **[JEE 2003 Screening, 3/90]**



(A) $\cos\theta - \sec\theta = \frac{\lambda}{4d}$ (B) $\cos\theta = \frac{\lambda}{4d}$

(C) $\cos\theta - \sin\theta = \frac{\lambda}{d}$ (D) $\cos\theta = \frac{\lambda}{2d}$

3. In a YDSE arrangement composite lights of different wavelengths λ_1 = 560 nm and λ_2 = 400 nm are used.If D = 1m, d = 0.1 mm. Then the distance between two completely dark regions is

[JEE 2004 Screening, 3/84]

(A) 4 mn (B) 5.6 mm (C) 14 mm (D) 28 mm

4. In the Young's double slit experiment using a monochromatic light of wavelength λ, the path difference (in terms of an integer n) corresponding to any point having half the peak intensity is :

[JEE (Advanced) 2013 ; P-1, 2/60]

(A) $(2n+1)\frac{\lambda}{2}$ (B) $(2n+1)\frac{\lambda}{4}$ (C) $(2n+1)\frac{\lambda}{8}$ (D) $(2n+1)\frac{\lambda}{16}$

5. Using the expression $2d \sin\theta = \lambda$, one calculates the values of d by measuring the corresponding angles θ in the range 0 to 90º. The wavelength λ is exactly knowns and the error in θ is constant for all values of θ. As θ increases from 0º : **[JEE (Advanced) 2013 ; P-2, 3/60, –1]**

(A) the absolute error in d remains constant. (B) the absolute error in d increases.
(C) the fractional error in d remains constant. (D) the fractional error in d decreases.

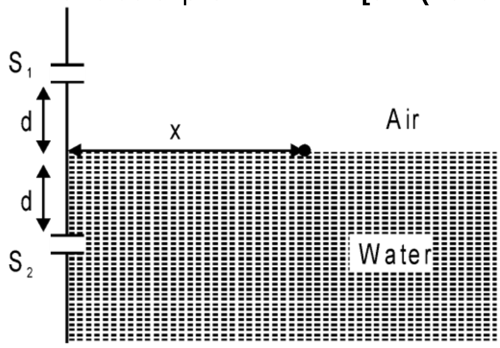
6*. A light source, which emits two wavelengths λ_1 = 400 nm and λ_2 = 600 nm, is used in a Young's double slit experiment. If recorded fringe widths for λ_1 and λ_2 are β_1 and β_2 and the number of fringes for them within a distance y on one side of the central maximum are m_1 and m_2, respectively, then

[JEE (Advanced)-2014,P-1, 3/60]

(A) $\beta_2 > \beta_1$
(B) $m_1 > m_2$
(C) From the central maximum, 3rd maximum of λ_2 overlaps with 5th minimum of λ_1
(D) The angular separation of fringes for λ_1 is greater than λ_2

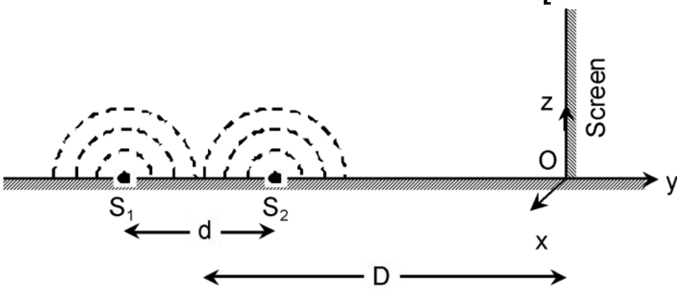
7. A young's double slit interference arrangement with slits S_1 and S_2 is immersed in water (refractive index = 4/3) as shown in the figure. The positions of maxima on the surface of water are given by

$x^2 = p^2m^2\lambda^2 - d^2$, where λ is the wavelength of light in air (refractive index = 1), 2d is the separation between the slits and m is an integer. The value of p is **[JEE(Advanced) 2015 ; P-1, 4/88]**



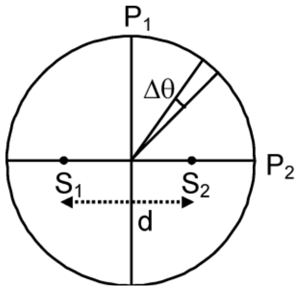
8. While conducting the Young's double slit experiment, a student replaced to two slits with a large opaque plate in the x-y plane containing two small holes that act as two coherent point sources (S_1, S_2) emitting light of wavelength 600 nm. The student mistakenly placed the screen parallel to the x-z plane (for z > 0) at a distance D = 3 m from the mid-point of S_1S_2, as shown schematically in the figure. The distance between the sources d = 0.6003 mm. The origin O is at the intersection of the screen and the line joining S_1S_2. Which of the following is(are) true of the intensity pattern on the screen ?

[JEE Advanced 2016, P-2, 4/62, –2]



(A) Semi circular bright and dark bands centered at point O
(B) Hyperbolic bright and dark bands with foci symmetrically placed about O in the x-direction
(C) The region very close to the point O will be dark
(D) Straight bright and dark bands parallel to the x-axis

9*. Two coherent monochromatic point sources S_1 and S_2 of wavelength λ = 600 nm are placed symmetrically on either side of the center of the circle as shown. The sources are separated by a distance d = 1.8 mm. This arrangement produces interference fringes visible as alternate bright and dark spots on the circumference of the circle. The angular separation between two consecutive bright spots is $\Delta\theta$. Which of the following options is/are correct ? **[JEE (Advanced) 2017, P-2, 4/61, –2]**



(A) The total number of fringes produced between P_1 and P_2 in the first quadrant is close to 3000
(B) A dark spot will be formed at the point P_2
(C) At P_2 the order of the fringe will be maximum
(D) The angular separation between two consecutive bright spots decreases as we move from P_1 to P_2 along the first quadrant

Answers

EXERCISE-1

Section (A)

A 1. (1) **A 2.** (3) **A 3.** (3)
A 4. (1)

Section (B)

B 1. (3) **B 2.** (1) **B 3.** (3)
B 4. (2) **B 5.** (4) **B 6.** (2)
B 7. (1) **B 8.** (2) **B 9.** (1)
B 10. (4) **B 11.** (4) **B 12.** (3)
B 13. (4) **B 14.** (1) **B 15.** (1)
B 16. (1) **B-17.** (D) **B-18.** (D)

Section (C)

C-1. (1)

Section (D)

D 1.	(3)	**D 2.**	(2)

Section (E)

E 1. (2)

Section (F)

F 1.	(1)	**F 2.**	(2)	**F 3.**	(2)
F 4.	(3)	**F 5.**	(3)		

Section (G)

G-1.	(1)	**G-2.**	(1)	**G-3.**	(2)
G-3.	(1)	**G-5.**	(3)	**G-6.**	(2)

EXERCISE-2

PART – I

1.	(1)	**2.**	(2)	**3.**	(3)
4.	(1)	**5.**	(2)	**6.**	(1)
7.	(3)	**8.**	(4)	**9.**	(2)
10.	(1)	**11.**	(2)	**12.**	(1)
13.	(2)	**14.**	(4)	**15.**	(3)
16.	(4)	**17.**	(1)	**18.**	(1)

PART - II

Section (A)

A-1.	(4)	**A-2.**	(3)	**A-3.**	(4)

Section (B)

B-1. (1 → r), (B → r), (C → s), (D → p)

Section (C)

C-1.	(1,3)	**C-2.**	(2,4)	**C-3.**	(1,3,4)

EXERCISE – 3

PART – I

1.	(4)	**2.**	(1)	**3.**	(4)
4.	(4)	**5.**	(2)	**6.**	(4)
7.	(3)	**8.**	(3)	**9.**	(3)
10.	(4)	**11.**	(1)	**12.**	(1)
13.	(2)	**14.**	(4)	**15.**	(3)
16.	(4)	**17.**	(4)	**18.**	(4)
19.	(2)	**20.**	(2)	**21.**	(3)

PART – II

1.	(A)	**2.**	(B)	**3.**	(D)
4.	(B)	**5.**	(D)	**6.**	(A, B, C)
7.	**3**	**8.**	(A,C)	**9.**	(A,C)