POLARIZATION

Introduction:

Types of waves:

We can classify the waves into two types:

1. **Longitudinal**: the thing that is waving is in the same direction as the velocity of the wave. Examples include sound waves.

2. **Transverse**: the thing that is waving is perpendicular to the velocity of the wave. Examples include water waves and waves on a string. It turns out that light is a transverse wave of electric and magnetic fields.

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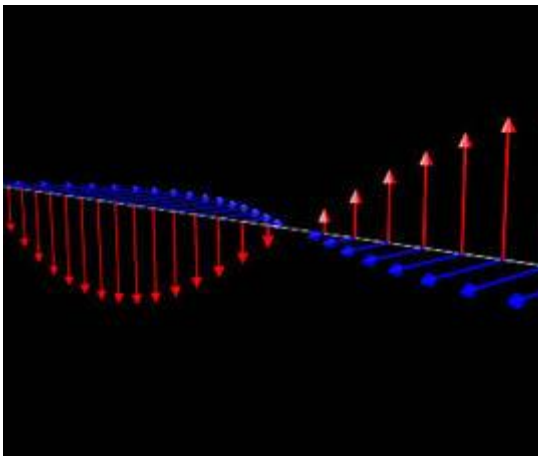
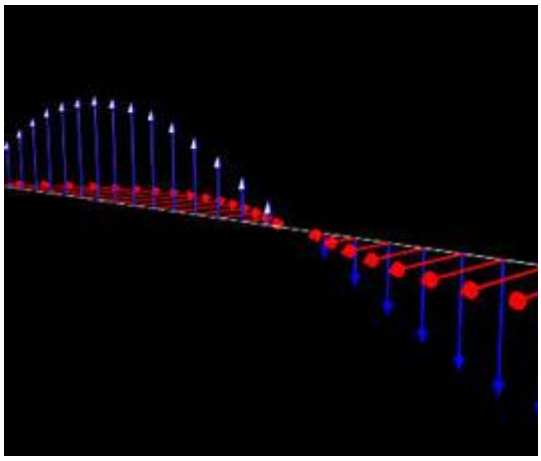




Light is a transverse electromagnetic wave motion passing in a vacuum and media. And that the source of this wave is a moving charge oscillates with a certain frequency, and with a certain direction. As a result of this oscillatory motion ,it will generate electromagnetic waves have two vectors are the electric field vector and magnetic field vector ,and the two vectors are vibrating at right angles to each other and also to the direction of light propagation ,

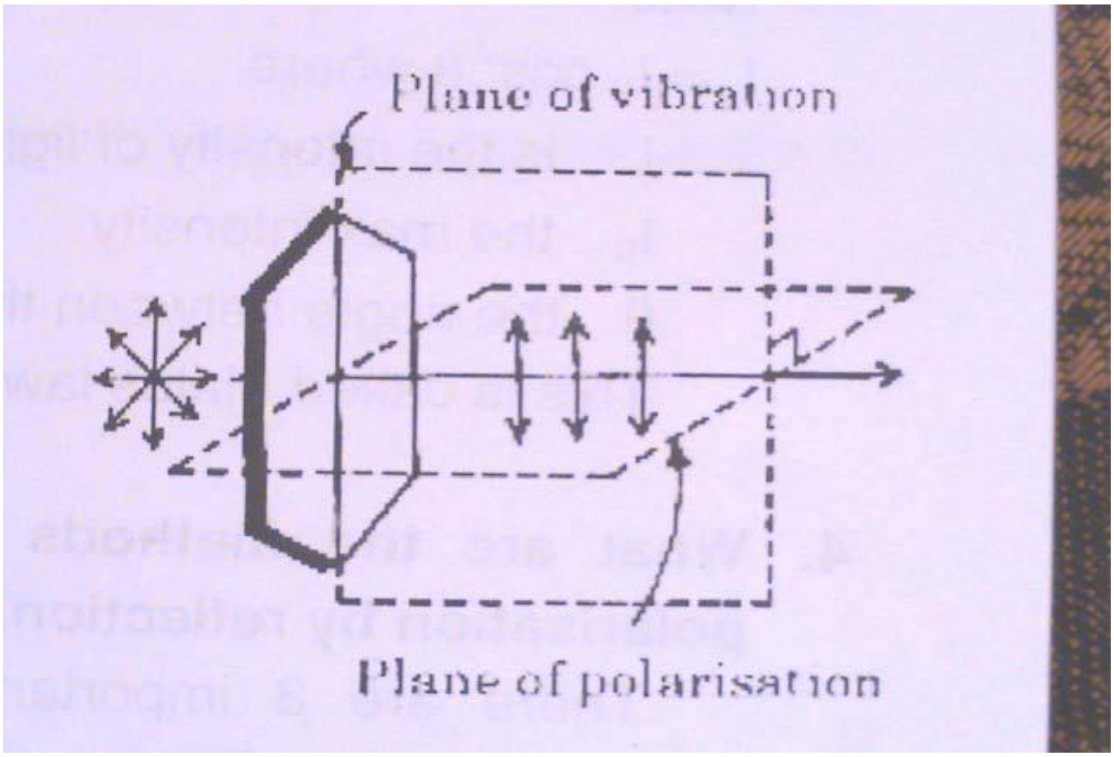
so that the cross product of the two vectors is in the direction of the wave propagation. Ordinary light or unpolarized light consists of transverse waves in which the vibrations takes place in all possible directions in a plane perpendicular to the direction of propagation of light.

Light having vibrations confined only to a single plane perpendicular to the direction of
propagation of light is said to be polarized and the phenomenon is known as **polarization.**

i.e if we have an operation so that we made the vector takes a certain direction, then we say that the light has polarized.
Therefore the **polarization: is a process determined by the form in which the vector will oscillates.**

The plane in which vibrations occur is called **plane of vibration**. A plane perpendicular to plane
of vibration is called **plane of Polarization**. No vibrations occur in the plane of polarization**.** the ratio of intensity of polarized component of a beam to the
total intensity is the degree of polarization

If the vector oscillation is always in a plane the is said to be(plane polarized).



Representation of the vibration in light:

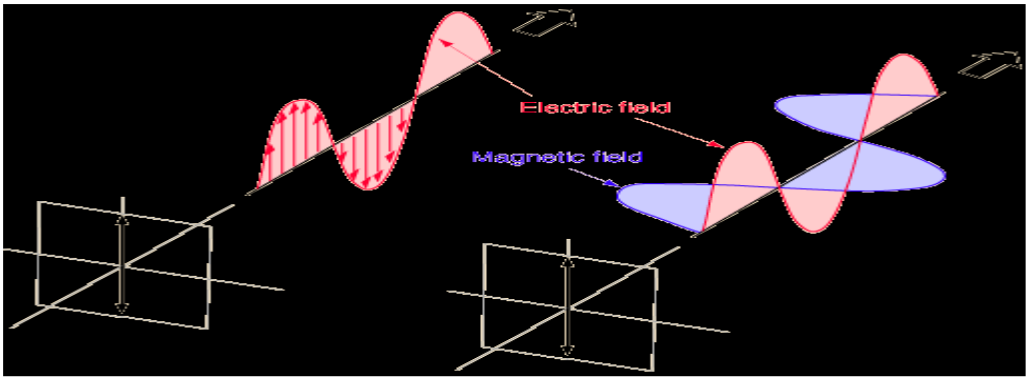
According to the electromagnetic theory, any type of light consist of transverse waves, in which the oscillating magnitudes are the electric and magnetic vectors.

We can represent the vibration of light as follows:

The figure shows a common way of picturing these vibrations ,parts a and b representing the two plane polarized components,and part c the two together in an unpolarized light.the dots represent the end-on view of linear vibrations,and pointed arrows ones confined to the plane of the paper.thus d,e,f of the figure show how the vibrations in a,b,c would appear when looking along the the direction of the r

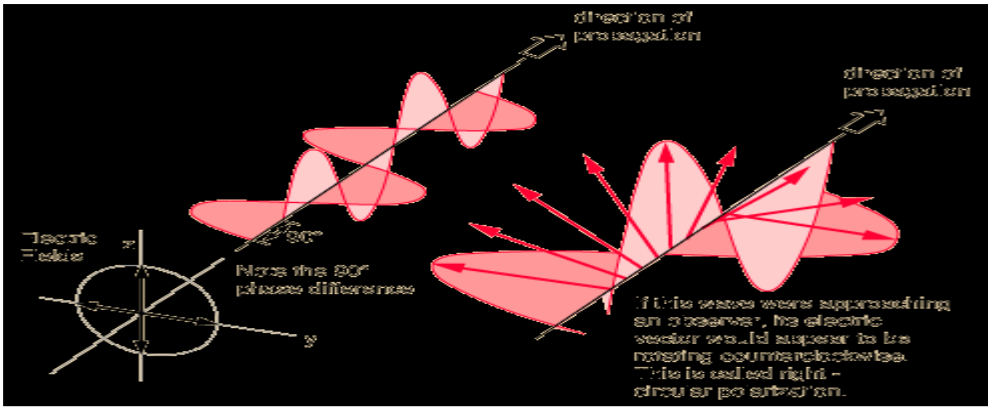
Types of polarization

1-**linear polarization**: For this radiation the electric field is directed along a single axis everywhere
along the light wave.
An example would be an electromagnetic wave whose fields take the form
$\mathbf{E}(z,t) = E_0 e^{j(kz - t)}\,\mathbf{i}$, $\mathbf{B}(z,t) = B_0 e^{j(kz - t)}\,\mathbf{j}$
This wave is traveling in the +z direction and is polarized along the x-axis.



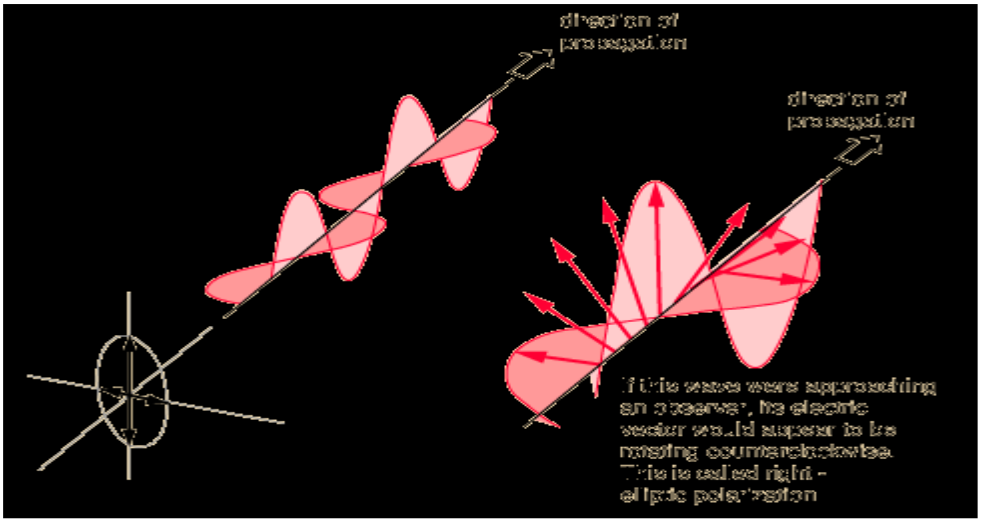
• Plane EM wave – linearly polarized
• Trace of electric field vector is linear
• Also called plane-polarized light
• Convention is to refer to the electric field vector
• Weather radars usually transmit linearly polarized radiation

2- circular polarization



• Two perpendicular EM plane waves of equal amplitude with 90° difference in phase
• Electric vector rotates counterclockwise ➔ right-hand circular polarization

3- elliptical polarization



Two plane waves not in phase, either with different amplitudes and/or not 90º out of phase
• The most general state of complete polarization is elliptical

Natural EM radiation

1• Generally a mixture of different types of polarization
2• Randomly polarized component
3• Direction of the electric field vector changes randomly on very short timescale
4• ‘Unpolarized’ radiation