Medical Physics II

2nd semester

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Lectures 7

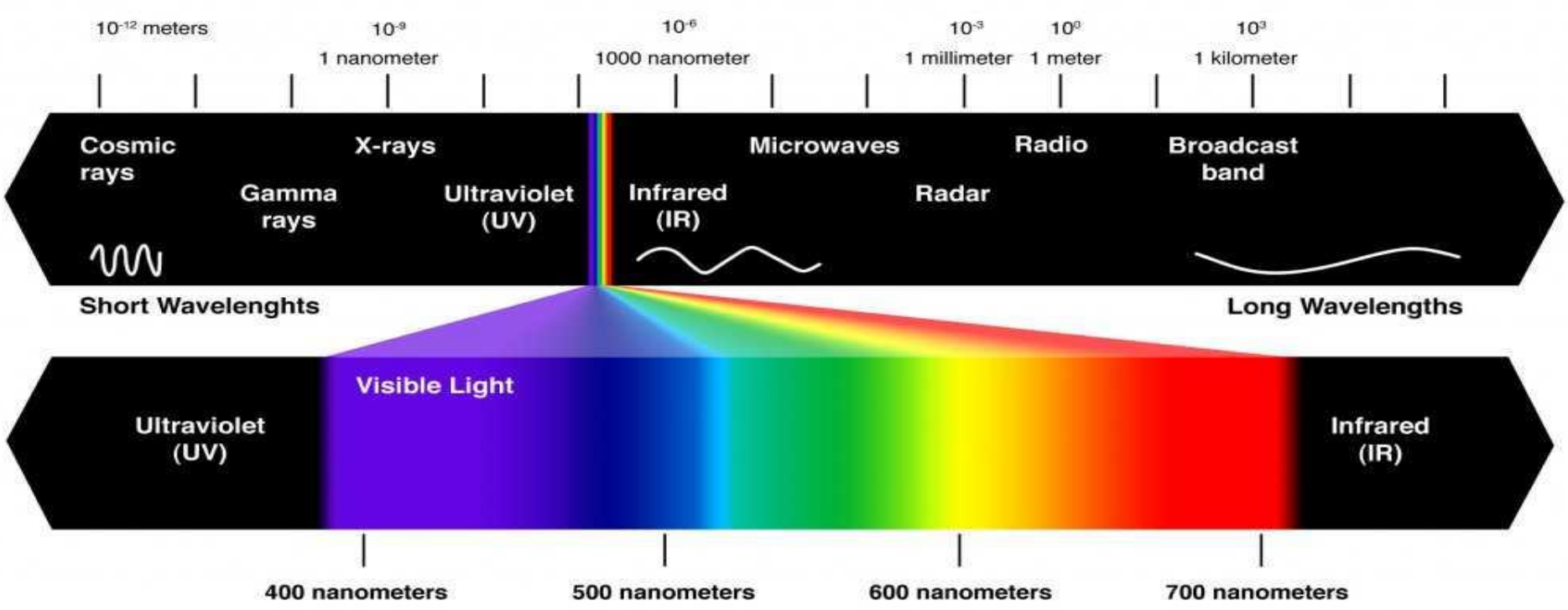
General properties of Light

Nature of Light

Light is a transverse, electromagnetic wave that can be seen by the typical human.

The **wave nature of light** was first illustrated through experiments on diffraction and interference.

Like all electromagnetic waves, **light** can travel through a vacuum.



The Nature of Light

- Light consists of perpendicular electric and magnetic fields propagating through space in a third perpendicular direction.
- Light has a "dual nature" – it is both a particle called a photon and a wave. We perceive the wavelength of light as color.
- The speed of light in a vacuum is the fastest possible speed

$$c = 3 \times 10^8 \frac{m}{s}$$

- The frequency of light is inversely proportional to the wavelength and proportional to the energy.

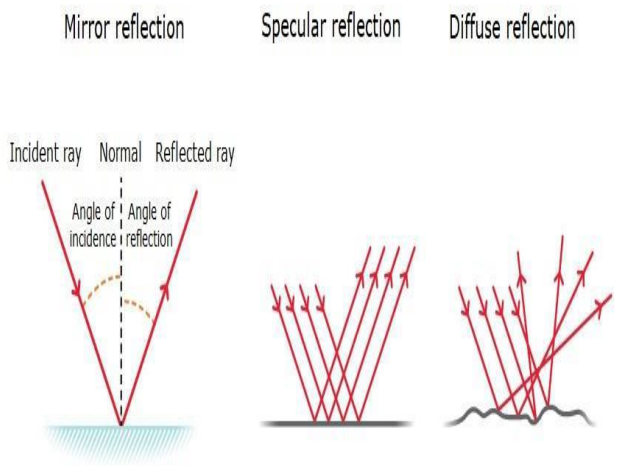
$$\lambda = \frac{c}{f} \qquad E = hf = \frac{hc}{\lambda}$$

Properties of light

1. **Reflection of light.**
2. **Refraction of light.**
3. **Diffraction of light.**
4. **Interference of light.**
5. **Polarization of light.**
6. **Dispersion of light.**
7. **Scattering of light.**

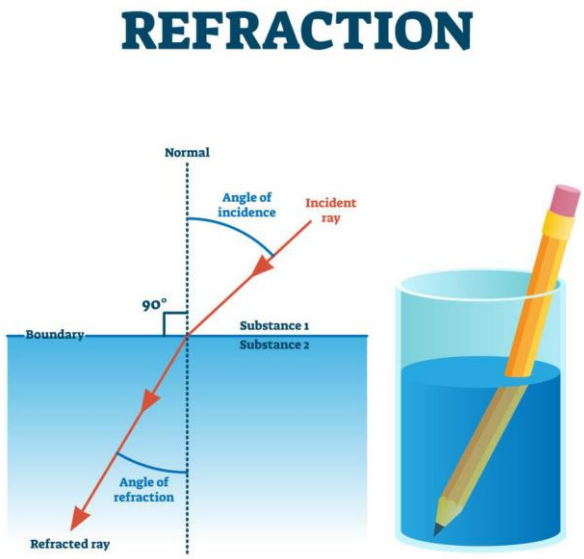
Reflection

Reflection of light (and other forms of **electromagnetic radiation**) **occurs** when the waves **encounter a surface or other boundary** that does not absorb the energy of the radiation and bounces the waves away from the surface.

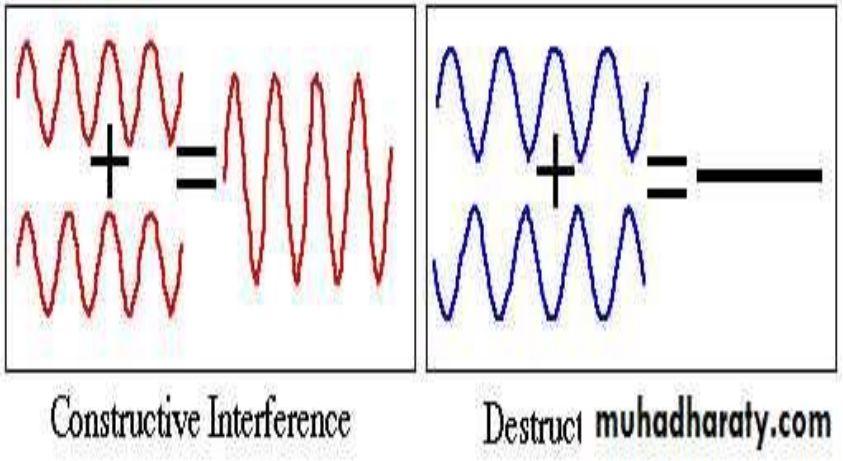


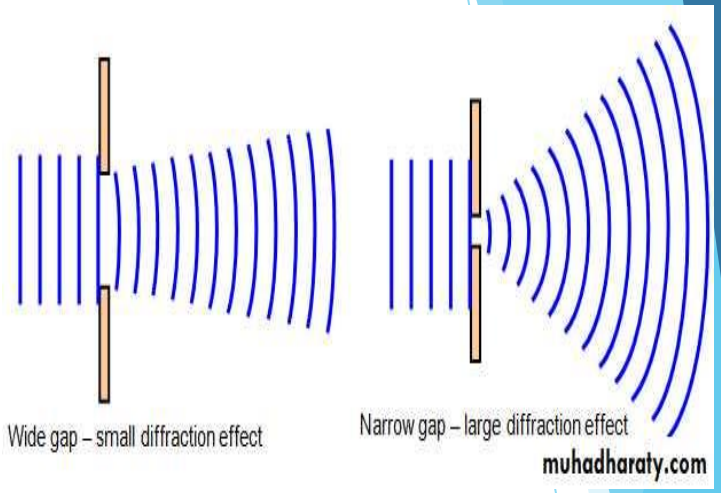
Refraction, in physics, the change in direction of a wave passing from one medium to another caused by its change in speed.

For example, waves travel faster in deep water than in shallow.

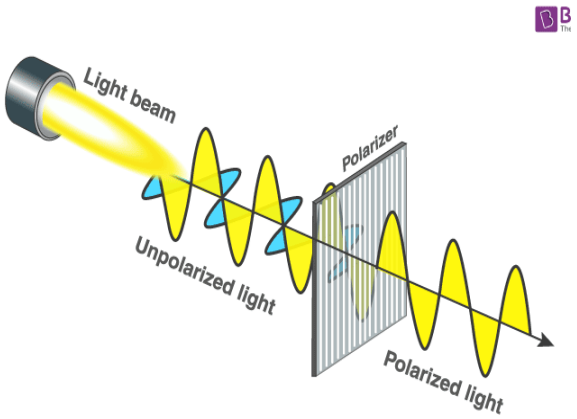


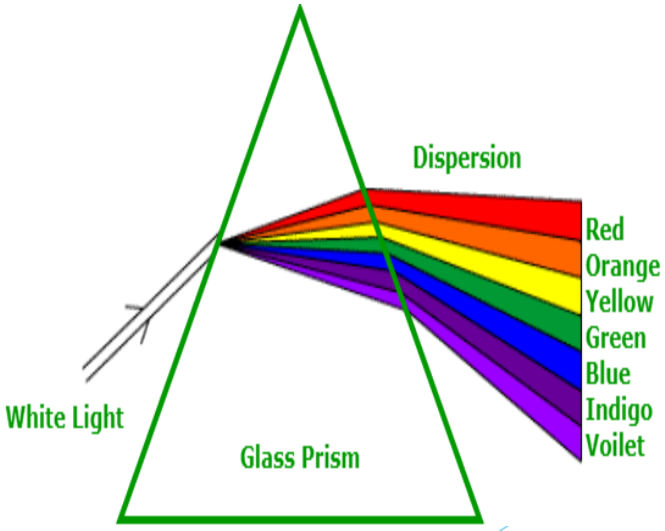
Interface and Diffraction

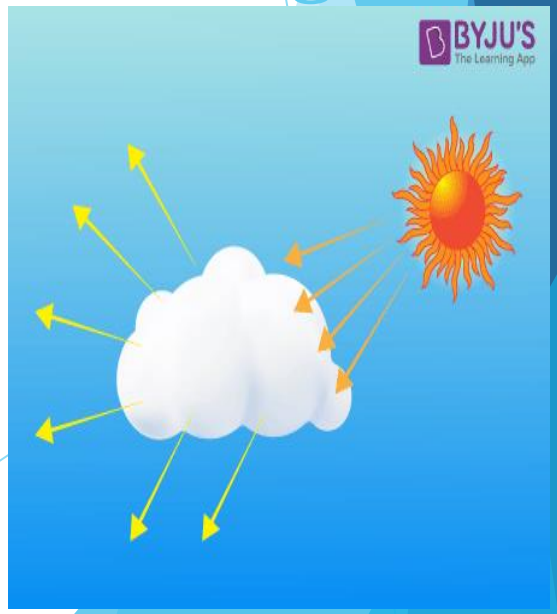




Polarization, Dispersion and Scattering







Measurement of light and its units

UV (100 to 400 nm),

visible (400 to 700 nm),

IR (extends from about 700 to 10000 nm) are defined in terms of their wavelengths.

Each of these categories is further subdivided according to wavelength (λ).

For example, UV-C (100 to 290nm), UV-B (290 to 320nm), and UV-A (320 to 400nm).

Note: (1 μ = 10-6 m), (1 Å = 10-10 m), and (1 nm = 10-9 m).

Visible light is **measured** in photometric units that relate to how light is seen by the average human eye.

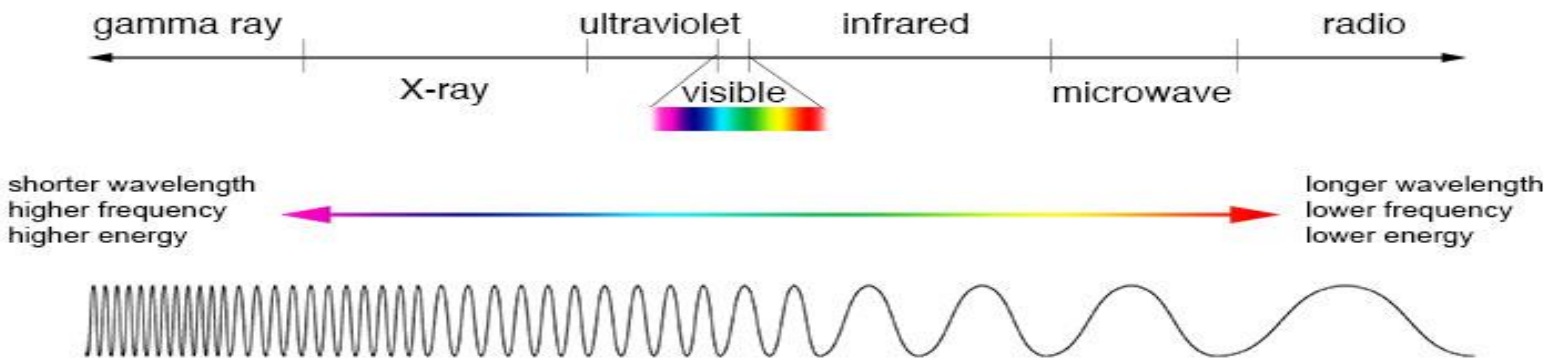
All light radiation, including UV and IR radiation can be measured in **radiometric units.**

Electromagnetic waves are transverse waves that transfer energy from the wave source to an absorber.

Electromagnetic waves form a **continuous spectrum** from the shortest gamma waves (< 10^{-11}m wavelength) to radio waves (> 100km wavelength).

Shorter wavelengths have a **higher frequency** and **higher energy**.

All electromagnetic waves travel at the same velocity in a vacuum: 300 000 000m/s.



Our **eyes** are only **able** to **detect a small range of these waves** shown as the visible range above. **Some animals can see in ultra violet and some can detect infra red**.