OPTICS

9.1 Reflection and Refraction

Reflection

Reflection is the bouncing off of a wave from a surface.

Law of reflection:

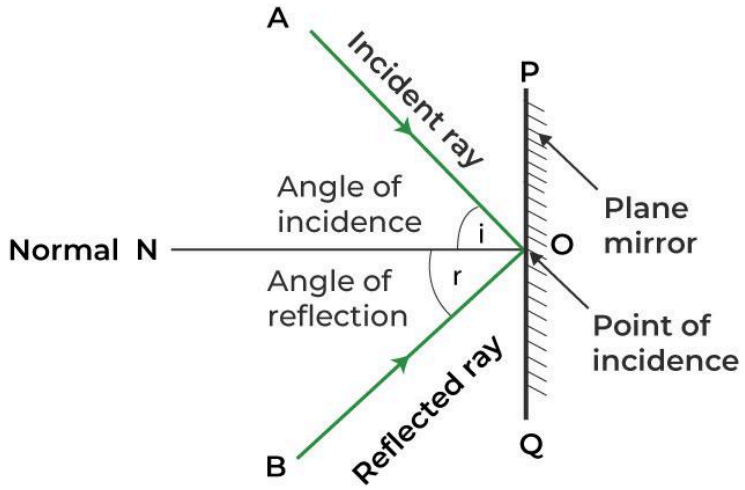


Image Credit: GeeksforGeeks

The law of reflection states that the angle of incidence is equal to the angle of reflection.

Regular and diffuse reflection

- **Regular reflection:** if the parallel beam of light falls on a plane mirror it is reflected as a parallel beam.
- **Diffuse reflection:** Most surfaces reflect light irregularly and the rays in an incident parallel beam are reflected in many directions.

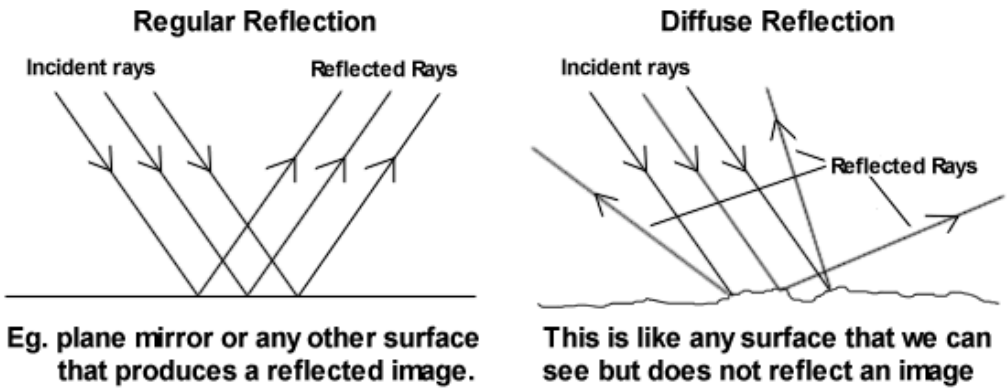


Image credit: Quora

Refraction

Refraction is the bending of a wave when it passes from one medium to another.

The real and apparent depth

Rays of light from a point O on the bottom of a pool are refracted away from the normal at the water surface because they are passing into an optically less dense medium i.e. air on entering the eye appears to come from a point I that is above O. I is the virtual image of O formed by refraction. The apparent depth of the pool is less than its real depth.

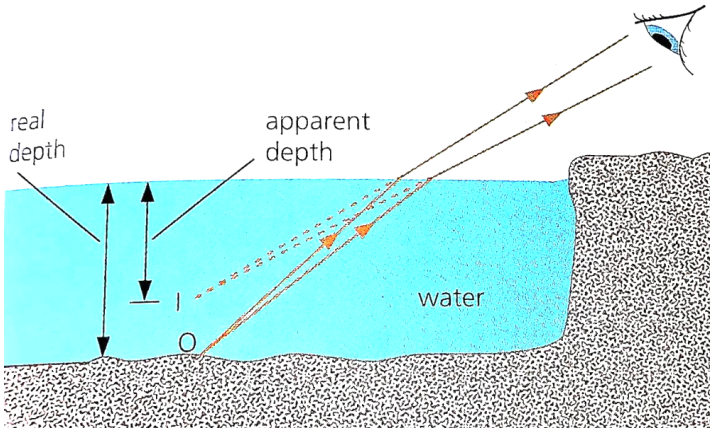


Image credit: Cambridge IGCSE™ Physics Fourth edition by Hodder Education

Critical Angle

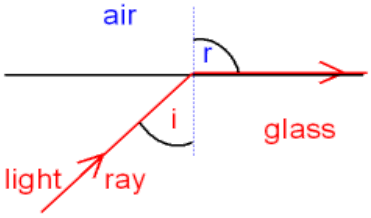


Image credit: https://www.gcsescience.com/

Refractive index and Critical angle

The critical angle (C): This is the angle of incidence which produces an angle of refraction of 90°.
Refracted index (n): This measures how much light or other electromagnetic radiation is bent or refracted when it enters from one medium to another.
It is a measure of how much a material can bend or refract light.

$n=\frac{Sin\ 90^{o}}{Sin\ C}$

$n=\frac{1}{Sin\ C}$ because Sin 90° is 1

For example:
If the critical angle for a diamond is 24°, calculate its refractive index.

→ $n=\frac{1}{Sin\ C}$

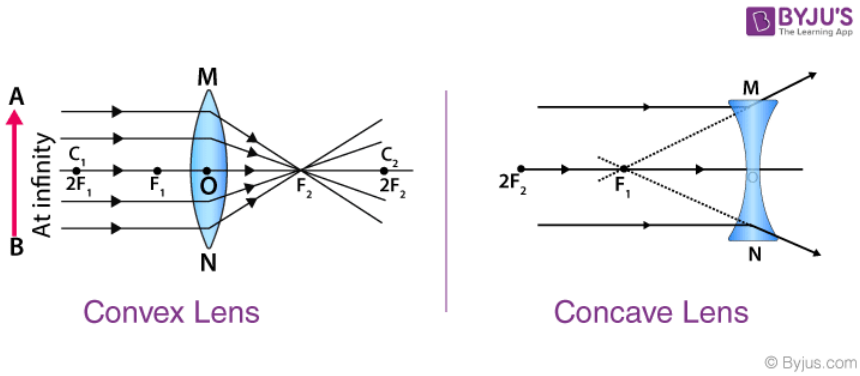
→ $n=\frac{1}{Sin\ 24^{o}}=\frac{1}{0.4}=2.5$

⟶ Refractive index= 2.5

9.2 Lenses and mirrors

Converging and diverging lens

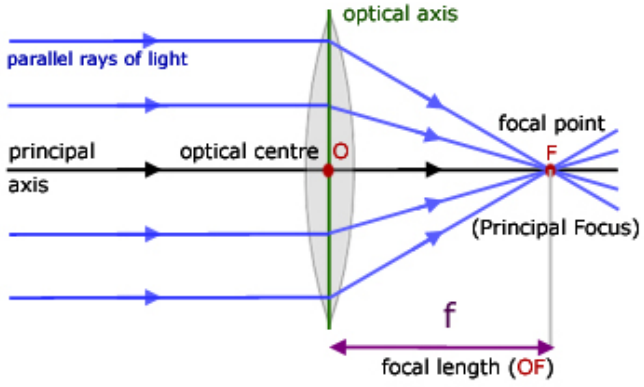
Converging lens/ convex lens: is the thickest in the center and bends lights inwards. Converging lenses can be used for magnifying glasses.
Diverging lens/ concave lens: is the thinnest in the center and spreads the light out. These lenses can be used for binoculars and telescopes.



Principle axis: line through the optical center of a lens at right angles to the lens
The center of a lens is its optical center (c), the line through **c** at right angles to the lens is the principle axis.

Principle focus (focal point): point on the principle axis of a lens to which light rays parallel to the principle axis converge or appear to diverge.

Focal length: Distance between the optical center and the principal focus of a lens.



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The focal length is f.
The focal point is F.

Note: The shorter the focal length of the lens, the stronger it is. The more curved the lens faces are, the smaller its focal length and the more powerful the lens.

Power of lens

We define the power of a lens P to be:

$$P=\frac{1}{f}$$

Where the focal length (f) is measured in meters.