Theories of Light and Interference

Questions for practice

1. Wavefront originating from a point source is
   1) cylindrical 2) spherical 3) plane 4) cubical
2. Huygen's wave theory of light could not explain
   1) diffraction 2) interference 3) polarization 4) photoelectric effect
3. The fact that light is transverse wave derives its evidence by the support from the observation that
   1) light travels as waves 2) light shows polarizing effects
   3) light can be diffracted 4) light waves undergo reflection
4. Velocity of light according to this theory, is greater in denser medium than in rarer medium:
   1) Corpuscular theory 2) Wave theory
   3) Electromagnetic theory 4) Quantum theory
5. The velocity of light in vacuum is
   1) $\frac{1}{\sqrt{\mu_o \varepsilon_o}}$ 2) $\sqrt{\frac{\mu_o}{\varepsilon_o}}$ 3) $\sqrt{\mu_o \varepsilon_o}$ 4) $\sqrt{\frac{\varepsilon_o}{\mu_o}}$
6. According to the modern theory for nature of light, the light has
   1) Wave nature only 2) Particle nature only
   3) Both wave and particle (dual nature 4) Neither particle nature nor wave nature
7. Which one among the following shows particle nature of light
   1) Photo electric effect 2) Interference 3) Refraction 4) Polarization
8. In Young's double slit experiment, the distance between two slits is made three times then the fringe width will become---
   1) 9 times 2) $\frac{1}{9}$ times 3) 3 times 4) $\frac{1}{3}$ times
9. The intensity ratio of two waves is 9 : 1 these waves produce the event of interference. The ratio of maximum to minimum intensity will be
   1) 1 : 9 2) 9 : 1 3) 1 : 4 4) 4 : 1
10. The refractive index of air is 1.0003. The thickness of air column which can accommodate one wave of wave length 6000 Å more than in vacuum will be
    1) 2 m 2) 2 cm 3) 2 mm 4) 0.2 m
11. In Young's double silt experiment, if one of the slits is closed then what change in the pattern is observed?
    1) Interference pattern will be obtained instead of diffraction pattern.
    2) Diffraction pattern will be obtained instead of interference pattern.
    3) Uniform illumination will be obtained.
    4) Alternate bright and dark interference rings will be obtained.
12. In Young's double slit experiment the amplitudes of two sources are 3a and a respectively. The ratio of intensities of bright and dark fringes will be
    1) 3 : 1 2) 2 : 1 3) 4 : 1 4) 9 : 1
13. The two coherent light sources will produce constructive interference if they differ in phase by
    1) 2 π 2) $\pi/2$ 3) $3\pi/2$ 4) $5\pi/2$
14. The ratio of maximum and minimum intensities obtained in the interference of waves emitted by two coherent sources is 121 : 81. The ratio of amplitudes of two coherent sources will be
    1) 1 : 10 2) 10 : 1 3) 81 : 121 4) 121 : 81

15. The two coherent sources of intensity ratio 2 : 8 produce an interference pattern. The values of maximum and minimum intensities will be respectively

1) I_1 and 9 I_1 2) 9I_1 and I_1 3) 2 I_1 and 8 I_1 4) 8 I_1 and 2 I_1

16. The equations of two light waves are $y_1 = 6\cos\omega t$, $y_2 = 8\cos(\omega t + \phi)$ the ratio of maximum to minimum intensities produced by the superposition of these wave will be

1) 49 : 1 2) 1 : 49 3) 1 : 7 4) 7 : 1

17. In Young's double slit experiment 10th order maximum is obtained at the point of observation in the interference pattern for λ =7000 Å. If the source is replaced by another one of wavelength 5000 Å then the order of maximum at the same point will be.

1) 12th 2) 14th 3) 16th 4) 18th

18. When a mica sheet (μ =1.6) of thickness 7 microns is placed in the path of one of interfering beams in the biprism experiment then the central fringe gets shifted at the position of seventh bright fringe. The wavelength of light used will be.

1) 4000 Å 2) 5000 Å 3) 6000 Å 4) 7000 Å

19. In a double slit experiment the intensity of each wave producing interference is I_o. Then the resultant intensity I will be.

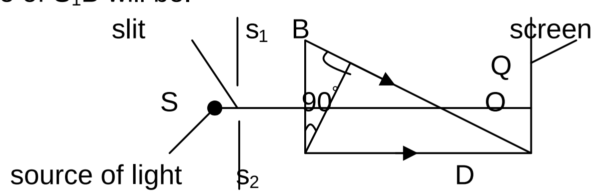
1) $4I_o\cos^2\frac{\phi}{2}$ 2) $4I_o\sin^2\frac{\phi}{2}$ 3) $4I_o\tan^2\frac{\phi}{2}$ 4) $2I_o\cos^2\frac{\phi}{2}$

20. The equations of two interfering waves are $y_1 = a\sin\omega t,\ and\ y_2 = a\sin(\omega t + \theta)$ respectively. Constructive interence will take place at the point of observation if the value of θ is

1) π 2) 3π 3) 2π 4) 5π

21. As shown in the figure Q, above point O is the position of the first bright fringe. On the other side of O, D is the position of 11th bright fringe with respect to Q. If the wavelength of light used is 6000 Å then the value of S_1B will be.

1) 6 x 10^{-4} m
2) 6 x 10^{-2} m
3) 6 x 10^{-3} m
4) 6 x 10^{-6} m



22. When a plastic thin film of refractive index 1.45 is placed in the path of one of the interfering waves then the central fringe is displaced through width of five fringes. The thickness of the film will be, if the wavelength of light is 5890Å.

1) 6.544 x 10^{-4} cm 2) 6.544 x 10^{-4} cm 3) 6.54 x 10^{-4} cm 4) 6.5 x 10^{-4} cm

23. The intensity variation in the interference pattern obtained with the help of two coherent sources is 5% of the average intensity. The ratio of intensities of two sources will be.

1) 1 : 1600 2) 1680 : 1 3) 1 : 400 4) 400 : 1

24. If the distance between two slits is halved then, the fringe width, as compared to its initial value, becomes

1) half 2) double 3) one fourth 4) four times

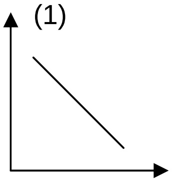
25. Interference event is observed in

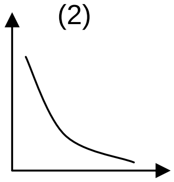
1) only transverse waves 2) only longitudinal waves
3) both types of waves 4) not observed in both type of waves

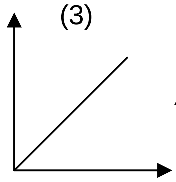
26. In Young's double slit experiment if the maximum intensity of light is I_{max} then the intensity at path difference $\frac{\lambda}{2}$ will be---

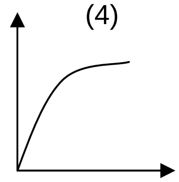
1) I_{max} 2) $\frac{I_{max}}{2}$ 3) $\frac{I_{max}}{4}$ 4) zero

27. The correct curve between fringe width β and distance between the slits (d) is

(1)
β

d

(2)
β

d

(3)
β

d

(4)
β

d

28. If in Young's double sit experiment, the distance between the slits is halved and the distance between slit and screen is doubled, then the fringe width will become

1) half 2) double 3) four times 4) unchanged

29. The fringe width for red colour as compared to that for violet colour is approximately

1) Three times 2) double 3) four times 4) eight times.

30. The oil layer on the surface of water appears coloured. This is due to

1) interference due to division of amplitude 2) dispersion

3) interference due to division of wavefront 4) diffraction

31. What will be the distance between two slits which when illuminated by light of wavelength 5000Å produce fringes of width 0.5 mm on a screen distant 1 m from the slits?

1) 10^{-2} m 2) 10^{-3} m 3) 10^{-4} m 4) 10^{-6} m

32. The equations of waves emitted by s_1, s_2, s_3 and s_4 are respectively $y_1 = 20\sin(100\pi t)$, $y_2 = 20\sin(200\pi t)$, $y_3 = 20\cos(100\pi t)$ and $y_4 = 20\cos(100\pi t)$. The phenomenon of interference will be produced by—

1) y_1 and y_2 2) y_2 and y_3 3) y_1 and y_3 4) Interference is not possible

33. The Young's double slit experiment is performed in succession using blue light of wavelength 4360 Å and green light of wavelength 5460 Å. If the distance of fourth maximum from central maximum is x, then

1) $X_{blue} > X_{green}$ 2) $X_{blue} < X_{green}$ 3) $X_{blue} = X_{green}$ 4) $\frac{X_{blue}}{X_{green}} = \frac{5460}{4360}$

34. In Young's double slit experiment the slits are illuminated by white light. The distance between two slits is b and screen is d distance apart from the slits. Some wavelengths are missing on the screen in front of one of the slits. These wavelengths are---

1) $\lambda = \frac{b^2}{d}, \frac{b^2}{3d}.....$ 2) $\lambda = \frac{2b^2}{d}$ 3) $\lambda = \frac{2b^2}{2d}$ 4) $\lambda = \frac{b^2}{d}, \frac{b^2}{2d}.$

35. Two independent monochromatic sodium lamps can not produce interference because

1) The frequencies of two sources are different
2) The phase difference between two sources changes with respect to time
3) The two sources become coherent
4) The amplitudes of two sources are different.

36. In Young's slit experiment one slit is covered with red filter and another slit is covered by green filter, then the interference pattern will be

1) red 2) green 3) yellow 4) invisible

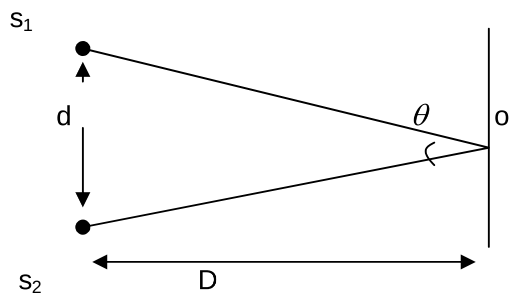
37. In double slit experiment the distance between two slits is 0.6 mm and these are illuminated with light of wavelength 4800Å. The angular width of dark fringe on the screen distant 1.20 m from slits will be

1) 8×10^{-4} Radian
2) 6×10^{-4} Radian
3) 4×10^{-4} Radian
4) 16×10^{-4} Radian

38. In Young's experiment the distance between two slits is $\frac{d}{3}$ and the distance between the screen and the slits is 3D. The number of fringes in $\frac{1}{3}$ m on the screen, formed by monochromatic light of wave length 3 λ, will be---

1) $\frac{d}{9D\lambda}$
2) $\frac{d}{27D\lambda}$
3) $\frac{d}{81D\lambda}$
4) $\frac{d}{D\lambda}$

39. The experimental arrangement of Young's double slit experiment is shown in the following figure. If λ is the wavelength of light used, the fringe width will be—



1) $\lambda\theta$
2) $\frac{2\lambda}{\theta}$
3) $\frac{\lambda}{2\theta}$
4) $\frac{\lambda}{\theta}$

40. On using white light in Young's double slit experiment, the fringes will be

1) Bright and dark
2) Central bright and rest of the fringes coloured
3) Only coloured fringes
4) Few coloured and few white fringes

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QUESTIONS ON DIFFRACTION AND POLARISATION

1) The diffraction effect can be observed in
   a) only sound waves b) only light waves
   c) only radio waves d) all type of waves
2) The explanation for the diffraction of light using Huygens' wave theory was first given by
   a) Grimaldi b) Fraunhoffer c) Fresnel d) Young
3) Which of the following waves undergo maximum diffraction ?
   a) X-rays b) γ - rays c) Light waves d) Radio waves
4) Identify the wrong statement.
   a) In Fraunhoffer diffraction source and screen are effectively placed at infinity wrt obstacle using lenses
   b) In Fresnel diffraction the central band of the diffraction pattern may be bright or dark.
   c) Analysis of Fresnel diffraction is easy
   d) In Fraunhoffer diffraction the central band of the diffraction pattern is always bright
5) The fringes obtained in Fraunhoffer diffraction at a single slit are of
   a) equal width and equal intensity
   b) equal width and unequal intensity
   c) unequal width and unequal intensity
   d) unequal width and equal intensity
6) In case of diffraction at single slit if the wavelength of light becomes equal to the slit width, then on the screen we shall observe
   a) image of the slit b) diffraction bands
   c) uniform illumination d) non uniform illumination
7) Light of wavelength 5000Å is incident on a slit of width 0.1 mm. The width of the central bright band on the screen distant 2 m from the slit will be
   a) 18mm b) 36mm c) 20mm d) 6mm
8) In Fraunhoffer diffraction at a single slit, the width of the central band is β . If the wave length of light is increased by 20%, distance of the screen from the slit is decreased by 10% and the slit width is decreased by 40% the new width of the central band will be
   a) 1.8 β b) 2.7 β c) 0.5 β d) 2 β
9) In Fraunhoffer diffraction at a single, the width of the central band is β. If the whole apparatus is immersed in water of RI 4/3, what is the percentage of change in the width of central band?
   a) 75% b) 25% c) 30% d) 40%
10) The angular width of the central band in Fraunhoffer diffraction at a single slit is independent of
   a) wavelenght of light b) width of the slit
   c) distance of the slit from the source d) frequency of light
11) The width of a slit is 0.012mm. The angular position of first secondary maximum is 5.2^0. The wavelength of light used in Å is [given $\sin 5.2^0 = 0.0906$]
   a) 6040 b) 4026 C) 5890 d) 7248
12) Light of wavelength 6000 Å is incident normally on a slit of width 24 $X10^{-5}$ cm. The angular position of second minimum will be
   a) 0^0 b) 15^0 c) 30^0 d) 60^0

13) In Fraunhoffer diffraction at a single slit, third secondary minimum is formed at a distance 5 mm from the centre of the pattern on a screen which is at a distance 1 m from the screen. If the slit width is 0.3 mm, the wavelength of light used is

a) 5000×10^{-10}m b) 2500×10^{-10}m c) 7500×10^{-10}m d) 8500×10^{-10}m

14) The path difference between the rays coming from the edges of a slit in Fraunhoffer diffraction at the position of 3rd secondary minimum is 18×10^{-7} m. The wavelength of light used is

a) 5×10^{-7}m b) 9×10^{-7}m c) 2×10^{-7}m d) 6×10^{-7}m

15) If (a+b) is the grating constant and λ is the wavelenght of light used, then the equation corresponding to 2nd order maxima is

a) $(a + b) \sin \theta = \frac{5\lambda}{2}$ b) $(a + b) \sin \theta = 2\lambda$ c) $(a + b) \sin \theta = \frac{3\lambda}{2}$ d) $(a + b) \sin \theta = 3\lambda$

16) Identify the wrong statement

a) In case of lens, the image of a point object is not a point image due to diffraction
b) Resolving power of a device is the reciprocal of limit of resolution
c) In case of two closely living objects, they can be seen as just separate using an optical instrument if the central maxima of the diffraction pattern of one overlaps with the first minima of the other
d) Resolving power of a microscope can be increased by increasing the wavelength of light used.

17) If limit of resolution of a microscope is 3×10^{-7} m and wavelength of light used is 4243Å, the semivertical angle is

a) 45^0 b) 30^0 c) 90^0 d) 60^0

18) If R_1, R_2 and R_3 are the resolving powers of oil immersion microscope, ultraviolet microscope and electron microscope respectively, then the relation between them is

a) $R_1 > R_2 > R_3$ b) $R_1 < R_3 < R_2$ c) $R_1 > R_3 > R_2$ d) $R_1 < R_2 < R_3$

19) Identify the wrong statement

a) The limit of resolution of a telescope is the angle subtended at its objective by two distant objects when their image are just seen as separate
b) Resolving power of a telescope can be increased by decreasing the diameter of the objective
c) Increasing the size of the aperture of a telescope increases the brightness of the images
d) Two distant objects separated by a distance 'x' will be just resolved if the distance between the telescope and the objects is equal to $d = \frac{XD}{1.22\lambda}$ where D is the diameter of the aperture.

20) In a telescope with aperture of diameter 60cm, the limit of resolution for a light of wavelength 6000 Å is

a) 1.22×10^{-5}rad b) 1.22×10^{-6} rad c) 1.22×10^{-4} rad d) 1.22×10^{-7}rad

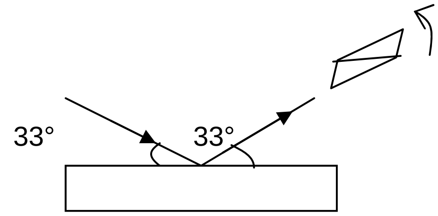
21) The phenomenon of polarisation of electromagnetic waves proves that the electromagnetic waves are

a) longitudinal b) transverse c) mechanical d) neither longitudinal nor transverse

22) The angle between the plane of polarisation and plane of vibration is

a) 90^0 b) 0^0 c) 45^0 d) 180^0

23) A beam of light is incident on the surface of a medium having polarising angle of 57^0 as shown in the figure. If the reflected light is observed through a rotating Nicol prism then



a) there is no change in intensity

b) intensity will be zero for all positions

c) intensity will be maximum for a particular position and becomes zero on rotating further through 90^0

d) intensity reduces somewhat and increases again

24) Ordinary light incidenting on a medium at the polarising angle suffers a deviation of 20^0. The value of angle of refraction inside that medium is

a) 55^0 b) 70^0 c) 35^0 d) 50^0

25) If the speed of light and the polarising angle for a given medium are C_m and i respectively, then from Brewster's law we find

a) C_m = cosec i b) C_m = tan i c) C_m = cos i d) C_m = C cos i

26) λ_a and λ_m are the wavelengths of a beem of light in air and medium respecticely. If θ is the polarising angle, the correct relation is

a) $\lambda_a = \lambda_m \tan^2\theta$ b) $\lambda_m = \lambda_a \tan^2\theta$ c) $\lambda_a = \lambda_m \cot\theta$ d) $\lambda_m = \lambda_a \cot\theta$

27) In double refraction, the angle between the plane of polarisation of E - ray and O - ray is

a) 0^0 b) 30^0 c) 90^0 d) 50^0

28) A calcite crystal is placed over a dot on a paper and rotated. On observing through calcite crystal, one will see

a) two stationary dots b) two rotating dots

c) a single dot d) one dot rotating about a stationary dot

29) If for a calcite crystal , n_o and n_e are the RI's for O - ray and E-ray respectively, then in a direction other than optic axis

a) $n_o = n_e$ b) $n_o > n_e$ c) $n_o < n_e$ d) $n_o \leq n_e$

30) The wavefront corresponding to O-ray and E-ray are .... and .... respectively

a) spherical, spherical b) spherical, spheroid

c) spheroid, spherical c) spheroid, spheroid

31) Nicol prism used to produce plane polarised light uses

a) double refraction only b) total internal reflection only

c) both double refraction and total internal reflection d) optical activity

32) Polaroids

a) increase the intensity of light

b) convert polarised light into unpolarised light

c) produce plane polarised light by refraction

d) produce plane polarised light by dicrosim

33) Identify the wrong statement

a) Optically active substance rotates the plane of vibration a plane polarised light passing through it

b) Arago discovered optical activity

c) Laevo rotatory substance turns the plane of vibration in clockwise direction

d) Polarimeter is used to measure specific rotation of solutions

34) Specific rotation of a solid is 380 rad/m. If the rotation produced in plane of vibration is 1.520 rad, then the thickness of the solid is

a) 4×10^{-2} m   b) 4×10^{-3} m   c) 0.4 m   d) 0.57 m

35) A solution rotates the plane of polarisation by 18^0. If the length of the solution is 0.2 m and concentration is 50 kg m^{-3}, then the specific rotation of the solution in rad $m^2 kg^{-1}$ is

a) 0.314   b) 3.14   c) 0.0314   d) 0.00314

36) A solution obtained by adding 50g of a substance in 70ml of water produces a rotation of 9^0 in the plane of polarisation. If same mass of substance added to 180 ml water produces a rotation of (all other factors remaining constant)

a) 4^0 b) 3.5^0 c) 1.4^0 d) 5^0

37) The thickness of the quartz plate required to produce half the rotation produced by a solution of length 0.19m and concentration 200kg m^{-3} is (given S_{quartz} = 380 rad m^{-1} and $S_{solution}$ = 0.01 rad m^2Kg^{-1})

a) 1mm   b) 0.7 mm   c) 0.9 mm   d) 0.5 mm

38) Light beam is observed with a rotating nicol prism. If intensity changes from maximum to minimum but not zero, then it may be

a) plane polarised   b) circularly polarised

c) elliptically polarised   d) unpolarised

39) If θ_C is the critical angle and θ_P is the polarsing angle for a medium, then

a) $\theta_C = \cos^{-1} (\sin \theta_P)$ b) $\theta_P = \cos^{-1} (\sin \theta_C)$

c) $\theta_C = \sin^{-1} (\cos \theta_p)$ d) $\theta_P = \sin^{-1} (\cos \theta_C)$

40) A polarised light cannot be produced by

a) reflection   b) scattering   c) double refraction   d) dispersion

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