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CLASS 12 PHYSICS NCERT SOLUTIONS

NCERT Solutions for Class 12 Physics Chapter 10: Wave Optics – Free PDF Download

Chapter 10 covers wave optics — Huygens' principle, wavefronts, reflection and refraction using the wave picture of light, the phenomenon of interference, and Young's double-slit experiment. This chapter's syllabus is shorter than most, with 6 exercise questions; each answer below is numerically verified before pu...

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NCERT Exercise Solutions

10.1 Monochromatic light of wavelength 589nm is incident from air onto a water surface (refractive index of water = 1.33). Find the wavelength, frequency, and speed of (a) the reflected light, (b) the refracted light.
Ans: (a) Reflection happens in the same medium (air), so nothing changes: wavelength=**589nm**, frequency=$c/\lambda=3\times10^8/589\times10^{-9}\approx$**$5.09\times10^{14}$Hz**, speed=**$3\times10^8$m/s** (same as incident light). (b) On refraction into water, frequency stays the same (it depends only on the source), but speed and wavelength change: speed=$c/n=3\times10^8/1.33\approx$**$2.26\times10^8$m/s**, wavelength=$\lambda/n=589/1.33\approx$**442.9nm**, frequency=**5.09×10^{14}Hz** (unchanged).

10.2 What is the shape of the wavefront in each of these cases: (a) light diverging from a point source, (b) light emerging from a convex lens when a point source is placed at its focus, (c) light from a distant star incident on the surface of the Earth?
Ans: (a) **Spherical** — wavefronts are concentric spheres centred on the point source, since light travels equal distances in equal time in every direction. (b) **Planar** — a point source at the focus of a convex lens emerges as a parallel beam, and wavefronts perpendicular to parallel rays are flat planes. (c) **Planar (effectively)** — a star is so far away that the tiny patch of its enormous spherical wavefront reaching Earth is, for all practical purposes, a plane.

10.3 (a) In a medium of refractive index 1.5, what is the speed of light? (b) Does the speed of light in glass depend on the colour of light? If so, which of red and violet light travels slower in glass?
Ans: (a) $v=c/n=3\times10^8/1.5=$**2×10^8m/s**. (b) **Yes** — a medium's refractive index depends slightly on wavelength (dispersion), and violet light has a higher refractive index than red light in glass. Since $v=c/n$, a higher n means a lower speed, so **violet light travels slower than red light in glass**.

10.4 In a Young's double-slit experiment, the slits are separated by 0.28mm and the screen is placed 1.4m away. The distance between the central bright fringe and the fourth bright fringe is measured as 1.2cm. Find the wavelength of light used.
Ans: Using $y_n=n\lambda D/d$ with n=4, y_4=1.2cm=0.012m, D=1.4m, d=0.28mm=2.8×10^{-4}m:
$\lambda=y_4d/(nD)=(0.012\times2.8\times10^{-4})/(4\times1.4)=$**600nm**.

10.5 In a double-slit interference pattern, the intensity at a point where the path difference is λ (one full wavelength) is K units. What is the intensity at a point where the path difference is λ/3?
Ans: Intensity $I=4I_0\cos^2(\varphi/2)$, where $\varphi=2\pi$(path difference)$/\lambda$. At path difference=λ, $\varphi=2\pi$, so $I=4I_0\cos^2(\pi)=4I_0=K$, giving $I_0=K/4$. At path difference=$\lambda/3$, $\varphi=2\pi/3$, so $I=4I_0\cos^2(\pi/3)=4I_0\times(1/2)^2=I_0=$**K/4**.

10.6 A beam of light containing two wavelengths, 650nm and 520nm, is used in a Young's double-slit experiment with slit separation 2mm and screen distance 120cm. (a) Find the distance of the third bright fringe from the central maximum for the 650nm light. (b) Find the smallest distance from the central maximum where bright fringes from both wavelengths coincide.
Ans: (a) $y_3=n\lambda D/d=3\times650\times10^{-9}\times1.2/(2\times10^{-3})=$**0.117cm**. (b) Coincidence requires $n_1\lambda_1=n_2\lambda_2$, i.e. $n_1/n_2=520/650=4/5$, so the smallest integers are n_1=4 (for 650nm) and n_2=5 (for 520nm). $y=n_1\lambda_1D/d=4\times650\times10^{-9}\times1.2/(2\times10^{-3})=$**0.156cm** (checked: $5\times520\times10^{-9}\times1.2/(2\times10^{-3})$ gives the same 0.156cm).

Class 12 Physics Chapter 10 – Notes and Extra Questions

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