Light

April 29, 2021

1. Introduction

Figure 1.1: Reflection, Refraction and Transmission of Light

When light falls on the interface separating two media, one or all of the three following processes can occur :

- The incident light or a part of it is turned back; that is reflected into the first medium.
- The incident light is partly or completely absorbed by the second medium.
- A fraction of the incident light is transmitted, i.e. refracted into the second medium as in case of air water interface.

1.1 Reflection

- Ability to see objects and their colours arises from reflection.
- Mirrors make use of reflection to form images.
- Laser pointers can be used to demonstate reflection.

Laws of Reflection

When a ray of light is incident at a plane interface the angle of incidence is equal to angle of reflection. This is known as law of reflection.

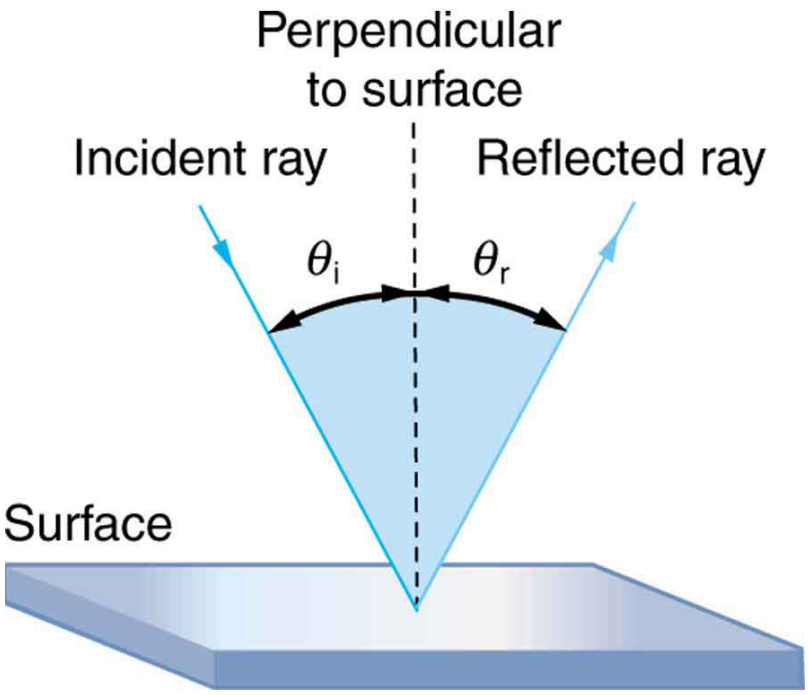

Figure 1.2: Laws of reflection

Specular and Diffuse Reflection

Reflection is of two types, specular reflection and diffuse reflection.

Specular reflection is produced from surfaces that are smoooth. The reflection that is produced in mirrors and other smooth surfaces is specular reflection. Diffuse reflection is caused from rough or uneven surfaces.

1.2 Refraction

As you might already know light is the fastest thing in the universe. It has a speed of 3 lakh km per second. (3×10^8 m/s). But this is its speed in vaccum. Light has a different speed in a different medium. When the speed of light is higher in a medium, it is called a denser medium (optically denser). If its higher in a medium it is called a rarer medium.

Laws of Refraction

When rays of light travel from a rarer medium to a denser medium, it bends toward the normal to the interface separating two media.

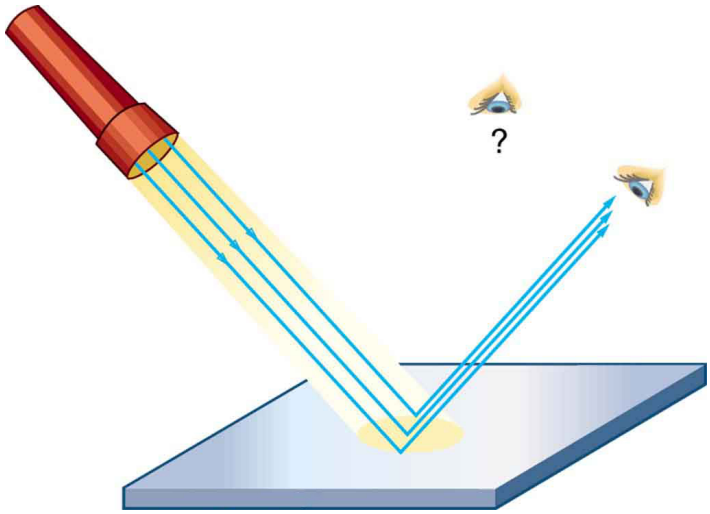

Figure 1.3: A mirror illuminated by many parallel rays reflects them in only one direction, since its surface is very smooth. Only the observer at a particular angle will see the reflected light.

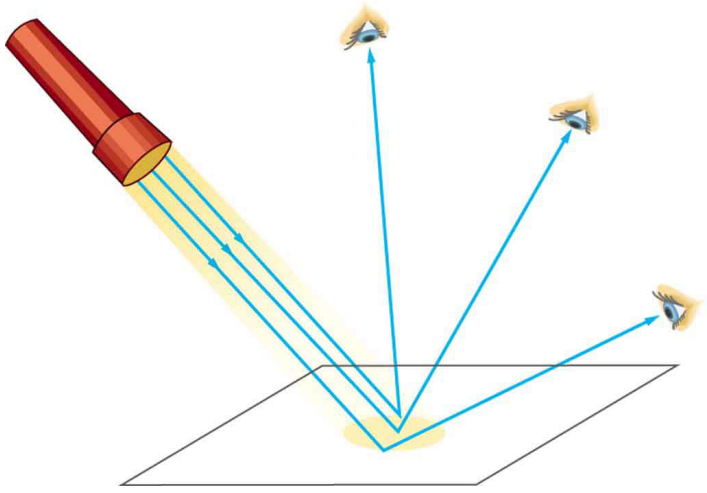

Figure 1.4: When a sheet of paper is illuminated with many parallel incident rays, it can be seen at many different angles, because its surface is rough and diffuses the light.

Figure 1.5: Moonlight is spread out when it is reflected by the lake, since the surface is shiny but uneven.

For a given media (for example, air or glass) the ratio of sine of angle of incidence to sine of angle of refraction is constant for all angles of incidence. This constant is known as the refractive index

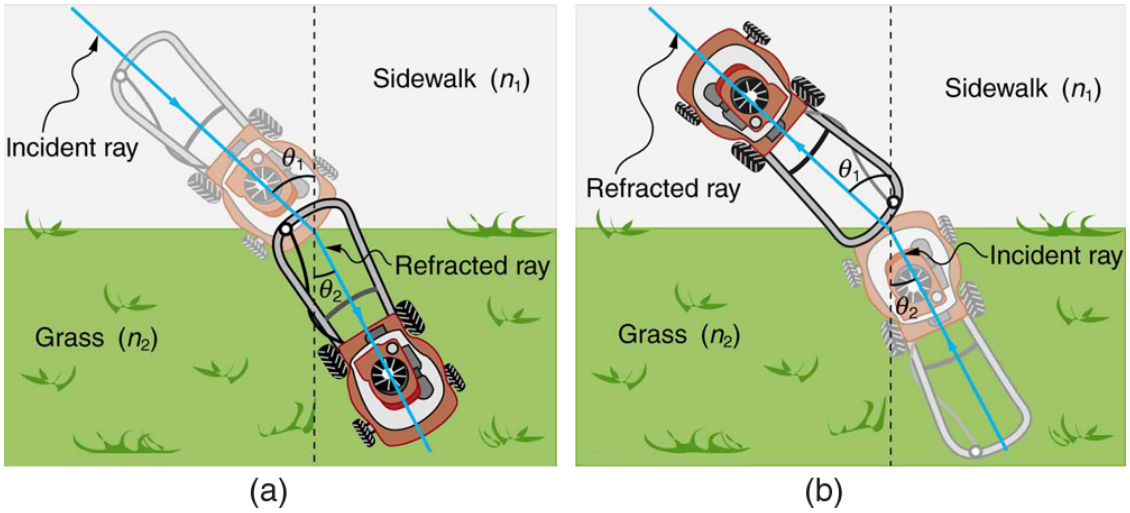

Figure 1.6: The change in direction of a light ray depends on how the speed of light changes when it crosses from one medium to another. The speed of light is greater in medium 1 than in medium 2 in the situations shown here. (a) A ray of light moves closer to the perpendicular when it slows down. This is analogous to what happens when a lawn mower goes from a footpath to grass. (b) A ray of light moves away from the perpendicular when it speeds up. This is analogous to what happens when a lawn mower goes from grass to footpath. The paths are exactly reversible.

1.3 Lenses and Images

1.3.1 Need for lenses

A rectangular glass slab produces parallel emerging rays. As a result it cannot change the size of the image formed. There is no magnification. However by changing the shape of one or both sides of the slab to a different shape (concave or convex) one is able to achieve this.

A concave or convex lens is able to bend the light coming out from the glass and hence produce real or virtual images.

1.4 Human Eye

1.4.1 Structure of Eye

1.4.2 Action of Eye

Light enters the eye through the hard and transparent cornea into a fluid called aqueous humor. It then passes through the eye lens and vitreous humor via iris. The combination of cornea, aqueous humor, lens and vitreous humor focuses the incoming light on the retina, in the normal eye, the principal focal

point coincides with the retina so that all objects are focused on it. The real inverted image formed on the retina is transmitted to the brain. Most of the refraction, which causes image formation in the retina, actually takes place at the cornea and vitreous humor. But the focal length of the lens is adjustable and

Power of Accomodation

Least distance of distant vision

1.4.3 Defects of Visions and Its Correction

Hypermetropia

The near point is greater than 25cm. This is because the image of the objects placed at the near point are formed behind the retina.

Myopia

Cannot see distant objects clearly. The image is formed in front of the retina.

Presbyopia

This is long sightedness caused due to old age.

Astigmatism