Wave Optics

Q.No.1:
State Huygens's principle. Show, with the help of a suitable diagram, how this 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 becomes weaker with increasing order (n) of the secondary maxima.
OR
Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point.
In a compound microscope, an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye piece has a focal length of 5 cm and the final image is formed at the near point, estimate the magnifying power of the microscope.

CBSE Board Paper 2010

Q.No.2:
(a) Write two characteristics features distinguish the diffractions pattern from the interference fringes obtained in Young's double slit experiment.
(b) Two wavelengths of sodium light 590 nm and 596 nm are used, in turn, to study the diffraction taking place due to a single slit of aperture 1×10^{-4} m. The distance between the slit and the screen is 1.8 m. Calculate the separation between the positions of the first maxima of the diffraction pattern obtained in the two cases.

CBSE Board Paper 2013

Q.No.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.

CBSE Board Paper 2014

Q.No.4:
(a) Using Huygens's construction of secondary wavelets explain how a

diffraction pattern is obtained on a screen due to a narrow slit on which a monochromatic beam of light is incident normally.

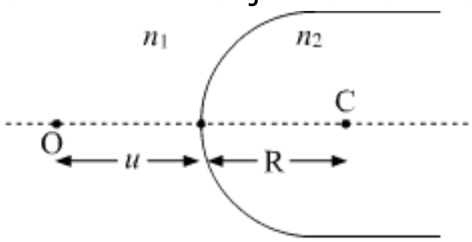
(b) Show that the angular width of the first diffraction fringe is half that of the central fringe.

(c) Explain why the maxima at $\theta = \left(n + \frac{1}{2}\right)\frac{\lambda}{a}$ become weaker and weaker with increasing *n*.

OR

(a) A point object 'O' is kept in a medium of refractive index n_1 in front of a convex spherical surface of radius of curvature *R* which separates the second medium of refractive index n_2 from the first one, as shown in the figure.

Draw the ray diagram showing the image formation and deduce the relationship between the object distance and the image distance in terms of n_1, n_2 and *R*.



(b) When the image formed above acts as a virtual object for a concave spherical surface separatig the medium n_2 from n_1 ($n_2 > n_1$), draw this ray diagram and write the similar (similar to (a)) relation. Hence obtain the expression for the lens maker's formula.

CBSE Board Paper 2015

Q.No.5:

State the importance of coherent sources in the phenomenon of interference.
In Young's double slit experiment to produce interference pattern, obtain the conditions for constructive and destructive interference. Hence deduce the expression for the fringe width.
How does the fringe width get affected, if the entire experimental apparatus of Young is immersed in water?

CBSE Board Paper 2011

Q.No.6:

(a) Draw a ray diagram showing the image formation by a compound microscope. Hence obtained expression for total magnification when the image is formed at infinity.
(b) Distinguish between myopia and hypermetropia. Show diagrammatically how these defects can be corrected.
OR
(a) State Huygen's principle. Using this principle draw a diagram to show how a plane wave front incident at the interface of the two media gets refracted when it propagates from a rarer to a denser medium. Hence verify Snell's law of refraction.
(b) When monochromatic light travels from a rarer to a denser medium, explain

the following, giving reasons:
(i) Is the frequency of reflected and refracted light same as the frequency of incident light?
(ii) Does the decrease in speed imply a reduction in the energy carried by light wave?

CBSE Board Paper 2013

Q.No.7:
(a) Why are coherent sources necessary to produce a sustained interference pattern?
(b) In Young's double slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is K units. Find out the intensity of light at a point where path difference is $\lambda/3$.

CBSE Board Paper 2012

Q.No.8:
Use Huygens's principle to explain the formation of diffraction pattern due to a single slit illuminated by a monochromatic source of light.
When the width of the slit is made double the original width, how would this affect the size and intensity of the central diffraction band?

CBSE Board Paper 2012

Q.No.9: (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 "ω", 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 on the screen where path difference is λ, is K units. Find out the intensity of light at a point where path difference is $\lambda/3$.

OR

(a) How does one demonstrate, using a suitable diagram, that unpolarised light when passed through a Polaroid gets polarised?
(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. **CBSE Board Paper 2014**

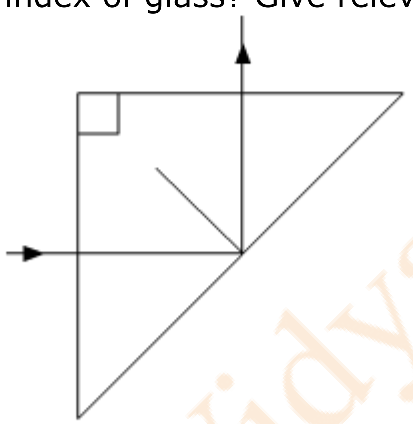
Q.No.10: Answer the following questions :
(a) In a double slit experiment using light of wavelength 600 nm, the angular width of the fringe formed on a distant screen is 0.1°. Find the spacing between

the two slits.
(b) Light of wavelength 5000 Å propagating in air gets partly reflected from the surface of water. How will the wavelengths and frequencies of the reflected and refracted light be affected? **CBSE Board Paper 2015**

Q.No.11: (i) In Young's double-slit experiment, deduce the condition for (a) constructive and (b) destructive interferences at a point on the screen. Draw a graph showing variation of intensity in the interference pattern against position 'x' on the screen.
(b) Compare the interference pattern observed in Young's double-slit experiment with single-slit diffraction pattern, pointing out three distinguishing features.

OR

(i) Plot a graph to show variation of the angle of deviation as a function of angle of incidence for light passing through a prism. Derive an expression for refractive index of the prism in terms of angle of minimum deviation and angle of prism.
(ii) What is dispersion of light? What is its cause?
(iii) A ray of light incident normally on one face of a right isosceles prism is totally reflected, as shown in fig. What must be the minimum value of refractive index of glass? Give relevant calculations.
CBSE Board Paper 2016



Q.No.12: (a) Distinguish between unpolarized light and linearly polarized light. How does one get linearly polarised light with the help of a polaroid?
(b) A narrow beam of unpolarised light of intensity I_0 is incident on a polaroid P_1. The light transmitted by it is then incident on a second polariod P_2 with its pass axis making angle of 60° relative to the pass axis of P_1. Find the intensity of the light transmitted by P_2.

OR

(a) Explain two features to distinguish between the interference pattern in Young's double slit experiment with the diffraction pattern obtained due to a single slit.

(b) A monochromatic light of wavelength 500 nm is incident normally on a single slit of width 0.2 mm to produce a diffraction pattern. Find the angular width of the central maximum obtained on the screen.
Estimate the number of fringes obtained in Young's double slit experiment with fringe width 0.5 mm, which can be accommodated within the region of total angular spread of the central maximum due to single slit.

CBSE Board Paper 2017

Q.No.13: (a) If one of two identical slits producing interference in Young's experiment is covered with glass, so that the light intensity passing through it is reduced to 50%, find the ratio of the maximum and minimum intensity of the fringe in the interference pattern.
(b) What kind of fringes do you expect to observe if white light is used instead of monochromatic light? **CBSE Board Paper 2018**