NEET ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 12th **PAPER CODE :- CWT-9**
CHAPTER :- WAVE OPTICS

ANSWER KEY

1.	(C)	**2.**	(D)	**3.**	(C)	**4.**	(C)	**5.**	(B)	**6.**	(D)	**7.**	(C)
8.	(C)	**9.**	(A)	**10.**	(D)	**11.**	(C)	**12.**	(C)	**13.**	(C)	**14.**	(A)
15.	(D)	**16.**	(B)	**17.**	(C)	**18.**	(D)	**19.**	(B)	**20.**	(B)	**21.**	(B)
22.	(C)	**23.**	(B)	**24.**	(A)	**25.**	(B)	**26.**	(C)	**27.**	(B)	**28.**	(B)
29.	(C)	**30.**	(D)	**31.**	(A)	**32.**	(C)	**33.**	(A)	**34.**	(C)	**35.**	(A)
36.	(B)	**37.**	(D)	**38.**	(C)	**39.**	(A)	**40.**	(C)	**41.**	(A)	**42.**	(B)
43.	(B)	**44.**	(D)	**45.**	(C)	**46.**	(C)	**47.**	(D)	**48.**	(B)	**49.**	(D)
50.	(D)												

SOLUTIONS

SECTION-A

1. (C)

Sol. $I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2 = (\sqrt{I} + \sqrt{4I})^2 = 9I$

$I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2 = (\sqrt{I} - \sqrt{4I})^2 = I$

2. (D)

Sol. Sound wave and light waves both shows interference.

3. (C)

Sol. For constructive interference path difference is even multiple of $\frac{\lambda}{2}$.

4. (C)

Sol. $I \propto a^2$

5. (B)

Sol. At point *A*, resultant intensity

$I_A = I_1 + I_2 = 5I$; and at point *B*

$I_B = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \pi = 5I + 4I$

$I_B = 9I$ so $I_B - I_A = 4I.$

6. (D)

Sol. $y_1 = a \sin \omega t,\ y_2 = a \cos \omega t = a \sin\left(\omega t + \frac{\pi}{2}\right)$

7. (C)

Sol. $\frac{I_{\max}}{I_{\min}} = \left(\frac{\frac{a_1}{a_2} + 1}{\frac{a_1}{a_2} - 1}\right)^2 = \frac{25}{1}$

8. (C)

Sol. When a beam of light is used to determine the position of an object, the maximum accuracy is achieved if the light is of shorter wavelength, because

$\text{Accuracy} \propto \frac{1}{\text{Wavelength}}$

9. (A)

Sol. When light reflect from denser surface phase change of π occurs.

10. (D)

Sol. For maximum intensity $\phi = 0°$

$\therefore\ I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi = I + I + 2\sqrt{I I}\cos 0° = 4I$

11. (C)

Sol. $\beta = \frac{\lambda D}{d} = \frac{5 \times 10^{-7} \times 2}{10^{-3}} m = 10^{-3} m = 1.0\ mm$.

12. (C)

Sol. Slit width ratio = 1 : 9

Since slit width ratio is the ratio of intensity and intensity $\propto$ (amplitude)^2

$\therefore I_1 : I_2 = 1 : 9$

$\Rightarrow a_1^2 : a_2^2 = 1 : 9 \Rightarrow a_1 : a_2 = 1 : 3$

$I_{\max} = (a_1 + a_2)^2,\ I_{\min} = (a_1 - a_2)^2 \Rightarrow \frac{I_{\min}}{I_{\max}} = \frac{1}{4}$

13. (C)

Sol. Suppose slit width's are equal, so they produces waves of equal intensity say I'.

Resultant intensity at any point $I_R = 4\,I' \cos^2 \phi$ where ϕ is the phase difference between the waves at the point of observation.

For maximum intensity $\phi = 0^o \Rightarrow I_{\max} = 4I' = I$ ...(i)

If one of slit is closed, Resultant intensity at the same point will be I' only *i.e.* $I' = I_O$ ...(ii)

Comparing equation (i) and (ii) we get $I = 4I_O$

14. (A)

Sol. $\theta = \frac{\lambda}{d}$; θ can be increased by increasing λ, so here λ has to be increased by 10%

i.e., % Increase $= \frac{10}{100} \times 5890 = 589\ \mathring{A}$

15. (D)

Sol. Distance of n^{th} dark fringe from central fringe

$$x_n = \frac{(2n-1)\lambda D}{2d}$$

$$\therefore\ x_2 = \frac{(2\times 2-1)\lambda D}{2d} = \frac{3\lambda D}{2d}$$

$$\Rightarrow 1\times 10^{-3} = \frac{3\times \lambda \times 1}{2\times 0.9\times 10^{-3}} \Rightarrow \lambda = 6\times 10^{-5}\ cm$$

16. (B)

Sol. $n_1\lambda_1 = n_2\lambda_2 \Rightarrow n_2 = n_1 \times \frac{\lambda_1}{\lambda_2} = 12\times\frac{600}{400} = 18$

17. (C)

Sol. If shift is equal to *n* fringes width, then

$$n = \frac{(\mu-1)t}{\lambda} = \frac{(1.5-1)\times 2\times 10^{-6}}{500\times 10^{-9}} = \frac{1}{500}\times 10^3 = 2$$

Since a thin film is introduced in upper beam. So shift will be upward.

18. (D)

Sol. Angular position of first dark fringe

$$\theta = \frac{\lambda}{d} = \frac{5460\times 10^{-10}}{0.1\times 10^{-3}} \times \frac{180}{\pi} \text{ (in degree)}$$

= 0.313°

19. (B)

Sol. Intensity of one slit = $\frac{I}{4}$

$$\therefore\quad \frac{I}{4} = \frac{I}{4} + \frac{I}{4} + 2\frac{I}{4}\cos\phi$$

$$\Rightarrow\quad \cos\phi = -\frac{1}{2}$$

$$\Rightarrow\quad \phi = \frac{2\pi}{3}$$

Also $\frac{\phi}{2\pi} = \frac{\Delta}{\lambda}$

$$\Rightarrow\quad \Delta = \frac{2\pi}{3\times 2\pi}\times\lambda = \frac{\lambda}{3}$$

$$\therefore\quad d\sin\theta = \frac{\lambda}{3}$$

$$\Rightarrow\quad \sin\theta = \frac{\lambda}{3d}$$

$$\Rightarrow\quad \theta = \sin^{-1}\left(\frac{\lambda}{3d}\right)$$

20. (B)

Sol. Lateral displacement of fringes = $\frac{\beta}{\lambda}(\mu-1)t$

$$= \frac{1\times 10^{-3}}{600\times 10^{-9}}(1.5-1)\times 0.06\times 10^{-3} \qquad = \frac{1}{20}\,m$$

$= 5\ cm.$

21. (B)

Sol. $\Delta\lambda = 5200 - 5000 = 200\ \mathring{A}$

Now $\frac{\Delta\lambda}{\lambda'} = \frac{v}{c} \Rightarrow v = \frac{c\Delta\lambda}{\lambda'} = \frac{3\times 10^8\times 200}{5000}$

$= 1.2\times 10^7\ m/\sec \approx 1.15\times 10^7\ m/\sec$

22. (C)

Sol. According to Doppler's principle

$\lambda' = \lambda\sqrt{\frac{1-v/c}{1+v/c}}$ for $v = c$

$$\lambda' = 5500\sqrt{\frac{(1-0.8)}{1+0.8}} = 1833.3$$

$\therefore$ Shift = 5500 – 1833.3 = 3167 Å

23. (B)

Sol. $\Delta\lambda = \lambda\frac{v}{c}$

$$\Rightarrow (3737 - 3700) = 3700\times\frac{v}{3\times 10^8} \Rightarrow v = 3\times 10^6\ m/s$$

24. (A)

Sol. $\Delta x_1 = 0$

$\Delta\phi = 0°$

$I_1 = I_0 + I_0 + 2I_0\cos 0° = 4I_0$

$\Delta x_2 = \frac{\lambda}{4}$

$\Delta\theta = \frac{2\pi}{\lambda}.\frac{\lambda}{4} = \left(\frac{\pi}{2}\right)$

$I_2 = I_0 + I_0 + 2I_0\cos\frac{\pi}{2} = 2I_0$

$\frac{I_1}{I_2} = \frac{4I_0}{2I_0} = \frac{2}{1}.$

25. (B)

Sol. $\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \frac{0.05}{100} = \frac{v}{3\times 10^8} \Rightarrow v = 1.5\times 10^5$ *m/s*

(Since wavelength is decreasing, so star coming closer)

26. (C)

Sol. The beautiful colours are seen an acount of interference of light reflected from the upper and the lower surfaces of the thin film. As conditions for constructive & destructive interference depend upon the wavelength of light, therefore coloured interference fringes are observed.

27. (B)

28. (B)

Sol. $v' = v\left(1 - \frac{v}{c}\right) = 4 \times 10^7\left(1 - \frac{0.2c}{c}\right) = 3.2 \times 10^7\ Hz$

29. (C)

Sol. When the source and observer approach each other, apparent frequency increases and hence wavelength decreases.

30. (D)

Sol. It will be concentric circles

31. (A)

Sol. $\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow 1 = \frac{v}{c} \Rightarrow v = c$

32. (C)

Sol. For first minima $\theta = \frac{\lambda}{a}$ or $a = \frac{\lambda}{\theta}$

$\therefore a = \frac{6500 \times 10^{-8} \times 6}{\pi}$ (As $30^o = \frac{\pi}{6}$ radian)

$= 1.24 \times 10^{-4}\ cm = 1.24$ microns

33. (A)

Sol. The angular half width of the central maxima is given by $\sin\theta = \frac{\lambda}{a}$

$\Rightarrow \theta = \frac{6328 \times 10^{-10}}{0.2 \times 10^{-3}}$ *rad*

$= \frac{6328 \times 10^{-10} \times 80}{0.2 \times 10^{-3} \times \pi}$ *degree* = 0.18^o

Total width of central maxima $= 2\theta = 0.36^o$

34. (C)

Sol. It is caused due to turning of light around corners.

35. (A)

Sol. Band width $\propto \lambda$,

$\because \lambda_{blue} < \lambda_{red}$, hence for blue light the diffraction bands becomes narrower and crowded together.

SECTION-B

36. (B)

Sol. $\theta_0 = \frac{2\lambda}{a} \Rightarrow \theta_0 \propto \lambda$

$\frac{\theta_0}{\theta_1} = \frac{\lambda_0}{\lambda_1} \Rightarrow \frac{\theta_0}{\theta_1} = \frac{6000}{\lambda_1}$

$(\theta_1 = .7\theta_0) \Rightarrow \frac{\theta_0}{.7\theta_0} = \frac{6000}{\lambda_1}$

$\Rightarrow \lambda_1 = 4200$ A°

37. (D)

Sol. The phase difference (ϕ) between the wavelets from the top edge and the bottom edge of the slit is $\phi = \frac{2\pi}{\lambda}(d\sin\theta)$ where d is the slit width. The first minima of the diffraction pattern occurs at $\sin\theta = \frac{\lambda}{d}$

so $\phi = \frac{2\pi}{\lambda}\left(d \times \frac{\lambda}{d}\right) = 2\pi$

38. (C)

39. (A)

40. (C)

Sol. Position of first minima = position of third maxima *i.e.*,

$\frac{1 \times \lambda_1 D}{d} = \frac{(2 \times 3 + 1)}{2}\frac{\lambda_2 D}{d} \Rightarrow \lambda_1 = 3.5\lambda_2$

41. (A)

Sol. Position of n^{th} minima $x_n = \frac{n\lambda D}{d}$

$\Rightarrow 5 \times 10^{-3} = \frac{1 \times 5000 \times 10^{-10} \times 1}{d}$

$\Rightarrow d = 10^{-4}\ m = 0.1\ mm$.

42. (B)

Sol. By using phase difference $\phi = \frac{2\pi}{\lambda}(\Delta)$

For path difference λ, phase difference $\phi_1 = 2\pi$ and for path difference $\lambda/4$, phase difference $\phi_2 = \pi/2$.

Also by using $I = 4I_0\cos^2\frac{\phi}{2}$

$\Rightarrow \frac{I_1}{I_2} = \frac{\cos^2(\varphi_1/2)}{\cos^2(\varphi_2/2)}$

$\Rightarrow \frac{K}{I_2} = \frac{\cos^2(2\pi/2)}{\cos^2\left(\frac{\pi/2}{2}\right)} = \frac{1}{1/2} \Rightarrow I_2 = \frac{K}{2}$.

43. (B)

Sol. Polariser produced prolarised light.

44. (D)

Sol. The amplitude will be $A \cos 60^{o} = A/2$

45. (C)

Sol. Intensity of polarized light from first polarizer $= \frac{100}{2} = 50$

$I = 50 \cos^2 60° = \frac{50}{4} = 12.5$

46. (C)

Sol. If an unpolarised light is converted into plane polarised light by passing through a polaroid, it's intensity becomes half.

47. (D)

48. (B)

Sol. When intensity of light emerging from two slits is equal, the intensity at minima,

$I_{min} = \left(\sqrt{I_a} - \sqrt{I_b}\right)^2 = 0,$ or absolute dark.

It provides a better contrast.

49. (D)

Sol. $\mu = \tan i_b$

$1 < \mu < \infty$

$1 < \tan i_b < \infty$

$\tan^{-1}(1) < i_b < \tan^{-1}(\infty)$

$45° < i_b < 90°$

50. (D)

Sol. Fringe width $\beta - \frac{\lambda D}{d}$

Now, $d' - \frac{d}{2}$ & $D' - 2D$

So, $\beta' - \frac{\lambda(2D)}{d/2} = \frac{4\lambda D}{d}$

$\beta' = 4\beta$