PHYSICS

BOOKS - OSWAAL PUBLICATION PHYSICS (KANNADA ENGLISH)

WAVE OPTICS

Topic 1 Huygen S Principle Very Short Answer Type Questions

1. Who proposed the wave nature of light?

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2. What is a wavefront?

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3. When monochromatic light travels from one medium to another its wavelength changes but frequency remains the same. Explain.

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Topic 1 Huygen S Principle Short Answer Type Question Ii

1. Derive the law of reflection of light on the basis of Huygens wave theory.

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2. Using Huygens principle, show that the angle of incidence is equal to angle of reflection during a plane wave front reflected by a plane surface.

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3. Arrive at Snell's law of refraction, using Huygen's principle for refraction of a plane wave.

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Topic 1 Huygen S Principle Long Answer Type Question

1. Arrive at Snell's law of refraction, using Huygen's principle for refraction of a plane wave.

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Topic 2 Interference Very Short Answer

1. What is the shape of a wavefront at a large distance away from a point source?

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2. Define the term' coherent sources' which are required to produce interference pattern in Young's double slit experiment.

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3. What happens to the fringe pattern when the Youngs double slit experiment is performed in water instead of air ?

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Topic 2 Interference Short Answer Type Question I

1. State any three conditions for a sustained interference of light waves.

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2. Write the relation between the path difference and wavelength of light wave used for constructive and destructive interference of light

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3. Laser light of wavelength $640mm$ incident on a pair of slits produces an interference pattern in which the bright fringes are separated by $7.2mm$. Calculate the wavelength of another source of light which produces interference fringes separated by $8.1mm$ using same arrangement. Also find the minimum value of the order (n) of bright fringe of shorter wavelength which coincides with that of longer wavelength.

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4. A beam of light consisting of two wavelengths $800nm$ and $600nm$ is used to obtain the interference fringes in a Young's double slit experiment on a screen placed $1.4m$ away. If the two slits are separated by $0.28mm$, calculate the least distance from the central bright maximum where the bright fringes of the two wavelengths coincide.

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5. (a) Two monochromatic waves emanating from two coherent sources have the displacements represented by

$y_1 = a \cos \omega t$

and $y_2 = a \cos(\omega t + \phi)$,

where ϕ is the phase difference between the two displacements . Show that the resultant intensity at a point due to their superposition is given by $I = 4I_0 \cos^2 \phi/2$, where $I_0 = a^2$.

(b) Hence obtain the conditions for constructive and destructive interference.

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Topic 2 Interference Short Answer Type Question Ii

1. In Young's double slit experiment the two slits $0.15mm$ apart are illuminated by monochromatic light of wavelength $450nm$. The screen is $1.0m$ away from the slits.

(a) Find the distance of the second (i) bright fringe, (ii) dark fringe from the central maxima.

(b) How will the fringe pattern change if the screen is moved away from the slits ?

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Topic 2 Interference Long Answer Type Question

1. Obtain the expression for fringe width in the case of interference of light waves.

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2. In Young's double slit experiment , describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit . Hence obtain the expression for the fringe width.

OR

Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression or the fringe width.

(b) The ratio of the intensities at the minima to the maxima in the Young's double slit experiment is $9:25$. Find the ratio of the widths of the two slits.

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3. Explain the theory of interference of light.

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4. (a) (i) 'Two independent monochromatic sources of light cannot produce a sustained interference pattern'. Give reason.

(ii) Light waves each of amplitude "a" and frequency "omega", emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by $y_1 = a\cos\omega t$ and $y_2 = a\cos(\omega t + \phi)$, where ϕ is the phase difference between the two, obtain the expression for the resultant intensity at the point.

(b) In Young's double slit experiment, using monochromatic light of wavelength λ, the intensity of light at a point where path difference is $\lambda/3$.

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Topic 2 Interference Numerical Problems

1. A beam of light consisting of two wavelengths 500 nm and 400 nm is used to obtain interference fringes in Young's double slit experiment. The distance between the slits is 0.3 mm and the distance between the slits and the screen is 1.5 m. Compute the least distance of the point from the central maximum, where the bright fringes due to both the wavelengths coincide.

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2. In Young's double slit experiment, fringes of certain width are produced on the screen kept at a certain distance from the slits. When the screen is moved away from the slits by 0.1m, fringe width increases by $6 \times 10^{-5} m$. The separation between the slits is 1 mm. calculate the wavelength of the light used.

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3. Calculate the distance between 5^{th} and 15^{th} bright fringes in an interference pattern obtained by experiment due to narrow slits separated by $0.2mm$ and illuminated by light of wavelength $560mm$. The distance between the slit and screen is $1m$.

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4. In Young's double slit experiment two coherent sources of intensity ratio of $64:1$, produce interference fringes. Calculate the ratio of maximum and minimum intensities.

Data : $I_1 : I_2 : : 64 : 1, \frac{I_{\max}}{I_{\min}} = ?$

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5. In Young's experiement the width of the fringes obtained with light of wavelength 6000Å is $2mm$. Calculate the fringe width if the entire apparatus is immersed in a liquid of refractive index 1.33.

Data : $\lambda = 6000\text{Å} = 6 \times 10^{-7}m$, $\beta = 2mm = 2 \times 10^{-3}m\mu = 1.33, \beta = ?$

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6. Two slits $0.3mm$ apart are illuminated by light of wavelength 4500Å. The screen is placed at $1m$ distance from the slits. Find the separation between the second bright fringe on both sides of the central maximum.

Data : $d = 0.3mm = 0.3 \times 10^{-3}m$, $\lambda = 4500\text{Å} = 4.5 \times 10^{-7}m$, $D = 1m$, $n = 2$, $2x = ?$

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7. A parallel bean of monochromatic light is allowed to incident normally on a plane transmission grating having 5000 lines per centimeter. A second order spectral line is found to be diffracted at an angle 30°. Find the wavelength of the light.

Data : $N = 5000$ lines/cm $= 5000 \times 10^2$ lines/m, $m = 2, \theta = 30^\circ, \lambda = ?$

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Topic 3 Diffraction Very Short Answer Type Question

1. How does the angular separation between fringes in single-slit diffraction experiment change when the distance of separation between the slit and screen is doubled ?

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2. If a monochromatic source of light is replaced by white light, what change would you observe in the diffraction pattern ?

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3. A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue light?

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Topic 3 Diffraction Short Answer Type Question I

1. Give any two differences between Fresnel and Fraunhoffer diffraction.

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2. Name the phenomenon which is responsible for bending of light around sharp corners of an obstacle. Under what conditions does this phenomenon take place ? Give one application of this phenomenon in everyday life.

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3. For a single slit of width "a", the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of $\frac{\lambda}{a}$. At the same angle of $\frac{\lambda}{a}$, we get a maximum for two narrow slits separated by a distance "a" . Explain.

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4. Write the distinguishing features between a diffraction pattern due to a single slit and the interference fringes produced in Young's double slit experiment.

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5. Answer the following questions:

(c) When a tiny circular obstacle is placed in the path of light from a distant source, a bright spot is seen at the centre of the shadow of the obstacle. Explain why?

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6. A parallel beam of light of wavelength 500nm falls on a narrow slit and resulting diffraction pattern is observed on a screen 1m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen. Find the width of the slit.

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7. The following table gives data about the single slit diffraction experiment :

Find the ratio of the widths of ths slits used in the two cases. Would the ratio of the half angular widths of the first secondary maxima, in the two cases, be also equal to q ?

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8. Yellow light $(\lambda = 6000\text{Å})$ illuminates a single slit of width $1 \times 10^{-4} m$. Calculate : (i) the distance between the two dark lines on either side of the central maximum, when the diffraction pattern is viewed on a screen kept

$1.5m$ away from the slit, (ii) the angular spread of the first diffraction minimum.

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Topic 3 Diffraction Short Answer Type Question Ii

1. A parallel beam of monochromatic light falls normally on a narrow slit of width 'a' to produce a diffraction pattern on the screen placed parallel to the plane of the slit. Use Huygens' principle to explain that

(i) The central bright maxima is twice as wide as the other maxima.

(ii) The intensity falls as we move to successive maxima away from the centre on either side.

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Topic 3 Diffraction Long Answer Type Question

1. (a) Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic souce of light. Hence obtain the conditions for the angular width of secondary maxima and secondary minima.

(b) Two wavelengths of sodium light of $590nm$ and $596nm$ are used in turn to study the diffraction taking place at a single slit of aperture $2 \times 10^{-6}m$. The distance between the slit and the screen is $1.5m$. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases.

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2. State Huygen's principle. Show , with the help of a suitable diagram, how the principle is used to obtain the diffraction pattern by a single slit.

Draw a plot of intensity distribution and explain clearly why the secondary maxima become weaker with increasing order (n) of the secondary maxima.

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3. Write the distinguishing features between a diffraction pattern due to a single slit and the interference fringes produced in Young's double slit experiment.

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Topic 3 Diffraction Numerical Problems

1. Monochrmoatic light of wavelength $500 nm$ from a narrow slit is incident on the double slit. If the separation of 10 fringes on the screen 1m away is $1cms$. Find the slit separation.

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Topic 4 Polarisation Very Short Answer Type Question

1. State Brewester's law

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2. Define plane polarised light.

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3. Give one use of polaroid.

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4. Which of the following waves can be polarized (i) Heat waves, (ii) Sound waves. Give reason to support your answer.

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Topic 4 Polarisation Short Answer Type Question I

1. How do you represent plane polarized and unpolarised light ?

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2. Name the phenomenon which proves transverse wave nature of light. Give two uses of the devices whose functioning is based on this phenomenon.

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Topic 4 Polarisation Short Answer Type Question Ii

1. (a) Unpolarised light of intensity I_0 passes through two polaroids P_1 and P_2 such that pass axis of P_2 makes an angle θ with the pass axis of P_1, Plot a graph showing the variation of intensity of light transmitted through P_2 as the angle θ varies from zero to 180°.

(b) A third polariod P_3 is placed between P_1 and P_2 with pass axis of P_3 making an angle β with that of P_1. If I_1, I_2 and I_3 represent the intensities of light transmitted by P_1, P_2 and P_3 determine the values of angle θ and β for which $I_1 = I_2 = I_3$.

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2. (a) Using the phenomenon of polarisation, show how transverse nature of light can be demonstrated.

(b) Two polaroids P_1 and P_2 are placed with their pass axes perpendicular to each other. Unpolarised light of intensity I_0 is incident on P_1. A third polaroid P_3 is kept in between P_1 and P_2 such that its pass axis makes an angle of 30° with that of P_1. Determine the intensity of light transmitted through P_1, P_2 and P_3.

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3. (i) Distinguish between unpolarised and linearly polarised light.

(ii) What does a polaroid consist of ? How does it produce a linearly polarised light ?

(iii) Explain briefly how sunlight is polarised by scattering through atmospheric particles.

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4. (i) Describe briefly, with the help of suitable diagram, how the transverse nature of light can be demonstrated by the phenomenon of polarization.

(ii) When unpolarized light passes from air to a transparent medium, under what condition does the reflected light get polarized ?

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5. What is an unpolarized light ? Explain with the help of suitable ray daigram how an unpolarized light can be polarized by reflection from a transparent medium. Write the expression for Brewster angle in terms of the refractive index of denser medium.

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6. How does an unpolarised light get polarised when passed through a polaroid ? Two polaroids are set in crossed positions. A third polaroid is placed between the two making an angle θ with the pass axis of the first polaroid. Write the expression for the intensity of light transmitted from the second polaroid. In what orientations will the transmitted intensity be (i) minimum and (ii) maximum ?

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Topic 4 Polarisation Long Answer Type Question

1. State Brewster's law . Show that the reflected and refracted rays are normal to each other at the polarising angle of incidence.

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2. (a) Distiguish between linearly polarised and unpolarised light.

(b) Show that the light waves are transverse in nature.

(c) Why does light from a clear blue portion of the sky show a rise and fall of intensity when viewed through a polaroid which is rotated ? Explain by drawing the necessary diagram.

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3. (a) How does one demonstrate, using a suitable diagram, that unpolarised light when passed through a polaroid gets polarized ?

(b) A beam of unpolarised light is incident on a glass-air interface. Show, using a suitable ray diagram, that light reflected from the interface is totally polarised , when $\mu \tan i_B$, where μ is the refractive index of glass with respect to air and i_B is the Brewster's angle.

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4. (a) How dpes an unpolarized light incident on a polaroid get polarized?

Describe briefly with the help of a necessary diagram the polarization of light by reflection from a transparent medium. (b) Two polaroids 'A' and 'B' are kept in crossed position . How should a third polaroid 'C' be placed between them so that the intensity of polarized light transmitted by polaroid B reduces to $1/8^{th}$ of the intensity of unpolarized light incident on A ?

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