QB365 Question Bank Software Study Materials

Wave Optics Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

Physics

Total Marks : 40

2 Marks

20 x 2 = 40

1) Write a short note on quantum theory of light.

Answer : **Quantum theory of light:**

Quantum theory states that light waves consist of small packets of energy called photons. The energy associated with each photon is E = hv, Where 'h' is Planck's constant (h = 6.625 x 10^{-34} J s) and v is frequency of electromagnetic radiation.

2) Mention the types of optically active crystals with example.

Answer : i) Uniaxial crystals (only one optic axes)

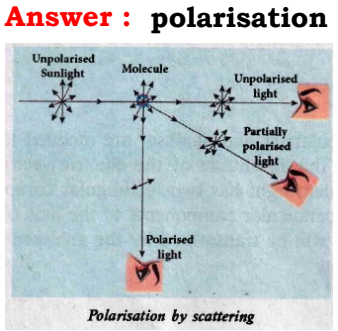
eg: calcite qrartz, ice, tourmaline

ii) Biaxial crystals. (two optic axes)

eg: Mica, topaz, selenite

3) How is polarisation of light obtained by scattering of light?

Answer : **polarisation of light obtained by scattering of light :**



Polarisation by scattering

When sun light gets scattered by the atmospheric molecules, the electrons of these molecules are influenced by the vibrating components of the electric field present in the sun light. As the sunlight is unpolarised, it produces these vibrations in all directions. These vibrating electrons radiate energy only in the direction perpendicular to their vibrations. When an observer views a beam of sunlight perpendicular to its direction of travel, the radiations produced by the electrons vibrating in the direction perpendicular to the direction of view will only reach the observer. Hence, the light reaching the observer is plane polarised.

4) Why is oil immersed objective preferred in a microscope?

Answer : Resolving Power of microscope

$d_{min} = \frac{1.22\lambda}{2n \sin \beta}$

To further reduce the value of d_{min}, the optical path of the light should be increased. So, in order to increase the optical path, the objective of the microscope immerses into a bath containing oil of refractive index 'n'.

5) What is the use of an erecting lens in a terrestrial telescope?

Answer : A terrestrial telescope has an additional erecting lens to make the final image erect.

6) What is presbyopia?

Answer : Farsightedness arising due to aging is called presbyopia as the aged people cannot strain their eye more to reduce the focal length of the eye lens.

7) Calculate the distance upto which ray optics is a good approximation for light of wavelength 500 nm falls on an aperture of width 0.5 mm.

Answer : a = 0.5 mm = 0.5 x 10^{-3} m = 5 × 10^{-4} m

ⲗ= 500 mm = 500 x 10^{-9} m; z = ?

Equation for Fresnel's distance, $z = \frac{a^2}{2\lambda}$

Substituting,

$$z = \frac{\left(5 \times 10^{-3}\right)}{2 \times 500 \times 10^{-9}} = \frac{25 \times 10^{-8}}{1 \times 10^{-6}} = 0.25nm$$

z = 0.25 m = 25 cm

8) Two polaroids are kept crossed (transmission axes at 90°) to each other.

(a) What will be the intensity of the light coming out from the second polaroid when an unpolarised light of intensity I falls on the first polaroid?

(b) What will be the intensity of light coming out from the second polaroid if a third polaroid is kept in between at 45° inclination to both of them.

Answer : (a) As the intensity of the unpolarised light falling on the first polaroid is I, the intensity of polarized light emerging from it will be $I_o = \left(\frac{1}{2}\right)$. Let I' be the intensity of light emerging from the second polaroid.

Malus' law, $I' = I_o \cos^2\theta$

Here θ is 90° as the transmission axes are perpendicular to each other.

Substituting,

$$I' = \left(\frac{1}{2}\right) cos^2\left(90^o\right) = 0 \left[\because cos\left(90^o\right) = 0\right]$$

No light comes out from the second polaroid

(b) Let the first polaroid be P_1 and the second polaroid be P_2. They are oriented at 90°. The third polaroid P_3 is introduced between them at 45°. Let 'I be the intensity of light emerging from P_3.

Angle between P_1 and P_3 is 45°. The intensity of light coming out from P_3 is, $I' = I_o \cos^2\theta$

Substituting,

$$I' = \left(\frac{1}{2}\right) cos^2\left(45^o\right) = \left(\frac{1}{2}\right)\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{4'}; I'\frac{I}{4}$$

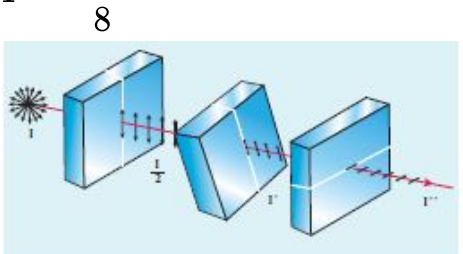
Finally, the light has to pass through P_2. Angle between P_3 and P_2 is 45°. Let I″ is the intensity of light coming out from P_2 $I'' = I'os^2\ \theta$

Here, I' is the intensity of polarized light existing between P_3 and P_2. $I' = \frac{1}{4}$

Substituting,

$$I^n = \left(\frac{1}{4}\right) cos^2\left(45^o\right) = \left(\frac{1}{4}\right)\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{8}$$

$$I^n = \frac{1}{8}$$



9) Calculate the power of the lens of the spectacles needed to rectify the defect of nearsightedness for a person who could see clearly up to a distance of 1.8 m.

Answer : The maximum distance the person could see is, x = 1.8 m.

The lens should have a focal length of,

f = –x m = –1.8 m.

It is a concave (or) diverging lens.

The power of the lens is,

$$P = -\frac{1}{1.8m} = -0.56D$$

10) The ratio of maximum and minimum intensities in an interference pattern is 36 : 1. What is the ratio of the amplitudes of the two interfering waves?

Answer : $\frac{I_{max}}{I_{min}} = \frac{36}{1}$

If a_1 and a_2 are their amplitudes,

$\frac{I_{max}}{I_{min}} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2} = \frac{36}{1}$ (or) $\frac{a_1+a_2}{a_1-a_2} = \frac{6}{1}$

$6a_1 - 6a_2 = a_1 + a_2$

$5a_1 - 7a_2 = 5a_1 = 7a_2$

$\frac{a_1}{a_2} = \frac{7}{5}$

$a_1 : a_2 = 7 : 5$

11) What is call 'grating element'?

Answer : (i) In Grating, the combined width of a ruling and a slit is called 'grating element' (1.e.) e = a + b.

12) What is known as destructive interference?

Answer : (i)If the crest of one wave meets the trough of the other wave and vice versa, the waves are out-of-phase.

(ii) At these points, the displacement is minimum and these points appear dark. This is known as destructive interference.

13) Define bandwidth.

Answer : The bandwidth (β) is defined as the distance between any two consecutive bright or dark fringes.

14) Write the uses of nicol prism.

Answer : (i) It produces plane polarised light and functions as a polariser.

(ii) It can also be used to analyse the plane polarised light i.e used at an analyser.

15) Why is the interference pattern not detected when two coherent sources are far apart?

Answer : (i) Fringe width of interference fringes, is given by $\beta = \frac{D\lambda}{d} \propto \frac{1}{d}$. If the sources are far apart, d is large; so fringe width (β) will be so small that the fringes are not resolved and they do not appear separate.

(ii) That is why the interference pattern is not detected for large separation of coherent sources.

16) Does the magnifying power of a microscope depend on the colour of the light used? Justify your answer.

Answer : Yes, since magnification depends upon the focal length and focal length depends on the color and different colours have different wavelengths (i.e., different refractive indices.)

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(By Lens Makers Formula) Also, magnification of the compound microscope

$$M = \frac{-L}{f_o}\left(1 + \frac{D}{f_e}\right)$$

17) If the angle between the pass axes of a polariser and analyser is 45°. Write the ratio of the intensities of original light and the transmitted light after passing through the analyser.

Answer : If I_0 is the intensity of original light, then the intensity of light passing through the polariser = $\frac{I_o}{2}$.

$$I = \frac{I_o}{2}cos^2 45^o \Rightarrow \frac{I_o}{I} = \frac{2}{cos^2 45^o} = \frac{4}{1}$$

18) Which of the following waves can be polarized

(i) Heat waves

(ii) Sound waves? Give reason to support your answer.

Answer : Heat waves are transverse or electromagnetic in nature whereas sound wave are not. Polarisation is possible only for transverse waves.

19) A convex lens is held in water. What would be the change in the focal length?

Answer : There will be an increases in the focal length of the convex lens. This is because the refractive index of glass with respect to water is less than the refractive index of glass with respect to air.

20) What are the two rays in double refraction? and mention the differences between two?

Answer : The two rays are ordinary ray and extraordinary ray.

S.No	Ordinary ray	Extraordinary ray
i	Ordinary ray is stationary.	Extraordinary ray is rotating.
ii	It obeys the laws of refraction.	It does not obey the laws of refraction
iii	It travels with same velocity in all directions.	It travels with different velocities in different directions.