Wave Optics

CHAPTER 10

TRY YOURSELF

ANSWERS

1. A ray is a straight line path along which light travels. A wavefront is continuous locus of all the particles of a medium, which are vibrating in the same phase.

2. It is cylindrical in shape.

3. Energy decreases because some of the energy is reflected back into water and the frequency remains same.

4. Reflection of waves at a denser medium causes a phase change of 180°.

5. Violet colour travels slower. This is because $\mu_v > \mu_r$ and $v = c/\mu$.

6. Phase difference between any two points on a wavefront is zero.

7. Wavefront is always normal to the rays corresponding to it.

8. Two light waves are said to show coherence when initial phase difference between them remains constant with time, *i.e.*, the light waves are in same phase or have a constant phase difference.

9. Resultant amplitude, $R = a - b = 5 - 3 = 2$ mm

10. $R = \sqrt{a^2 + b^2 + 2ab\cos\frac{\pi}{2}} = \sqrt{3^2 + 4^2} = 5\,\text{mm}$

11. Their independent source are not coherent sources and independent sources emit the waves which don't have same phase or a constant phase difference. That is why they cannot produce interference.

12. No, because two independent sources of light cannot be coherent, even when light emitted by them is of same wavelength.

13. As, a and b are amplitudes of two waves,
$I_{max} = (a + b)^2$ and $I_{min} = (a - b)^2$, when second slit is covered by a transparent paper, then b decrease.
$\therefore$ $I_{max} \rightarrow$decrease and $I_{min} \rightarrow$increase.

14. No, interference pattern is not obtained these is because phase difference between the light waves emitted from two lamps will change continuously.

15. The colours of a soap bubble are seen due to interference of light. In the prism, colours appear due to dispersion of light.

16. When $t << \lambda$, path difference in light reflected from two surfaces of thin film $= 2\,\mu t\cos r + \lambda/2$ reduces to $\lambda/2$ which is the condition for destructive interference. So, the film appears black.

17. $\frac{w_1}{w_2} = \frac{I_1}{I_2} = \frac{a^2}{b^2} = \left(\frac{\sqrt{3}}{\sqrt{2}}\right)^2 = \frac{3}{2}$

18. As the fringe width is given by $\beta = \frac{D\lambda}{d}$, so

(i) fringe width will increase when D is increased.

(ii) fringe width will decrease when λ is decreased.

(iii) Coloured fringes will be obtained when light consists of different wavelength and the centre of the interference pattern will be white.

(iv) fringes are no longer distinct due to overlapping of the interference fringes.

(v) fringe width will decrease when, d is increased.

(vi) fringes are no longer distinct due to overlapping of the interference fringes.

(vii) The single slit diffraction effects will superimpose the interference pattern.

19. As, $\lambda_r > \lambda_y > \lambda_b$ and $\beta = \frac{D\lambda}{d}$, so the fringe width will be maximum for red colour.

20. Diffraction of light occurs only when size of obstacle/aperture is of order of wavelength of light.

21. This is because the objects around us are much bigger in size as compared to the wavelength of visible light.

22. Ray optics is good approximation upto fresnel distance.

$$Z_F = \frac{a^2}{\lambda} = \frac{(6\times10^{-3})^2}{600\times10^{-9}} = 60\,\text{m}$$

23. When source of light or the observer approach each other, the apparent frequency of light increases or apparent wavelength decreases. This is called blue shift as wavelength of blue colour is smaller.

24. (i) Measuring speed of stars and galaxies.

(ii) Measuring speed of rotation of sun around its awn axis.

(iii) Measuring velocities of satellites, aeroplanes, rockets and submarines.

25. It shows that universe in expanding.

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