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UDUPI

CET25P10 WAVE OPTICS

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 75**

1. The maximum number of possible interference maxima for slit separation equal to twice the wavelength in Young's double-slit experiment is: **[1]**

   a) three
   b) infinite
   c) zero
   d) five

2. Phenomenon of bending of waves around corners of obstacle without a change in medium is called _____. **[1]**

   a) diffraction
   b) interference
   c) reflection
   d) refraction

3. Two periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is: **[1]**

   a) $(\sqrt{I_1} - \sqrt{I_2})^2$
   b) $2(I_1 + I_2)$
   c) $I_1 + I_2$
   d) $(\sqrt{I_1} + \sqrt{I_2})^2$

4. The intensity at the maximum in Young's double-slit experiment is I_0. Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance D = 10 d? **[1]**

   a) $\frac{3}{4}$ I_0
   b) $\frac{I_0}{2}$
   c) I_0
   d) $\frac{I_0}{4}$

5. How is interference pattern in double slit experiment affected, if a source of blue light is used in place of yellow light producing the same intensity? **[1]**

   a) The fringe width will increase
   b) The fringe width will become fainter
   c) The fringe width will become brighter
   d) The fringe width will decrease

6. Two waves have intensity ratio 25 : 4. What is the ratio of maximum to minimum intensity? **[1]**

   a) $\frac{9}{49}$
   b) $\frac{16}{25}$
   c) $\frac{49}{9}$
   d) $\frac{25}{4}$

7. In an interference experiment monochromatic light is replaced by white light; we will see: **[1]**

   a) uniform illumination on the screen
   b) equally spaced white and dark bands
   c) a few coloured bands and then uniform illumination
   d) uniform darkness on the screen

8. A parallel beam of light in air makes an angle of 47.5° with the surface of a glass plate having a refractive index **[1]**

of 1.66. What is the angle between the refracted beam and the surface of the glass?

a) 66.0°

b) 67.0°

c) 69.0°

d) 68.0°

9. In Young's double slit experiment, intensity at a point is (1/4) of the maximum intensity. Angular position of this point is: **[1]**

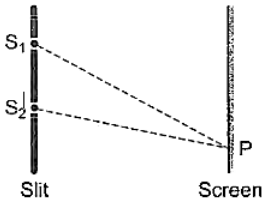
a) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$

b) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

c) $\sin^{-1}\left(\frac{\lambda}{d}\right)$

d) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

10. In a Young's double slit experimental arrangement shown here, if a mica sheet of thickness t and refractive index μ is placed infront of the slit S_1, then the path difference (S_1P - S_2P): **[1]**



a) decreases by (μ - 1)t

b) increases by μt

c) does not change

d) increases by (μ - 1)t

11. In Young's double-slit experiment, the intensity of light at a point on the screen where the path difference is λ is k (λ being the wavelength of light used). The intensity at a point where the path difference is $\frac{\lambda}{4}$, will be **[1]**

a) k

b) $\frac{k}{4}$

c) $\frac{k}{2}$

d) zero

12. In Young's double-slit experiment the intensity at the centre of the screen is I. If one of the slits is closed, the intensity at centre now will be **[1]**

a) I

b) $\frac{I}{3}$

c) $\frac{I}{2}$

d) $\frac{I}{4}$

13. What happens, if the monochromatic light used in Young's double slit experiment is replaced by white light? **[1]**

a) Only the central fringe is white and all the other fringes are coloured

b) All bright fringes have colours between violet and red

c) All bright fringes become white

d) No fringes are observed

14. In Young's double-slit experiment the separation d between the slits is 2 mm, the wavelength λ of the light used is 5896 $\mathring{A}$ and distance D between the screen and slits is 100 cm. It is found that the angular width of the fringes is 0.20^o. To increase the fringe angular width to 0.21° (with same λ and D) the separation between the slits needs to be changed to **[1]**

a) 2.1 mm

b) 1.7 mm

c) 1.8 mm

d) 1.9 mm

15. Two waves are said to be coherent, if they have: **[1]**

a) same frequency but different amplitude

b) different frequency, phase and amplitude

c) same phase and different amplitude

d) same frequency, phase and amplitude

16. The interference pattern is obtained with two coherent light sources of intensity ratio **n**. In the interference pattern, the ratio $\frac{I_{max}-I_{min}}{I_{max}+I_{min}}$ will be **[1]**

a) $\frac{\sqrt{n}}{(n+1)^2}$ b) $\frac{2\sqrt{n}}{(n+1)^2}$

c) $\frac{\sqrt{n}}{n+1}$ d) $\frac{2\sqrt{n}}{n+1}$

17. In a certain double slit experimental arrangement, interference fringes of width 1 mm each are observed when the light of wavelength 5000 $\mathring{A}$ is used. Keeping the set up unaltered, if the source is replaced by another source of wavelength 6000 $\mathring{A}$, the fringe width will be **[1]**

a) 1.2 mm b) 0.5 mm

c) 1 mm d) 1.5 mm

18. The angular width of central maximum in the Fraunhoffer's diffraction pattern is measured. A slit is illuminated by the light of wavelength 6000 $\mathring{A}$. If the slit is illuminated by the light of another wavelength, angular width decreases by 30%. The wavelength of light used is: **[1]**

a) 4200 $\mathring{A}$ b) 3500 $\mathring{A}$

c) 6000 $\mathring{A}$ d) 4700 $\mathring{A}$

19. In Young's double-slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case **[1]**

a) there shall be an interference pattern for red distinct from that for blue

b) there shall be no interference fringes

c) there shall be alternate interference patterns of red and blue

d) there shall be an interference pattern for red mixing with one for blue

20. A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5×10^8 $ms^{-1}$and 230 nm respectively. The wavelength of light in air will be **[1]**

a) 230 nm b) 345 nm

c) 690 nm d) 460 nm

21. Huygens' theory could not explain **[1]**

a) interference of light. b) reflection of light.

c) diffraction of light. d) photoelectric effect.

22. The idea of secondary wavelets for the propagation of a wave was first given by: **[1]**

a) Newton b) Maxwell

c) Fresnel d) Huygens

23. Interference was observed in interference chamber, when air was present. Now, the chamber is evacuated and if the same light is used, a careful observer will see **[1]**

a) no interference b) interference with bright bands

c) interference, in which width of the fringe will be slightly increased

d) interference with dark bands

24. A linear aperture whose width is 0.02 cm is placed immediately in front of a lens of focal length 60 cm. The aperture is illuminated normally by a parallel beam of wavelength 5×10^{-5} cm. The distance of the first dark band of the diffraction pattern from the centre of the screen is **[1]**

a) 0.20 cm
b) 0.15 cm
c) 0.10 cm
d) 0.25 cm

25. If two sources have a randomly varying phase different ϕ(t), the resultant intensity will be given by **[1]**

a) 2 I_0
b) $\frac{I_0}{\sqrt{2}}$
c) $\frac{3}{2}I_0$
d) $\frac{I_0}{2}$

26. Two waves of intensities I and 4I superpose. Then, the maximum and minimum intensities are **[1]**

a) 9 I and I
b) 5 I and I
c) 9 I and 3 I
d) 5 I and 3 I

27. A beam of light of λ = 600 nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between the first dark fringes on either side of the central bright fringe is **[1]**

a) 1.2 cm
b) 2.4 mm
c) 1.2 mm
d) 2.4 cm

28. In Young's double-slit experiment, two slits are made 5 mm apart and the screen is placed 2 m away. What is the fringe separation when light of wavelength 500 nm is used? **[1]**

a) 2 mm
b) 0.02 mm
c) 0.002 mm
d) 0.2 mm

29. In single slit diffraction, the distance between the plane of slit and screen is 1 m. The size of the slit is 0.7 mm and the second maximum is formed at the distance of 2 mm from the centre of the screen, then the wavelength of light used is **[1]**

a) 5600 $\mathring{A}$
b) 2800 $\mathring{A}$
c) 3000 $\mathring{A}$
d) 6000 $\mathring{A}$

30. At the first minimum adjacent to the central maximum of a single-slit diffraction pattern, the phase difference between the Huygen's wavelet from the edge of the slit and the wavelet from the midpoint of the slit is **[1]**

a) $\frac{\pi}{2}$
b) $\frac{\pi}{4}$ radian
c) π radian
d) $\frac{\pi}{8}$ radian

31. The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000 $\mathring{A}$. The refractive index of material will be **[1]**

a) 1.40
b) 1.33
c) 1.50
d) 3.00

32. If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled? **[1]**

a) $2\ I_0$ b) $I_0/\ 2$

c) $4\ I_0$ d) I_0

33. In Young's double-slit experiment, the spacing between the slits is d and wavelength of light used is 6000 $\mathring{A}$. If the angular width of a fringe formed on a distant screen is 1^o, then the value of d is **[1]**

a) 0.05 mm b) 0.01 mm

c) 0.03 mm d) 1 mm

34. A plane wavefront is incident on a concave mirror of radius of curvature R. The radius of the refracted wavefront will be: **[1]**

a) 2R b) R

c) $\frac{R}{2}$ d) $\frac{R}{4}$

35. A parallel beam of monochromatic light of wavelength 900 nm passes through a long slit of width 0.4 mm. The angular divergence in which most of the light is diffracted is **[1]**

a) 4.5×10^{-3} rad b) 9.0×10^{-3} rad

c) 2.25×10^{-3} rad d) 4.25×10^{-3} rad

36. In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30^o when light of wavelength 5000 $\mathring{A}$ is incident on the slit. The first secondary maximum is observed at an angle of **[1]**

a) $\sin^{-1}\left(\frac{1}{2}\right)$ b) $\sin^{-1}\left(\frac{1}{4}\right)$

c) $\sin^{-1}\left(\frac{3}{4}\right)$ d) $\sin^{-1}\left(\frac{2}{3}\right)$

37. The ratio of intensity at the centre of a bright fringe to the intensity at a point distant one-fourth of the distance between two successive bright fringes will be **[1]**

a) 2 b) 3

c) 4 d) 1

38. A ray of light of wavelength 600 nm propagates from air into a medium. If its wavelength in the medium becomes 400 nm, the refractive index of the medium is **[1]**

a) 1.4 b) 1.6

c) 1.5 d) 1.8

39. Consider a ray of light incident from air onto a slab of glass (refractive index n) of width d, at an angle θ. The phase difference between the ray reflected by the top surface of the glass and the bottom surface is **[1]**

a) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}$ b) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+2\pi$

c) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+\frac{\pi}{2}$ d) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+\pi$

40. The phenomena which is not explained by Huygens' construction of wavefront is: **[1]**

a) diffraction b) refraction

c) origin of spectra d) reflection

41. Interference occurs in which of the following waves? **[1]**

a) all of these

b) longitudinal

c) electromagnetic

d) transverse

42. The main condition for diffraction to be observed is **[1]**

a) size of obstacle should be much larger than the wavelength of the wave

b) size of obstacle should be comparable to the wavelength of the wave

c) for any size of obstacle

d) size of obstacle should be much smaller than the wavelength of the wave

43. Two waves are said to be coherent if they have **[1]**

a) different frequency, phase and amplitude

b) same frequency but different amplitude

c) same frequency, phase and amplitude

d) same phase and different amplitude

44. What is the path difference for destructive interference? **[1]**

a) $\frac{(n+1)\lambda}{2}$

b) n λ

c) n (λ + 1)

d) $\frac{(2n+1)\lambda}{2}$

45. In Young's double-slit experiment, the two slits act as coherent sources of equal amplitude a and of wavelength λ. In another experiment with the same setup, the two slits are sources of equal amplitude a and wavelength λ, but are incoherent. The ratio of intensities of light at the midpoint of the screen in the first case to that in the second case is **[1]**

a) 1 : 2

b) 3 : 4

c) 2 : 1

d) 4 : 3

46. Light appears to travel in a straight line, because **[1]**

a) it is not absorbed by surrounding

b) its velocity is very large

c) its wavelength is very small

d) it is reflected by surrounding

47. A double-slit experiment is performed with light of wavelength 500 nm. A thin film of thickness 2 μm and refractive index 1.5 is introduced in the path of the upper beam. The location of the central maximum will: **[1]**

a) shift downward by ten fringes

b) shift upward by nearly two fringes

c) remain unshifted

d) shift downward by nearly two fringes

48. Two slits in Young's experiment have Widths in the ratio 1 : 25. The ratio of intensity at the maxima and minima in the interference pattern, $\frac{I_{max}}{I_{min}}$ is **[1]**

a) $\frac{49}{121}$

b) $\frac{121}{49}$

c) $\frac{4}{9}$

d) $\frac{9}{4}$

49. The two slits at a distance of 1 mm are illuminated by the light of wavelength 6.5×10^{-7} m. The interference fringes are observed on a screen placed at a distance of 1 m. The distance between the third dark fringe and the fifth bright fringe will be **[1]**

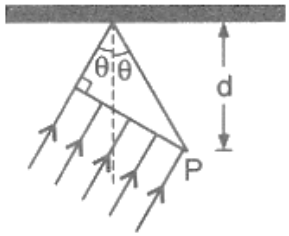
a) 3.25 cm

b) 4.8 mm

c) 1.63 mm

d) 0.65 cm

50. A plane wavefront of light is incident on a plane mirror as shown in the figure. Intensity is maximum at P, when: **[1]**



a) $\cos\theta = \frac{\lambda}{2d}$

b) $\cos\theta = \frac{3\lambda}{4d}$

c) sec θ - cos $\theta = \frac{3\lambda}{4d}$

d) sec θ - cos $\theta = \frac{\lambda}{2d}$

51. What speed should a galaxy move with respect to us so that the sodium line at 589.0 nm is observed at 589.6 nm? **[1]**

a) 336 km/s

b) 326 km/s

c) 356 km/s

d) 306 km/s

52. Which out of the following, cannot produce two coherent sources? **[1]**

a) Young's double slit

b) Lloyd's mirror

c) Fresnel briprism

d) Prism

53. A diffraction pattern is obtained by using a beam of red light. What will happen, if the red light is replaced by the blue light? **[1]**

a) no change will take place

b) bands disappear

c) diffraction bands become narrower and crowded together

d) bands become broader and farther apart

54. Angular width (θ) of central maximum of a diffraction pattern of a single slit does not depend upon **[1]**

a) wavelength of light used

b) distance between slit and screen

c) width of the slit

d) frequency of light used

55. Interference is possible in **[1]**

a) light waves only

b) sound waves only

c) neither light nor sound waves

d) both light and sound waves

56. Shape of the wave front of light diverging from a point source is **[1]**

a) conical

b) spherical

c) hyperboloid

d) plane

57. Four independent waves are expressed as **[1]**

i. $Y_1 = a_1 \sin \omega t$

ii. $Y_2 = a_2 \sin 2\omega t$

iii. $Y_3 = a_3 \cos \omega t$

iv. $Y_4 = a_4 \sin (\omega t + \frac{\pi}{3})$

a) (iii) and (iv)

b) not possible at all

c) (i) and (iii)

d) (i) and (iv)

58. A ray of monochromatic light propagating in air, is incident on the surface of water. Which of the following will **[1]**

be the same for the reflected and refracted rays?

a) Frequency
b) Energy carried
c) Wavelength
d) Speed

59. According to Huygens' principle, light is a form of **[1]**

a) wave
b) particle
c) rays
d) Beam

60. What happens to fringe width in the Young's double slit experiment, if it is performed in glycerine instead of air? **[1]**

a) The fringes shrink
b) The fringes disappear
c) The fringes remain unchanged
d) The fringes get enlarged

61. Two slits are made one millimetre apart and the screen is placed one metre away. What is the fringe separation when bluegreen light of wavelength 500 nm is used? **[1]**

a) 0.65 mm
b) 0.56 mm
c) 0.6 mm
d) 0.5 mm

62. Light travels through a glass plate of thickness t and having a refractive index μ. If c is the velocity of light in vacuum, the time taken by the light to travel this thickness of the glass is **[1]**

a) $\frac{\mu c}{t}$
b) tμc
c) $\frac{tc}{\mu}$
d) $\frac{\mu t}{c}$

63. In a double-slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. Monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double-slit within the central maxima of single-slit pattern? **[1]**

a) 0.1 mm
b) 0.5 mm
c) 0.02 mm
d) 0.2 mm

64. Ratio of intensities of two waves are given by 4 : 1. The ratio of the amplitude of the two waves is **[1]**

a) 1 : 4
b) 4 : 1
c) 1 : 2
d) 2 : 1

65. In Huygens' theory, light waves **[1]**

a) are transverse waves and require no medium to travel.
b) are longitudinal waves and require a medium to travel.
c) are transverse waves and require a medium to travel.
d) are longitudinal waves and require no medium to travel.

66. Which of the phenomenon is not common to sound and light waves? **[1]**

a) Diffraction
b) Polarisation
c) Interference
d) Coherence

67. A monochromatic beam of light is used for the formation of fringes on the screen by illuminating the two slits in Young's double-slit interference experiment. When a thin film of mica is interposed in the path of one of the interfering beams, then **[1]**

a) the fringe pattern disappears

b) the fringe width decreases

c) the fringe width increases

d) the fringe width remains the same but the pattern shifts

68. Two beams of light will not give rise to an interference pattern, if: **[1]**

a) they are coherent

b) they have the same wavelength

c) they are not monochromatic

d) they are linearly polarized perpendicular to each other

69. Intensity of light depends upon: **[1]**

a) frequency

b) wavelength

c) velocity

d) amplitude

70. In Young's double slit interference experiment, the slit separation is made 3 fold. The fringe width becomes: **[1]**

a) 9 times

b) 1/3 times

c) 1/9 times

d) 3 times

71. A laser beam is coherent because it contains **[1]**

a) waves of several wavelengths

b) incoherent waves of a single wavelength

c) coherent waves of several wavelengths

d) coherent waves of a single wavelength

72. Phase difference between any two points of a wavefront is **[1]**

a) π

b) 0

c) $\frac{\pi}{4}$

d) $\frac{\pi}{2}$

73. A light beam travels at $1.94 \times 10^{8} \mathrm{ms}^{-1}$ in quartz. The wavelength of the light in quartz is 355 nm. If this same light travels through air, what is its wavelength there? **[1]**

a) 549 nm

b) 620 nm

c) 579 nm

d) 600 nm

74. In a Fraunhofer diffraction at a single slit of width d with incident light of wavelength 5500 $\mathring{A}$, the first minimum is observed at angle 30^{o}. The secondary maximum is observed at an angle θ = **[1]**

a) $\sin^{-1} \frac{1}{\sqrt{2}}$

b) $\sin^{-1} \frac{3}{4}$

c) $\sin^{-1} \frac{\sqrt{3}}{2}$

d) $\sin^{-1} \frac{1}{4}$

75. The wavefront of a distant source of unknown shape is approximately: **[1]**

a) plane

b) elliptical

c) cylindrical

d) spherical