

11. WAVE OPTICS

1. Polarization experiments provide evidence that light is _____.
2. (a) How does the electric field vary in linearly polarized light and un-polarized light.
(b) Give a source for each of the above.
3. An un-polarized beam of light has intensity I_0 . It is incident on two ideal polarizing sheets. The angle between the axes of polarization of the sheets is θ . Find θ if the emerging light has intensity $I_0/4$.
4. Derive the relation between refractive index of a medium and Brewster angle.
5. What is meant by axis of a polarizing sheet?
6. What is a Polaroid? When light from a bulb is incident on a Polaroid, why is its intensity cut down to half?
7. Briefly describe an experiment to show that some substances are able to change the plane of polarization.
8. Light can be polarized by and _____.
9. (a) Show that the intensity of transmitted light can vary from zero to maximum as the angle between the polarizing directions of the polarizer and analyser vary from 0 to 90° .
(b) Show that the intensity is always half for the orientations of a single Polaroid when un-polarized light is incident on it.
10. (a) What is meant by Doppler Effect in light?
(b) The 6563 \AA H_α line emitted by hydrogen in a star is found to be red-shifted by 15 \AA . Estimate the speed with which the star is receding from the Earth.
11. State some uses of Polarized light.

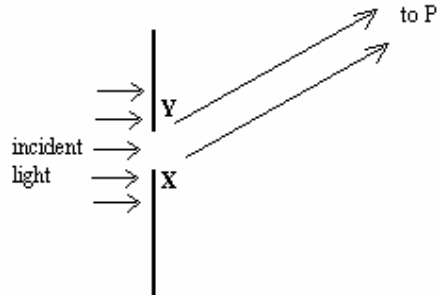
Interference

1. Define a wave front.
2. Interference of light is evidence that light is _____.
3. The reason that there are two slits, rather than one, in a Young's experiment is _____.
4. In Young's double-slit experiment the centre of a bright fringe occurs whenever waves from the slit differ in the distance they travel by a multiple of _____.
5. Waves from slits are in phase and travel to distant screen to produce the second minimum of the interference pattern. The difference in the distance travelled by the waves is _____.
6. A monochromatic light source illuminates a double slit and the resulting interference pattern is observed on a distant screen. If d is centre to centre spacing, a is individual slit width, D is screen to slit distance, l is adjacent dark line spacing in the interference pattern. The wavelength of light is _____.

7. In a Young's double-slit experiment, light of λ $500\mu\text{m}$ illuminates two slits that are separated by 1mm . Find the separation between adjacent bright fringes on a screen 5m from the slits.
8. In Young's double slit experiment, if slit separation is doubled which of the following factors will change?
- An increase in fringe intensity
 - A decrease in fringe intensity
 - A halving of the wave length
 - A halving of the fringe spacing
 - Doubling of fringe spacing
9. When are two light waves said to be coherent?
10. In a Young's double-slit experiment, the separation between slits is d and the screen is D from the slits. The number of bright fringes per unit length of the screen is _____.
11. In an experiment, to measure the wave length of light using a double slit, it is found that the fringes are too close together to count. To spread out the fringe pattern, one could _____. (Choose the right option).
- Halve the slit separation
 - Double the slit separation
 - Double the width of each slit
 - Halve the width of each slit
 - None of these
12. A light with electric field amplitude of $2E_0$ and a phase constant of zero is to be combined with one of the following waves. Which of these combinations produces least intensity?
- Wave A has an amplitude of E_0 and phase constant 0
 - Wave B has an amplitude of E_0 and phase constant of π
 - Wave C has an amplitude of $2 E_0$ and phase constant of zero
 - Wave D has an amplitude of $3 E_0$ and phase constant of π
13. In a Young's experiment, a thin sheet of mica is placed over one of the two slits. As a result, the centre of the fringe pattern (on the screen) shifts by an amount corresponding to 30 dark bands. The wavelength of the light in this experiment is $480\mu\text{m}$ and the index of the mica is 1.60. What is the mica thickness?
14. Why are coloured fringes seen in a thin film when white light is incident on it?

Diffraction

- What is diffraction?
- Why is diffraction more easily observed with sound waves rather than light waves?
- The diagram shows a single slit with the direction to a point P on a distant screen shown. At P, the pattern has its second minimum (from its central maximum). If X and Y are the edges of the slit, what is the path length difference (PX) - (PY)?



4. A diffraction pattern is produced on a viewing screen by illuminating a long narrow slit with light of wavelength λ . If λ is increased and no other changes are made how does the diffraction pattern change?
5. A diffraction pattern is produced on a viewing screen by illuminating long narrow slit with light of wavelength λ . If λ is increased and no other changes are made, how does the (i) fringe pattern (ii) intensity of the pattern get affected?
6. Consider a single-slit diffraction pattern caused by a slit of width a .
 - (i) There is a maximum at $\sin\theta$ equal to _____.
 - (ii) There is a minimum at $\sin\theta$ equal to _____.
7. In a single-slit diffraction pattern, the central maximum is about twice as wide as the other maximum. This is because _____.
8. Compare the pattern formed in Young's double slit experiment and a single-slit diffraction experiment.
9. Single slit pattern is obtained by using monochromatic light. Consider the following possible changes in conditions:
 - (i) Decrease the frequency
 - (ii) Increase the frequency
 - (iii) Increase the width of each slit
 - (iv) Increase the separation between the slits
 - (v) Decrease separation between slits

How would the pattern change in each case?

10. By dividing the slit into 2 parts and using the condition of destructive interference, explain the observation of a minima at $\theta = \lambda/a$.