

# SHORT QUESTIONS

**9.1 Under what conditions two or more sources of light behave as coherent sources?**

**Ans.** Two or more sources of light behaves as coherent sources if they have no phase difference or have a constant phase difference between the waves emitted by them.

A common method for producing two coherent light sources is to use single source to illuminate a screen containing two narrow slits. Hence two or more sources derived from a single source of light behaves as coherent source because they are in the same phase.

**9.2 How is the distance between interference fringes affected by the separation between the slits of Young's experiment? Can fringes disappear?**

**Ans.** The fringe spacing or distance between two consecutive bright or dark fringes in young's experiment is given by

$$\Delta y = \frac{\lambda L}{d}$$

where  $\lambda$  is the wavelength of light used,  $L$  is the distance of screen and source and  $d$  is the separation of slits. This relation shows that the fringe spacing is inversely proportional to the separation of slits. It means that greater the separation between the slits, the smaller will be fringe spacing. If by increasing the separation, the fringe spacing decreases and the bright fringes becomes so close that uniform intensity of light is seen and fringes disappear.

**9.3 Can visible light produce interference fringes? Explain.**

**Ans.** Yes, the white light or visible light can produce the interference fringes. Since the white light is the mixture of seven colours so each colour will produce interference fringes corresponding to its own wavelength. Hence the fringe pattern will be coloured but the fringes will be so closed that it would be difficult to observe the interference fringes of visible or white light.

**9.4 In the Young's experiment, one of the slits is covered with blue filter and other with red filter. What would be the pattern of light intensity on the screen?**

**Ans.** Since red and blue light have different wavelengths and will not be in phase coherence. Therefore there will be no dark and bright bands on the screen. So the interference of light cannot be observed properly. For better interference pattern, the monochromatic light should be used.

**9.5 Explain whether the Young's experiment is an experiment for studying interference or diffraction effects of light.**

**Ans.** Young's double slit experiment is basically used to study the interference of light. However spreading of light around the corners of the slits also produce diffraction of light. However interference on the screen takes place only when the light coming out of the narrow slits suffers from diffraction first.

**9.6 An oil film spreading over a wet footpath shows colours. Explain how does it happen?**

**Ans.** The colours are seen on the oil film spreading on the wet foot path due to interference of light waves. When a light beam is incident, a part of it is reflected from the upper surface of the then oil film and a part of it is reflected from the lower surface of the thin film. The two reflected beams are coherent. When oil film is very thin, these coherent beams overlap. Hence constructive and destructive interference exhibit colours.

**9.7 Could you obtain Newton's rings with transmitted light? If yes, would the pattern be different from that obtained with reflected light?**

**Ans.** Yes, Newton rings can be obtained with transmitted light. However no phase is changed in transmitted light, so bright fringes can be replaced by dark fringes and so on. In case of transmitted light, the central point is bright.

**9.8 In the white light spectrum obtained with a diffraction grating, the third order image of a wavelength coincides with the fourth order image of a second wavelength. Calculate the ratio of the two wavelengths.**

**Ans.** For diffraction grating, the equation is

$$d \sin \theta = n\lambda$$

where  $d \sin \theta$  is the phase difference, and  $n$  is the number of order and  $\lambda$  is the wavelength of light used.

For first wavelength  $\lambda_1$  and 3<sup>rd</sup> order,  $n = 3$

$$d \sin \theta = 3\lambda_1 \quad \dots\dots (i)$$

and for second wavelength  $\lambda_2$  and fourth order,  $n = 4$

$$d \sin \theta = 4\lambda_2 \quad \dots\dots (ii)$$

Equating the eq. (i) and (ii)

$$3\lambda_1 = 4\lambda_2$$

$$\frac{\lambda_1}{\lambda_2} = \frac{4}{3}$$

$$\lambda_1 : \lambda_2 = 4 : 3$$

**9.9 How would you manage to get more orders of spectra using a diffraction grating?**

**Ans.** For diffraction grating, the equation is given by

$$d \sin \theta = n\lambda$$

where  $d$  is the grating element,  $\lambda$  is the wavelength. In order to get more orders of spectra from  $\theta = 0^\circ$  to  $\theta = 90^\circ$  for a given wavelength, the grating element  $d$  must be increased i.e. Less number of lines per unit length be ruled on diffraction grating.

**9.10 Why the polaroid sunglasses are better than ordinary sunglasses?**

**Ans.** The sunlight reflected from smooth surfaces such as water, wet roads, lakes and glass is horizontally polarized and produces glare. This glare can be reduced by using polaroid sunglasses because they can decrease the intensity of light passing through them. Hence the polaroid sunglasses are better than ordinary sunglasses. Since polaroid sunglasses reduce the glare of light entering into the eye.

**9.11 How would you distinguish between un-polarized and plane-polarized lights?**

**Ans.** Un-polarized and plane polarized light can be distinguished from each other by using polarizer. When light is viewed through polarizer and it can be seen continuously even if the polarizer is rotated, the light seen is unpolarized. However if on rotating the polarizer, the light becomes dim and cuts off by rotating the polarizer through  $90^\circ$ , then the light observed is plane polarized light.

**9.12 Fill in the Blanks:**

- (i) According to \_\_\_\_\_ principle, each point on a wavefront acts as a source of secondary \_\_\_\_\_.
- (ii) In Young's experiment, the distance between two adjacent bright fringes for violet light is \_\_\_\_\_ than that for green light.
- (iii) The distance between bright fringes in the interference pattern \_\_\_\_\_ as the wavelength of light used increase.
- (iv) A diffraction grating is used to make a diffraction pattern for yellow light and then for red light. The distances between the red spots will be \_\_\_\_\_ than that for yellow light.
- (v) The phenomenon of polarization of light reveals that light waves are \_\_\_\_\_ waves.
- (vi) A polaroid is a commercial \_\_\_\_\_.
- (vii) A polaroid glass \_\_\_\_\_ glare of light produced at a road surface.

**Ans.** (i) Huygen's, wavelets      (ii) less      (iii) increases      (iv) more  
(v) transverse      (vi) polarizer      (vii) eliminates (reduces)