

Chapter	8 Physical Optics and Gravitational Waves	Class	1 st Year	Subject	Physics
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Give Short Answers of the Following Questions

1. Write two uses of Michelson interferometer.

Ans. Uses:

Michelson's interferometer is used for the following purposes:

(1) it is used for the determination of wavelength of light.

(2) Michelson measured the length of the standard meter in terms of wavelength of red cadmium light and proved that Standard meter = 1553163.5 wavelength of light.

(3) If light of wavelength $\lambda = 400 \text{ nm}$ is used, then it can measure the thickness upto 10^{-4} mm (or 100 nm).

(4) It is used to observe the interference of light.

2. How would you distinguish between unpolarized and plane polarized light?

Ans. Plane Polarized Unpolarized And Light:

The beam of light in which all vibrations are confirmed to single plane of vibration is called polarized light.

Suppose light is incident on a polaroid. The polaroid is slowly rotated about an axis which is along the direction of incident ray.

If the transmitted light is plane polarized, it becomes dimmer and dimmer and disappears at certain orientation.

If the transmitted light is unpolarized, it becomes dim but not completely blocked at any orientation.

3. Write down some applications of plane polarized and circularly polarized light.

Ans. Plane Polarized Light:

Sunglasses: Plane polarized sunglasses reduce glare from reflective surfaces like water, snow, and car windshields.

LCD Screens: Liquid crystal displays (LCDs) use plane polarized light to control the orientation of liquid crystals, creating images on the screen.

Optical Fiber Communications: Plane polarized light is used to transmit data through optical fibers.

Circularly Polarized Light:

3D Movies: Circularly polarized light is used in 3D cinemas to separate the left and right eye images.

Laser Technology: Circularly polarized light is used in laser applications, such as material processing and spectroscopy.

Biomedical Applications: Circularly polarized light is used in biomedical applications, such as optical coherence tomography (OCT) and laser-induced breakdown spectroscopy (LIBS). Both plane and circularly polarized light are used in remote sensing applications, such as monitoring ocean currents and tracking changes in land use also both are used in optical communication systems to transmit data through free space or optical fibers.

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4. Would it be possible to use a polarizer as an analyzer? If yes, give at least two examples.

Ans. Yes, it is possible to use a polarizer as an analyzer.

A polarizer is an optical filter that allows only light with a specific polarization to pass through, while an analyzer is an optical filter that selects only light with a specific polarization to pass through.

Examples:

Polarized Light Microscopy: In polarized light microscopy, a polarizer is used to polarize the light before it passes through the sample. The same polarizer can be used as an analyzer to select only the polarized light that has passed through the sample, enhancing contrast and reducing glare.

Ellipsometry: In ellipsometry, a polarizer is used to polarize the light before it reflects off a sample. The same polarizer can be used as an analyzer to measure the change in polarization state of the reflected light, providing information about the sample's optical properties.

5. Explain how Malus's law is used in the design of polarized sunglasses. How do these surfaces reduce glare from reflective surface? Provide an example to illustrate your answer.

Ans. Malus's law is used in the design of polarized sunglasses to reduce glare from reflective surfaces by filtering out horizontally polarized light. This is achieved through the use of linear polarizers, which block horizontally polarized light and transmit vertically polarized light.

6. How will the sky appear if there had been no atmosphere?

Ans. The sky would appear black.

Reason:

As sky appears blue because the scattering of shorter wavelengths (like blue and violet) by atmospheric molecules is responsible for the blue color. But without an atmosphere, there would be no molecules to scatter sunlight, which means that sky will appear black.

7. What is the significance of detecting gravitational waves?

Ans. Gravitational waves offer a new way to observe the universe, electromagnetic observations (e.g., light, radio waves), comprehensive understanding of cosmic phenomena.

Insights into Extreme Cosmic Events:

Gravitational waves reveal information about catastrophic events, such as binary black hole mergers, neutron stars mergers and supernova explosions.

8. How are tidal forces formed?

Ans. Gravitational waves passing through a body with mass can cause the body to experience periodic stretching and compressing, also known as "spacetime distortion". This effect is known as "tidal forces" and is a result of the gravitational wave's oscillating nature.

9. Why are the polaroid sunglasses better than the ordinary sunglasses?

Ans.

- Polaroid sunglasses pass small light having specific planes of vibration.
- Polarized sunglasses reduce glare.
- They protect the eyes from bright rays of sun light.

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- Polaroid sun glasses blot out only the harmful glares.

10. Is light from the sky partially polarized? How is it so?

Ans. Yes, light from the sky is partially polarized.

Reason

The polarization of light from the sky is due to scattering. When sunlight enters the Earth atmosphere, it interacts with tiny molecules. During the scattering process, the light waves are scattered in all directions, but the scattered light is partially polarized.

The polarization occurs because the scattered light waves are oscillating perpendicular to the plane of incidence (the plane containing the incident and scattered light rays).

11. How is Malus's law used in everyday life?

Ans. Applications

- 1. Reducing Glare:** When driving, polarized sunglasses can reduce glare from the road, making it easier to see.
 - 2. Enhancing Colors:** Polarizing filters in photography can enhance the colors of a sunset or reduce haze in a landscape.
 - 3. Improving Screen Visibility:** Polarized screens on devices, like smartphones or tablets, can reduce glare and improve visibility in bright environments.
- Malus's law plays an important role in different technologies, reducing glare and improving visibility.

12. What are the applications of Brewster's angle?

Ans. Brewster's angle, which is the angle at which light with a particular polarization is perfectly transmitted through a surface, has several practical applications:

Applications:

- 1. Reducing Glare:** Car windshields and sunglasses often use coatings that incorporate Brewster's angle to reduce glare.
- 2. Improving Laser Efficiency:** Laser manufacturers use Brewster's angle to optimize laser design and minimize reflection losses.
- 3. Enhancing Microscopic Images:** Microscopists use polarized light, created using Brewster's angle, to enhance contrast and reduce glare in microscopic images.

13. What is the space-time curvature?

Ans. Space-time is the fabric that combines space and time, describing the universe as a four-dimensional entity. Every event in the universe is embedded in this fabric, which is curved by the presence of mass and energy. According to General Relativity, the presence of mass and energy warps the fabric of space-time, creating curvature. This curvature affects not only objects with mass but also the path of light.