PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

CSIR NET Physics - Optics

All PYQs (2015-2025) with answer key

21 questions . Answer key included

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Q1. [Dec 2015] . 3.5 marks

Optics > Polarization

CSIR NET	2015 Dec	3.5 M

A beam of unpolarized light in a medium with dielectric constant ϵ_1 is reflected from a plane interface formed with another medium of dielectric constant $\epsilon_2 = 3\epsilon_1$. The two media have identical magnetic permeability. If the angle of incidence is 60°, then the reflected light

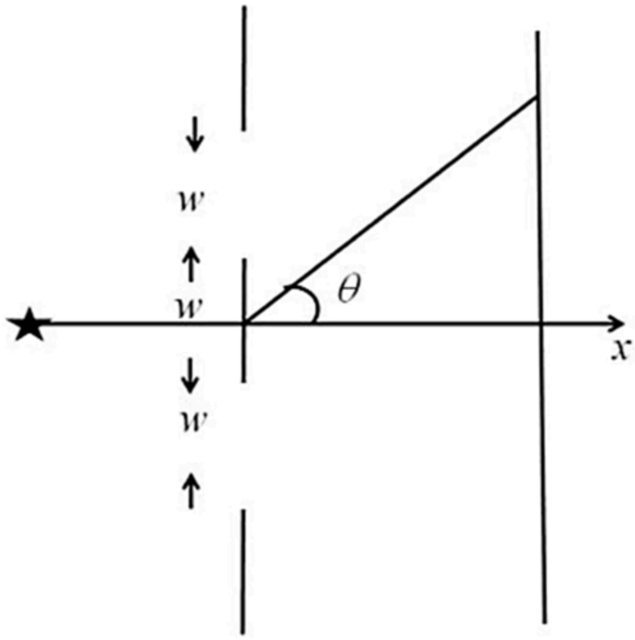
1. is plane polarized perpendicular to the plane of incidence
2. is plane polarized parallel to the plane of incidence
3. is circularly polarized
4. has the same polarization as the incident light

Q2. [Dec 2016] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2016 Dec	3.5M

A screen has two slits, each of width w, with their centres at a distance $2w$ apart. It is illuminated by a monochromatic plane wave travelling along the x-axis. The intensity of the interference pattern, measured on a distant screen, at an angle $\theta = n\lambda/w$ to the x-axis is



1. zero for $n = 1,2,3\ldots$
2. maximum for $n = 1,2,3\ldots$
3. maximum for $n = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}\ldots$
4. zero for $n = 0$ only

Q3. [Dec 2016] . 3.5 marks
Optics > Polarization

CSIR NET	2016 Dec	3.5M

The electric field of an electromagnetic wave is $\vec{E}(z,t) = E_0\cos(kz+\omega t)\hat{\imath} + 2E_0\sin(kz+\omega t)\hat{\jmath}$, where ω and k are positive constants. This represents

1. a linearly polarised wave travelling in the positive z-direction
2. a circularly polarised wave travelling in the negative z-direction
3. an elliptically polarised wave travelling in the negative z-direction
4. an unpolarised wave travelling in the positive z-direction

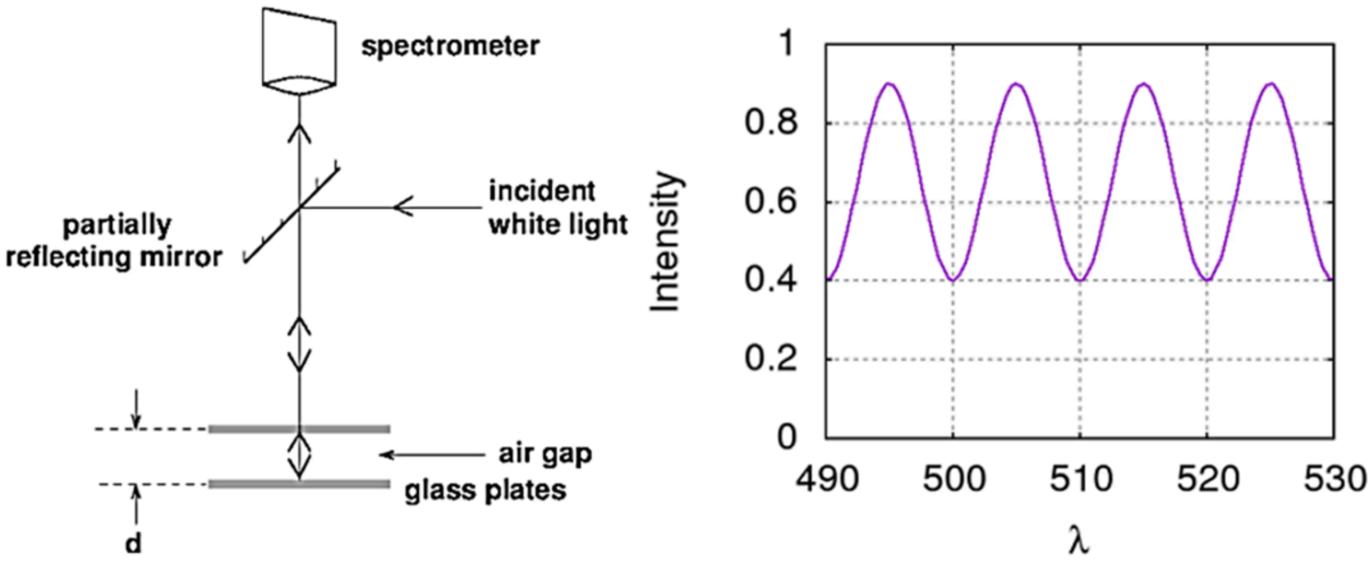
Q4. [Dec 2016] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2016 Dec	3.5M

A pair of parallel glass plates separated by a distance d is illuminated by white light as shown in the figure below. Also shown is the graph of the intensity of the reflected light I as a function of the wavelength λ recorded by a spectrometer.

Assuming that the interference takes place only between light reflected by the bottom surface of the top plate and the top surface of bottom plate, the distance d is closest to



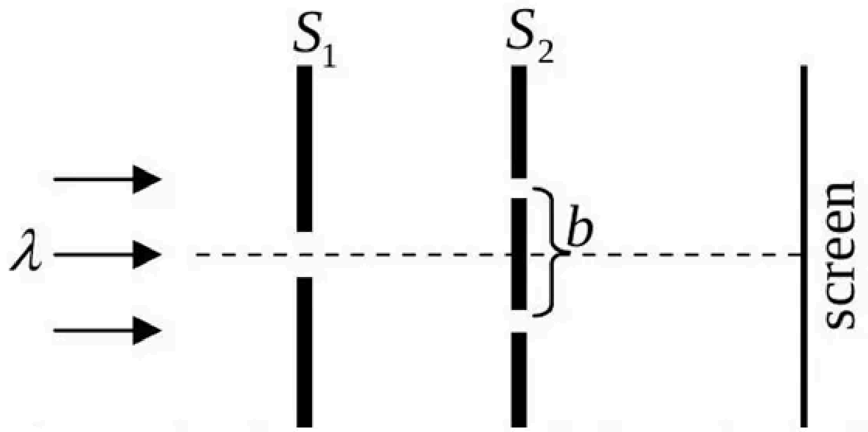
1. 12μ m
2. 24μ m
3. 60μ m
4. 120μ m

Q5. [June 2017] . 5.0 marks

Optics > Interference and diffraction

CSIR NET	2017 June	5M

The figure below describes the arrangement of slits and screens in a Young's double slit experiment. The width of the slit in S_1 is a and the slits in S_2 are of negligible width.



If the wavelength of the light is λ, the d for which the screen would be dark is

1. $b\sqrt{\left(\frac{a}{\lambda}\right)^2 - 1}$
2. $\frac{b}{2}\sqrt{\left(\frac{a}{\lambda}\right)^2 - 1}$
3. $\frac{a}{2}\left(\frac{b}{\lambda}\right)^2$
4. $\frac{ab}{\lambda}$

Q6. [Dec 2018] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2018 Dec	3.5M

A monochromatic and linearly polarized light is used in a Young's double slit experiment. A linear polarizer, whose pass axis is at an angle 45^0 to the polarization of the incident wave, is placed in front of one of the slits. If $I_{\max}$ and $I_{\min}$, respectively, denote the maximum and minimum intensities of the interference pattern on the screen, the visibility, defined as the ratio $\frac{I_{max}-Imin}{I_{max}+Imi_n}$, is

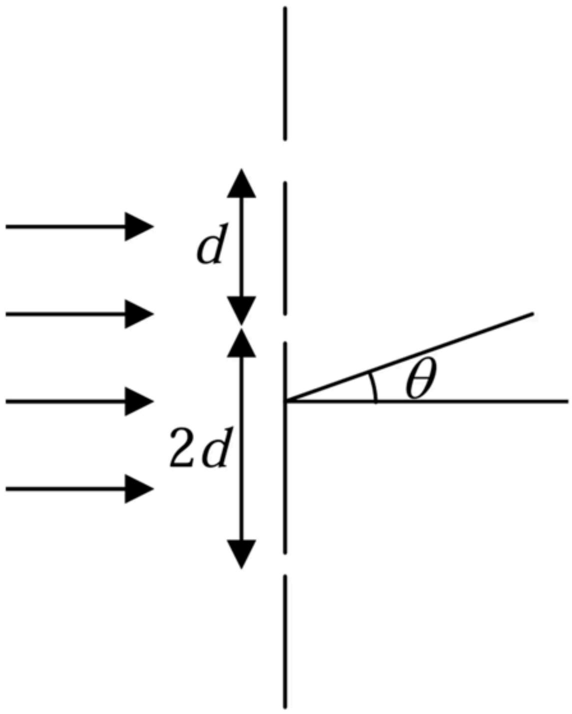
1. $\frac{\sqrt{2}}{3}$
2. $\frac{2}{3}$
3. $\frac{2\sqrt{2}}{3}$
4. $\sqrt{\frac{2}{3}}$

Q7. [June 2018] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2018 June	3.5M

The following configuration of three identical narrow slits are illuminated by monochromatic light of wavelength λ (as shown in the figure below). The intensity is measured at an angle θ (where θ is the angle with the incident beam) at a large distance from the slits. If $\delta = \frac{2\pi d}{\lambda}\sin\theta$, the intensity is proportional to



1. $2cos\ \delta + 2cos\ 2\delta$

2. $3 + \frac{1}{\delta^2}\sin^2 3\delta$

3. $3 + 2cos\ \delta + 2cos\ 2\delta + 2cos\ 3\delta$

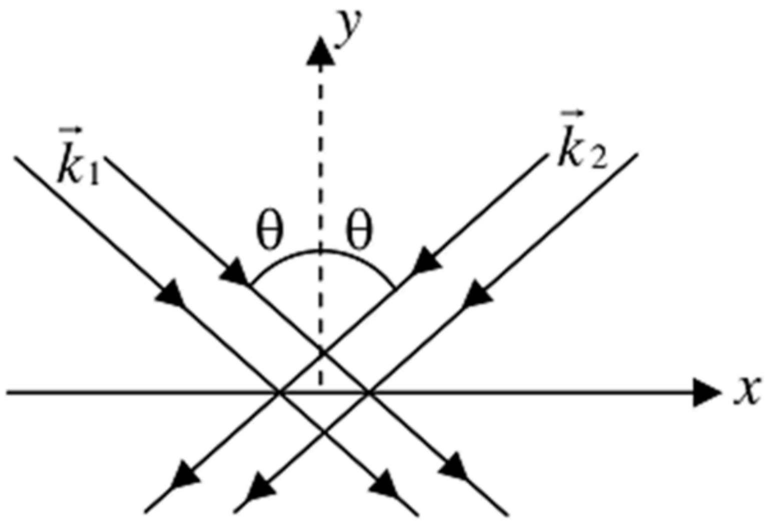
4. $2 + \frac{1}{\delta^2}\sin^2 3\delta$

Q8. [June 2019] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2019 June	3.5M

Two coherent plane electromagnetic waves of wavelength $0.5\mu m$ (both have the same amplitude and are linearly polarized along the z-direction) fall on the $y = 0$ plane. Their wave vectors k_1 and k_1 are as shown in the figure



If the angle θ is $30°$, the fringe spacing of the interference
pattern produced on the plane is

1. 1.0μ m
2. 0.29μ m
3. 0.58μ m
4. 0.5μ m

Q9. [June 2019] . 3.5 marks

Optics > Polarization

CSIR NET	2019 June	3.5M

The permittivity tensor of a uniaxial anisotropic medium, in the standard Cartesian basis, is

$$\begin{pmatrix} 4\varepsilon_0 & 0 & 0 \\ 0 & 4\varepsilon_0 & 0 \\ 0 & 0 & 9\varepsilon_0 \end{pmatrix}$$ where ε_0 is a constant. The wave number of an electromagnetic plane wave polarized along the x-direction, and propagating along the y-direction in this medium (in terms of the wave number k_0 of the wave in vacuum) is

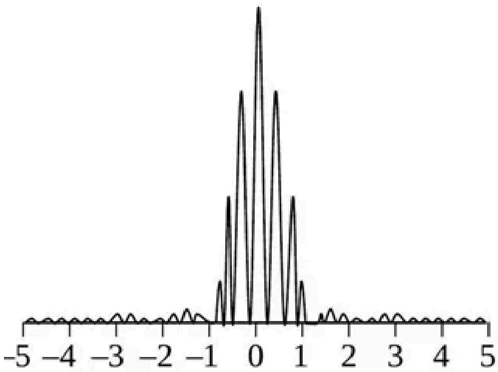
1. $4k_0$
2. $2k_0$
3. $9k_0$
4. $3k_0$

Q10. [June 2020] . 3.5 marks

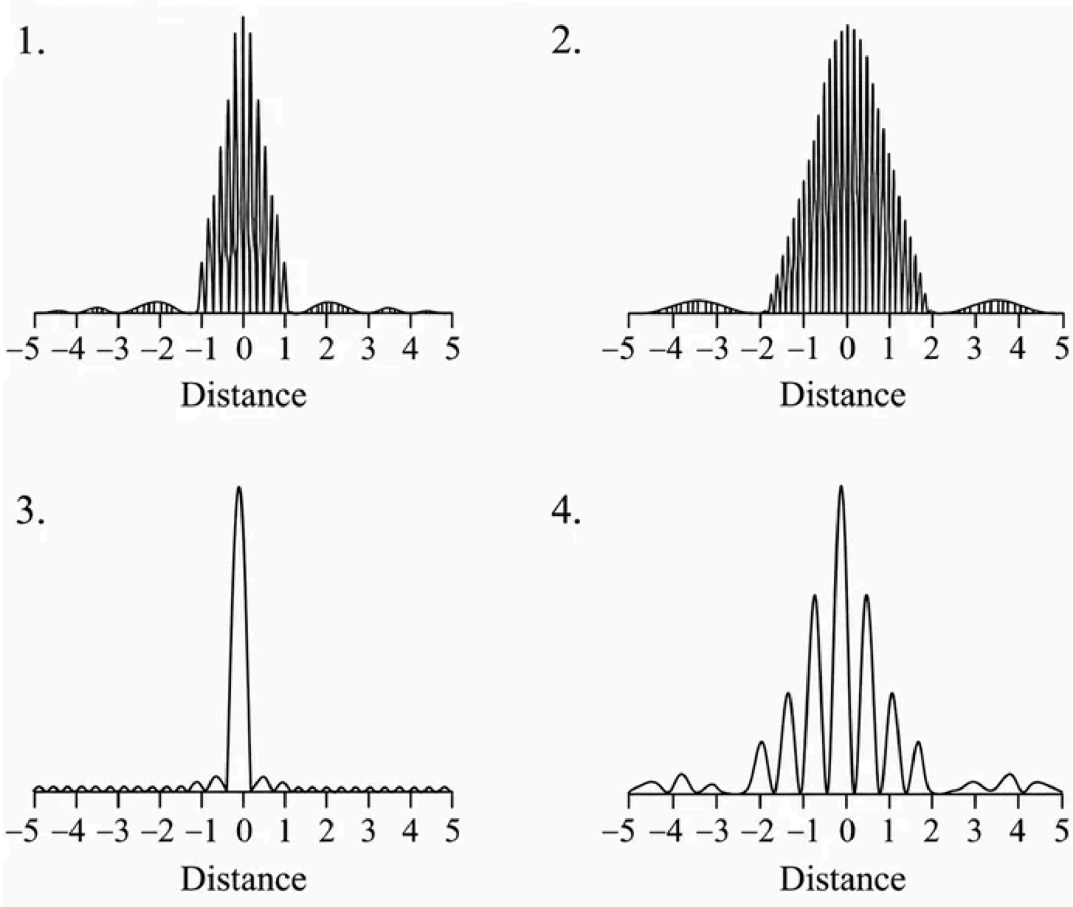
Optics > Interference and diffraction

CSIR NET	2020 June	3.5M

The following figure shows the intensity of the interference pattern in the Young's double-slit experiment with two slits of equal width is observed on a distant screen.



If the separation between the slits is doubled and the width of each of the slits is halved, then the new interference pattern is best represented by

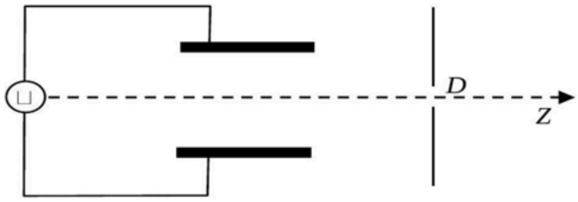


Q11. [June 2022] . 5.0 marks

Optics > Interference and diffraction

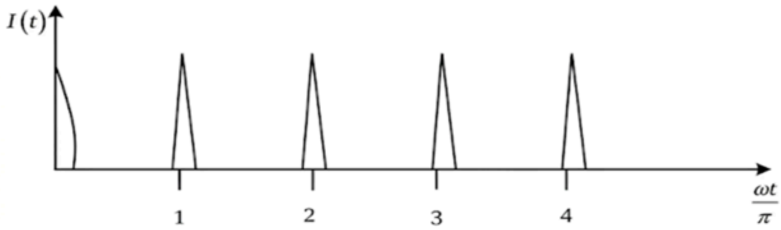
CSIR NET	2022 June	5M

A high frequency voltage signal $V_i = V_m \sin \omega t$ is applied to a parallel plate deflector as shown in the figure.

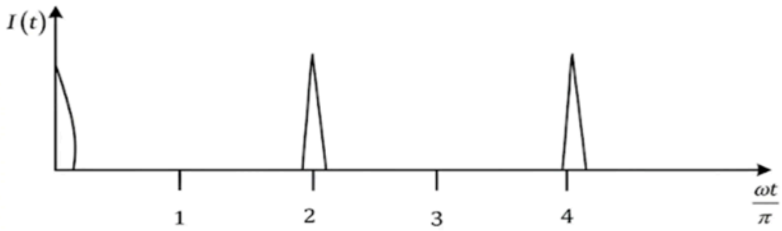


An electron beam is passing through the deflector along the central line. The best qualitative representation of the intensity $I(t)$ of the beam after it goes through the narrow circular aperture D, is

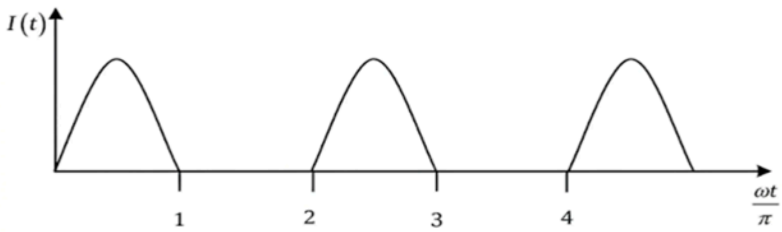
1.



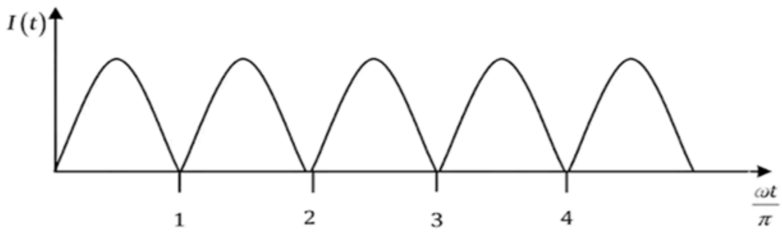
2.



3.



4.

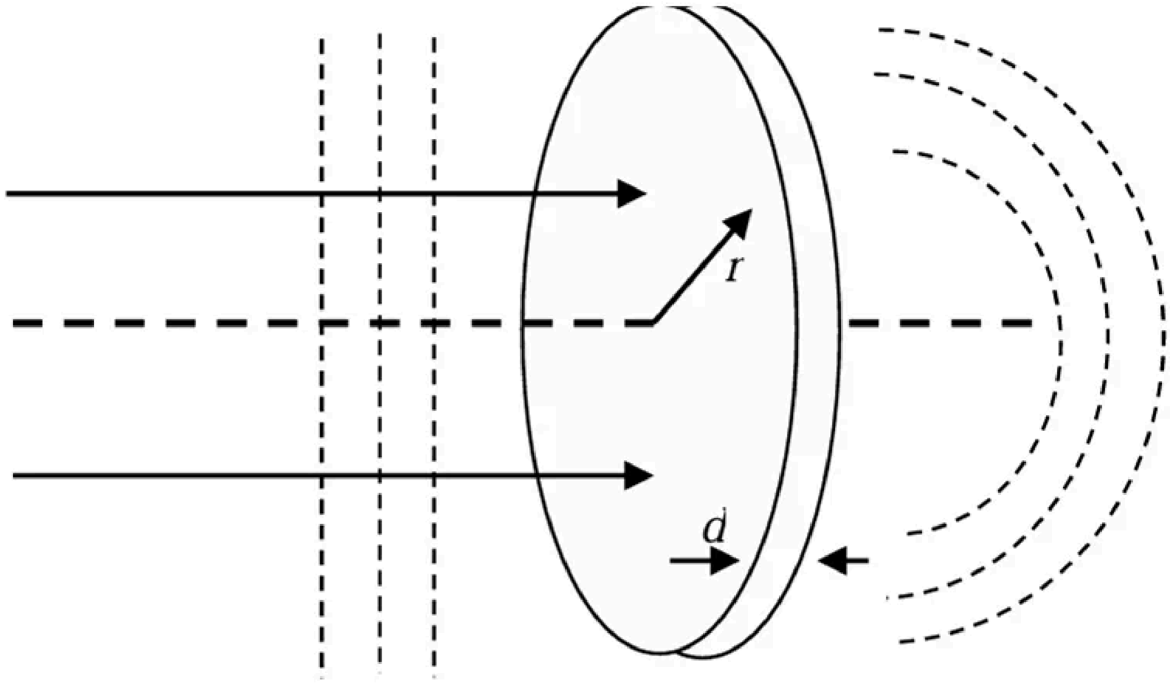


Q12. [Dec 2023] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2023 Dec	3.5 M

For a flat circular glass plate of thickness d, the refractive index $n(r)$ varies radially, where r is the radial distance from the centre of the plate. A coherent plane wavefront is normally incident on this plate as shown in the figure below.



If the emergent wavefront is spherical and centered on the axis of the plate, then $n(r) - n(0)$ should be proportional to

1. $r^{1/2}$
2. r
3. r^2
4. $r^{3/2}$

Q13. [June 2023] . 3.5 marks

Optics > Polarization

CSIR NET	2023 June	3.5M

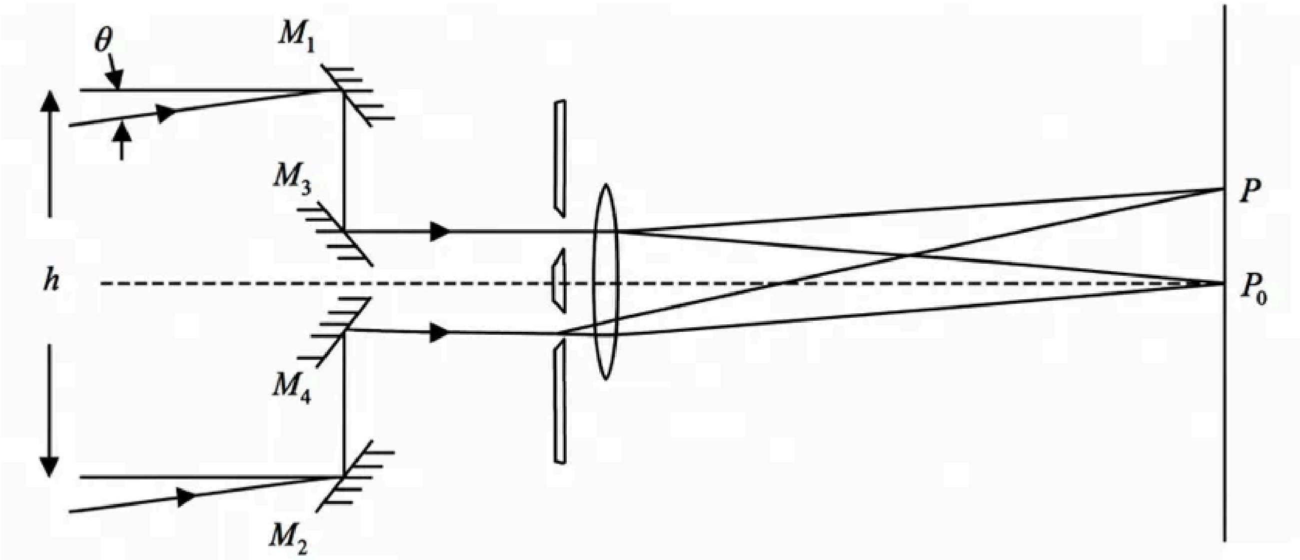
A charged particle moves uniformly on the xy-plane along a circle of radius a centred at the origin. A detector is put at a distance d on the x-axis to detect the electromagnetic wave radiated by the particle along the x direction. If $d \gg a$, the wave received by the detector is

1. Unpolarised
2. circularly polarized with the plane of polarization being the yz-plane
3. linearly polarized along the y-direction
4. linearly polarized along the z-direction

Q14. [June 2023] . 5.0 marks
Optics > Interference and diffraction

CSIR NET	2023 June	5M

The angular width θ of a distant star can be measured by the Michelson radiofrequency stellar interferometer (as shown in the figure below).



The distance h between the reflectors M_1 and M_2 (assumed to be much larger than the aperture of the lens), is increased till the interference fringes (at P_0, P on the plane as shown) vanish for the first time. This happens for $h = 3\text{ m}$ for a star which emits radiowaves of wavelength 2.7 cm. The measured value of θ (in degrees) is closest to

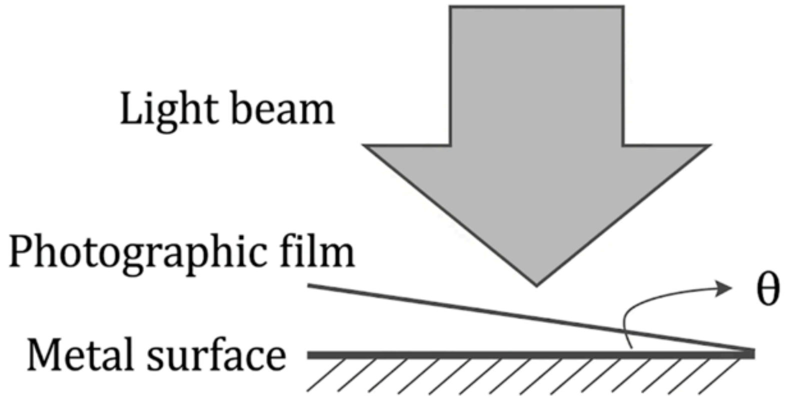
1. 0.63
2. 0.32
3. 0.52
4. 0.26

Q15. [Dec 2024] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2024 Dec	3.5M

When a photographic film is exposed to light, the electric field of light causes the film to turn dark after chemical processing. A photographic film of thickness 50 *nm* is kept inclined to a shiny metal surface at an angle of θ = 0.01 radian, as shown in the figure. After exposing this film to a linearly polarized beam of light of wavelength 500 *nm* incident normally to the metal surface, it developed periodic bright bands. We can explain this observation as the proof of



1. Interference between the incident wave and the wave reflected from the surface of the metal.
2. Diffraction pattern produced by the photographic film.
3. Interference of light due to the presence of photographic film.
4. Polarization of light due to photographic film.

Q16. [Dec 2024] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2024 Dec	3.5M

A grating spectrometer in vacuum, illuminated by 500 nm light, gives first-order spectrum at an angle of 20°. When the vacuum chamber is filled with Argon gas at pressure P, this angle

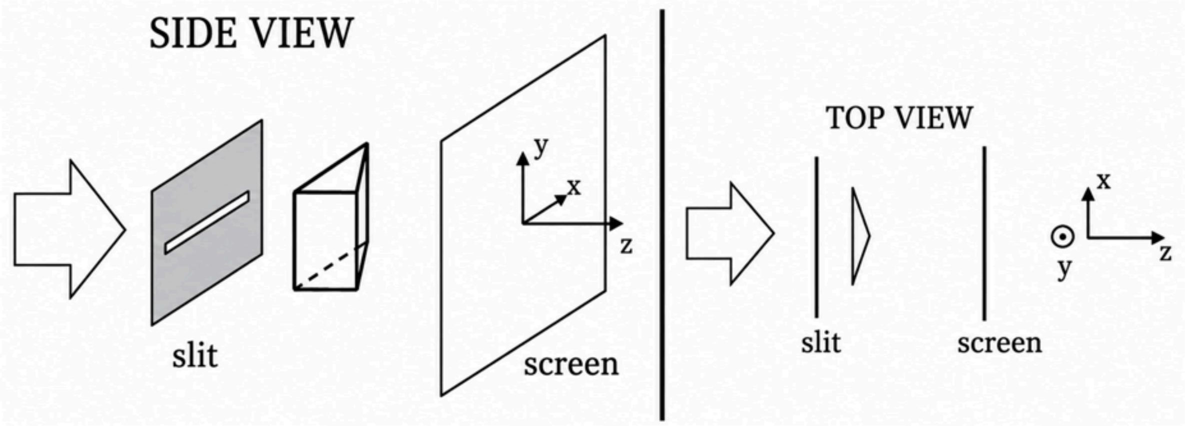
1. increases, due to increase in the refractive index of the medium
2. decreases, due to increase in the refractive index of the medium
3. decreases, due to decrease in the frequency of light in argon gas
4. increases, due to decrease in the frequency of light in argon gas

Q17. [Dec 2024] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2024 Dec	3.5M

A narrow horizontal slit is illuminated by an extended sodium lamp. A thin Fresnel biprism with its edge aligned perpendicular to the slit is positioned, as shown in the figure. Given that the length of the slit is larger than the base of the biprism, the pattern of illumination on the screen is best described by



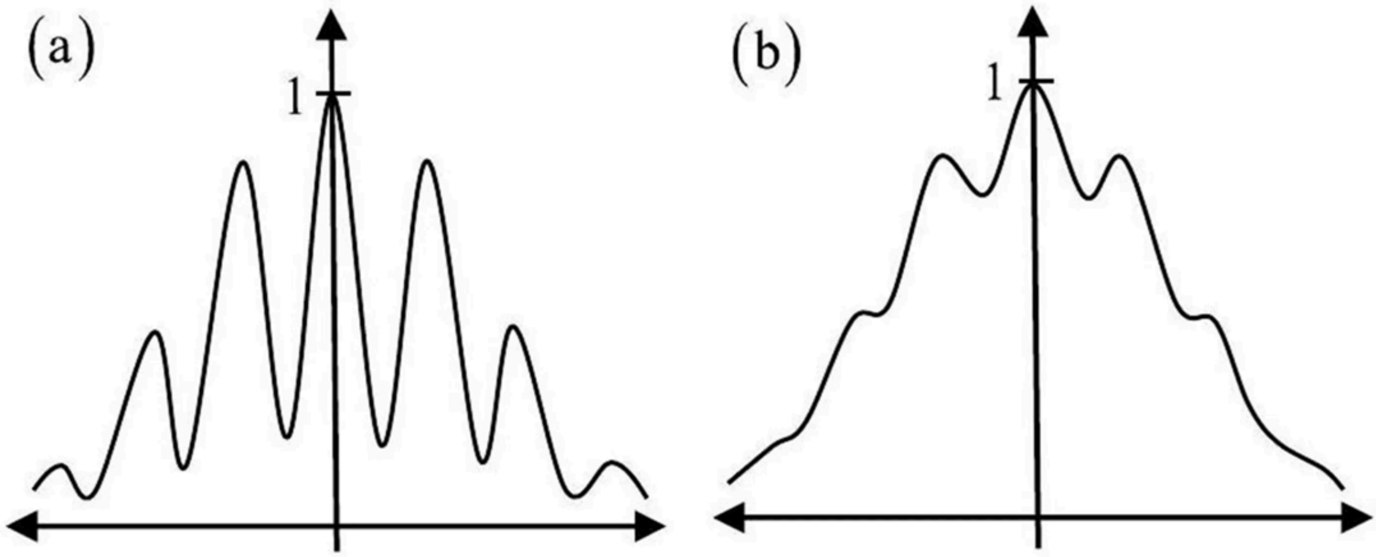
1. Fringes in both x and y direction.
2. Almost uniform illumination.
3. Horizontal fringes periodic only along the x-axis.
4. Horizontal fringes periodic only along the y-axis

Q18. [June 2024] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2024 June	3.5M

A finite sized light source is used in a double slit experiment. The observed intensity pattern changes from figure (a) to figure (b), as shown below.



The observed change can occur due to

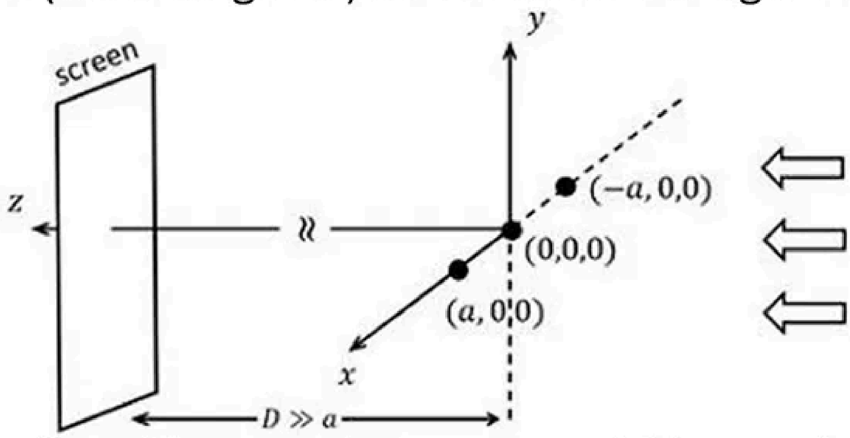
1. narrowing of the slits
2. a reduction in the distance between the slits
3. a decrease in the coherence length of the light source
4. a reduction in the size of the light source

Q19. [Dec 2025] . 3.5 marks

Optics > Interference and diffraction

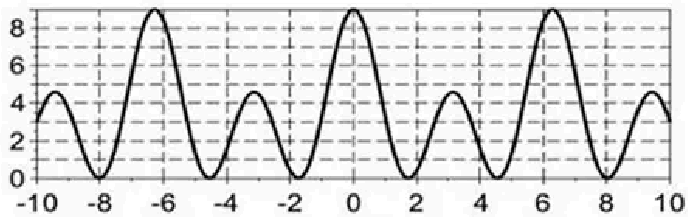
CSIR NET	2025 Dec	3.5M	Wave/Optic

Three identical pinholes separated by distance a along the x-axis are illuminated by a collimated monochromatic coherent beam of light (wavelength λ) as shown in the figure below.

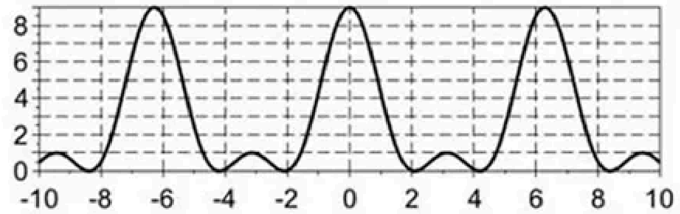


The intensity (in arbitrary units) pattern of fringes obtained on a screen kept at distance $D (D \gg a)$ along the z - axis is best represented by

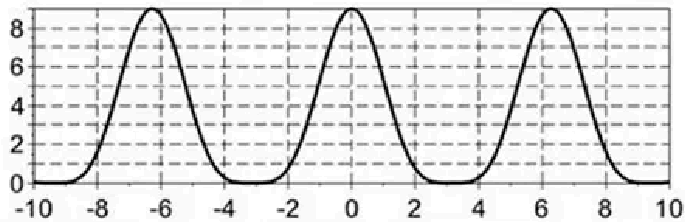
1.



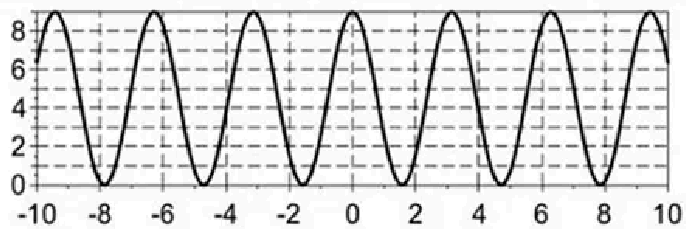
2.



3.



4.



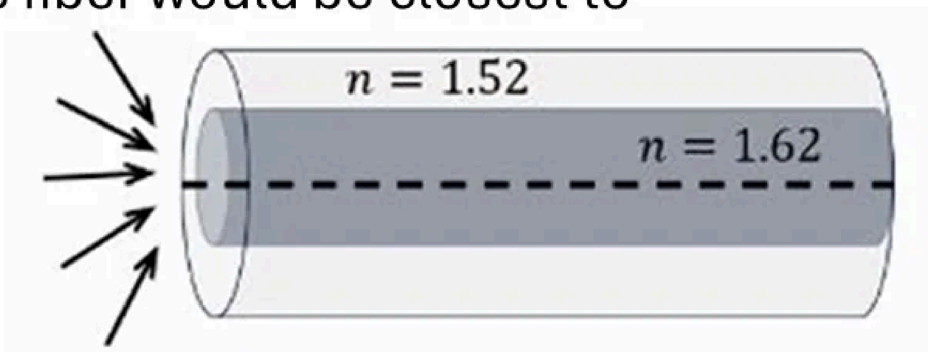
$x \left(\text{in units of} \dfrac{\lambda D}{2\pi a}\right) \rightarrow$

Q20. [June 2025] . 3.5 marks
Optics > Ray Optics

CSIR NET	2025 June	3.5M	EMT

A 1 km long optical fiber of core and clad refractive indices 1.62 and 1.52 , respectively, is laid in a straight line. Several identical light pulses are launched simultaneously from air on the entrance of this fiber from different angles about its axis, as shown below. The diameter of the fiber is small compared to its length. The maximum time difference between the pulses emerging at the other end of the fiber would be closest to

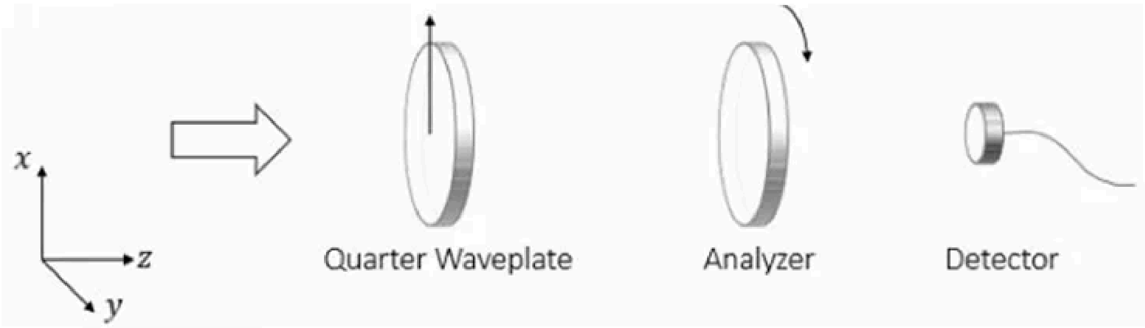
1. $355 ns$
2. $317 ns$
3. $5.40 \mu s$
4. $5.75 \mu s$



Q21. [June 2025] . 5.0 marks
Optics > Polarization

CSIR NET	2025 June	5M	Optics

A beam of light along the z-axis passes through a quarter wave plate and an analyzer as shown in the figure. The fast axis of the quarter wave plate is aligned with the x-axis. The light intensity is measured by a detector placed after the analyzer. Consider two scenarios where the incident light beam is (a) circularly polarized and (b) linearly polarized along the x-axis. If the polarization axis of the analyzer is rotated by one full cycle about the z-axis, the number of times the detector measures the maximum intensity in each case would be



1. (a) 4 and (b) 0
2. (a) 2 and (b) 0
3. (a) 4 and (b) 4
4. (a) 2 and (b) 2

Answer Key

21 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Optics	Polarization	**1**
Q2	Optics	Interference and diffraction	**1**
Q3	Optics	Polarization	**3**
Q4	Optics	Interference and diffraction	**1**
Q5	Optics	Interference and diffraction	**2**
Q6	Optics	Interference and diffraction	**2**
Q7	Optics	Interference and diffraction	**3**
Q8	Optics	Interference and diffraction	**4**
Q9	Optics	Polarization	**2**
Q10	Optics	Interference and diffraction	**2**
Q11	Optics	Interference and diffraction	**1**
Q12	Optics	Interference and diffraction	**3**
Q13	Optics	Polarization	**3**
Q14	Optics	Interference and diffraction	**1**
Q15	Optics	Interference and diffraction	**1**
Q16	Optics	Interference and diffraction	**2**
Q17	Optics	Interference and diffraction	**2**
Q18	Optics	Interference and diffraction	**3**
Q19	Optics	Interference and diffraction	**2**
Q20	Optics	Ray Optics	**1**
Q21	Optics	Polarization	**4**