كلية المستقبل الجامعة

قسم تقنيات البصريات

الفيزياء الطبية والبصرية

المرحلة الاولى

المحاضرة الثانية

Department of Optics Techniques

Lecture 2

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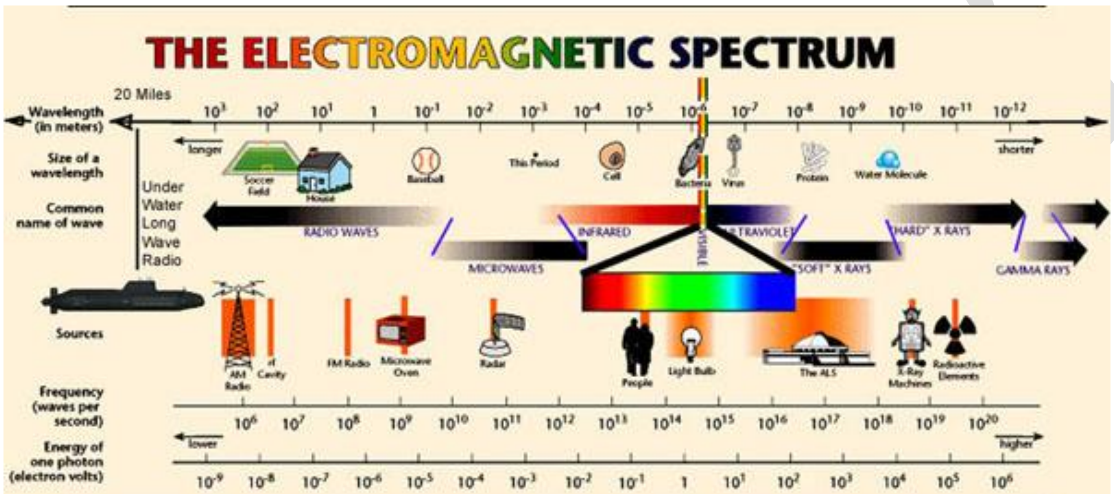
Electromagnetic Spectrum

Optical radiation lies between X-rays and microwaves in the electromagnetic spectrum, and is subdivided into seven wavebands. Each of these seven wavebands group together wavelengths which elicit similar biological reactions. These seven domains are ultraviolet C (UV-C), 200–



EM spectrum

- **Light is really, really fast**
- ***$c_{\circ} = 3x10^8$ m/s***
- ***= 30 cm/n***

Ultraviolet

Ultraviolet light is high enough to trigger chemical reactions in the body. These can be both harmful, The most common harmful effect is the development of sunburn,. Some newborns have immature livers that cannot carry out the conjugation. The standard form of phototherapy used to be to place the baby "under the lights." Since the lights were bright and also emitted some ultraviolet, . , since the baby's skin had to be exposed to the lights, it had to be placed in an incubator to keep it warm.

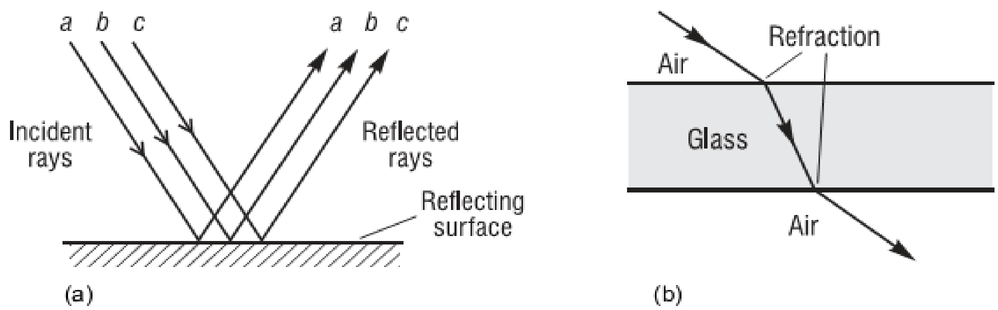
The Ultraviolet Spectrum Ultraviolet light can come from the sun or from lamps,The sharp cutoff at 320 nm is due to atmospheric ozone (O3), which absorbs strongly from 200 to 320 nm. It absorbs more weakly at wavelengths as long as 360 nm. Molecular oxygen absorbs strongly below 180 nm. The ultraviolet spectrum is qualitatively divided into the following regions: UVA 315–400 nm UVB 280–315 nm12 UVC or middle UV 200–280 nm Vacuum UV <240 nm Far UV 120–200 nm Extreme UV 10–120 nm Only the first three are of biological significance, because the others are strongly absorbed in the atmosph. Atoms and Light.

There are several responses of the skin to ultraviolet light. In order to understand them one must know something about the anatomy and physiology of skin Blue and Ultraviolet . .

The acute effect of ultraviolet radiation is reddening of the skin or erythema due to increased blood flow in the dermis, the layer beneath the epidermis.

The laws of Reflection and Refraction

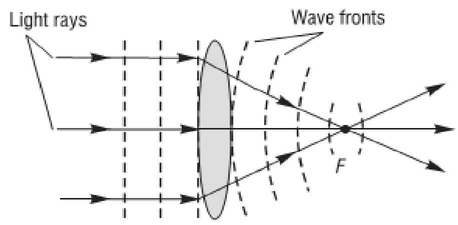
We begin our study of basic geometrical optics by examining how light reflects and refracts at smooth, plane interfaces. Figure a shows ordinary reflection of light at a plane surface, and Figure b shows refraction of light at two successive plane surfaces. In each instance, light is pictured simply in terms of straight lines, which we refer to as light rays.



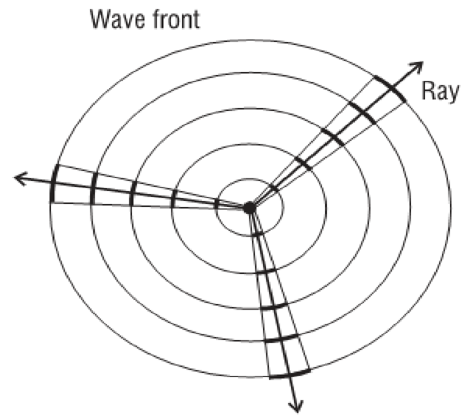
Light rays and light waves

wave motion is easily visualized in terms of water waves—such as those created on a quiet pond by a bobbing cork. See Figure a. The successive high points (crests) and low points (troughs) occur as a train of circular waves moving radially outward from the bobbing cork. Each of the circular waves represents a wave front. A wave front is defined here as a locus of points that connect identical wave displacements—that is, identical positions above or below the normal surface of the quiet pond.

(a) Waves from a bobbing cork

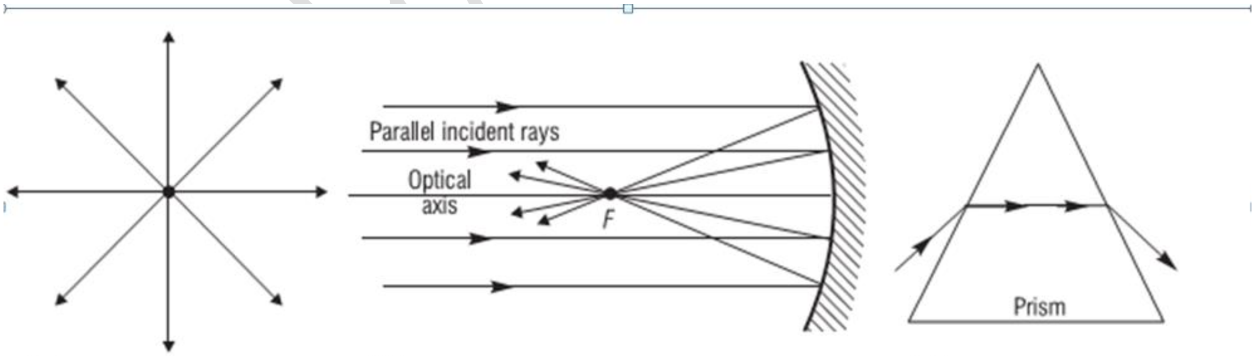


(c) Changing wave fronts and bending light rays



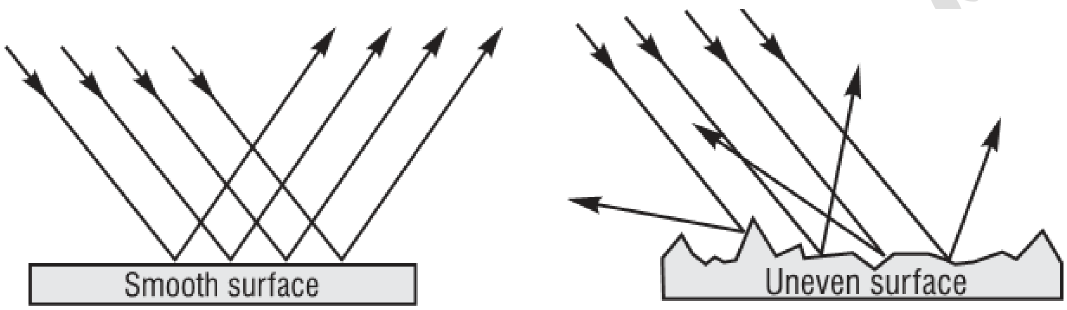
(b) Light rays and wave fronts

With the useful geometric construct of a light ray we can illustrate propagation, reflection, and refraction of light in clear, uncomplicated drawings. For example, in Figure a, the propagation of light from a "point source" is represented by equally spaced light rays emanating from the source. Each ray indicates the geometrical path along which the light moves as it leaves the source. Figure b shows the reflection of several light rays at a curved mirror surface, and Figure c shows the refraction of a single light ray passing through a prism.



Reflection of light from optical surfaces

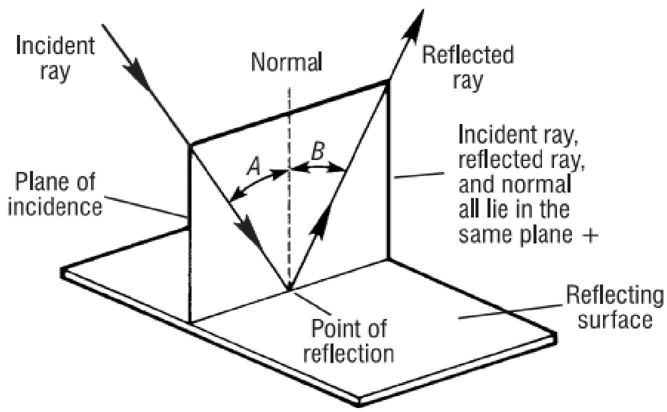
In our introductory study of geometrical optics we shall consider only smooth surfaces that give rise to specular(regular, geometric) reflections (Figure a) and ignore ragged, uneven surfaces that give rise to diffuse(irregular) reflections (Figure b).



(a) Specular reflection (b) Diffuse reflection

The law of reflection: plane surface.

When light reflects from a plane surface as shown in Figure , the angle that the reflected ray makes with the normal(line perpendicular to the surface) at the point of incidence is always equal to the angle the incident ray makes with the same normal. Note carefully that the incident ray, reflected ray, and normal always lie in the same plane.



Law of reflection: Angle B equals angle A

Laws of reflection

First law: The incident ray¸ the reflected ray and the normal at the point of incidence are in the sama plane

Second law: The angle of reflection is equal to the angle of incidence

Reflection from a curved surface.

With spherical mirrors, reflection of light occurs at a curved surface. The law of reflection holds, since at each point on the curved surface one can draw a surface tangent and erect a normal to a point P on the surface where the light is incident, as shown in Figure. One then applies the law of reflection at point P just as was illustrated in Figure above, with the incident and reflected rays making the same angles (A and B) with the normal to the surface at P. Note that successive surface tangents along the curved surface in Figure are ordered(not random) sections of "plane mirrors" and serve—when smoothly connected—as a spherical surface mirror, capable of forming distinct images.