Al-Mustaqbal University

Department of Optics Techniques

Medical and optical physics 1

First stage
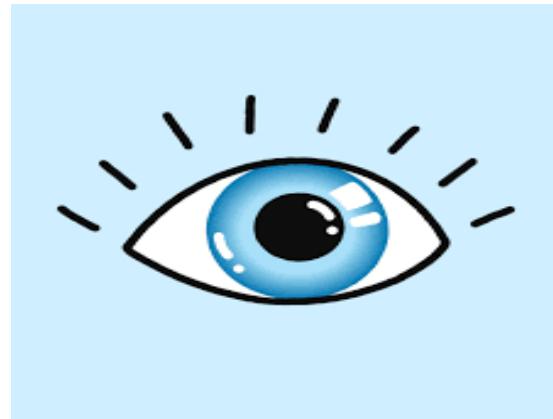
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Light

Light is one of the forms of electromagnetic energy and is considered one of the most important physical phenomena upon which humans rely for vision and in many scientific and technological applications. The science of optics studies light, its properties, and how it interacts with different materials.

1.Definition of Light

Light is electromagnetic radiation consisting of an electric field and a magnetic field, and speed in a vacuum at a constant of:

$c = 3 \times 10^8$ m/s

Question: Light travels in air at an approximate speed of $c = 3 \times 10^8$ m/s. If light travels a distance of 900,000 km in space,calculate the time it takes light to reach that distance in seconds.

Solution:

Step 1: Convert the distance to meters

900,000 km

$900,000 \times 1,000 = 9 \times 10^8$ m

Step 2: Use the formula for speed

Time =Distance /Speed

$t = d/s$

9×10^8 m/3×10^8 m/s

$t = 3$ s

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2. Nature of Light

Light has a dual nature; it can behave as a wave or as a particle:

A. The Wave Nature of Light

Light behaves as an electromagnetic wave, such as:

1)Interference

2)Diffraction

3)Polarization

B. The Particle Nature of Light

Light behaves as tiny particles called photons. This behavior is demonstrated in the photoelectric effect.

3. Properties of Light Waves

1) Wavelength (λ)**:**This is the distance between two successive crests or troughs.

2) Frequency (f)**:**This is the number of oscillations per second and is measured in

(Hz). $(c = \lambda f)$

3) The Relationship Between Wavelength and Frequency

Question:

If green light has a frequency of $f = 5.5 \times 10^{14}$ Hz and the speed of light is $c = 3 \times 10^{8}$ m/s , calculate the wavelength λ.

Solution:

We use the relationship between speed, wavelength, and frequency:

$(c = \lambda f)$

$\lambda = c/f$

$\lambda = 3 \times 10^{8} / 5.5 \times 10^{14}$ m\s

We divide the numbers step by step:

3/5.5=0.545

$10^8/0^{14} = 10^{-6}$

So

$\lambda \approx 0.545 \times 10^{-6}$ m

$\therefore 5.45 \times 10^{-7}$ m=545 nm

4. Divided Light, which the human eye can see, into two typs:

1)<u>Visible light:</u> Light with wavelengths ranging from 400 nm to 700 nm.

2)<u>Invisible light:</u> Light with wavelengths outside the visible light spectrum, such as ultraviolet (UV) and infrared (IR) radiation.

5. Propagation of Light

Light propagates in homogeneous media in straight lines. This is explained by the concept of light rays, which is used in the study of:

1)Mirrors

2)Lenses

3)Optical devices

6.Optical Phenomena

Some of the most important phenomena related to the behavior of light are:

1)Reflection

2)Refraction

3)Interference

4)Diffraction

5)Polarization

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7.Objects and Light

Objects are affected by light, either by absorbing some of it, reflecting some of it, or transmitting some of it.

Objects are classified into three types:

1)<u>Transparent objects:</u> These are colorless objects that allow large amounts of light to pass through, such as glass.

2)<u>Colored transparent objects:</u> These are objects that absorb one or more colors and the rest no absorb, such as(red glass).

3)<u>Opaque(dark) objects:</u> These are opaque objects that It does not allow light to pass through at all ,such as (wood, iron).

* Because light does not pass through opaque objects, they form a shadow when light falls on them.
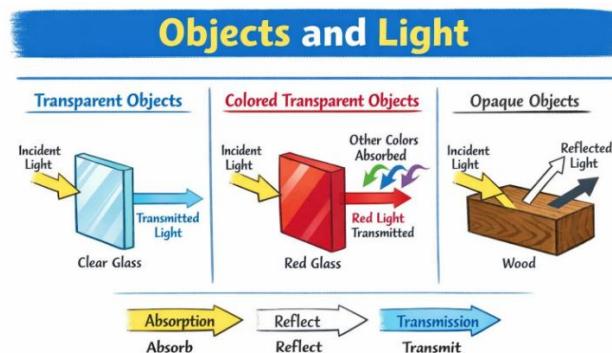
8. The Importance of Studying Light

Its applications in many fields, such as:

1)Medicine

2)Communications

3)Lasers

4)Microscopes

5)Telescopes

6)Imaging

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