SCIENTIA TUTORIALS

SUMMARY

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REFRACTION OF LIGHT

INTRODUCTION

In the previous chapter we have seen how light gets reflected when it is incident on a surface. Now let us see what happens when a ray of light traveling from one medium to another medium of different density.

REFRACTION OF LIGHT

Let us now see what happens when a ray of light is incident on the boundary separating the two mediums having different densities. A part of the light gets reflected and rest of the light changes its direction as it enters the second medium.

LAWS OF REFRACTION

The incident ray, the refracted ray and the normal to the surface at the point of incidence all lie in one plane.

RELATION BETWEEN THE REFRACTIVE INDICES

According to the principle of reversibility of light, the path of a ray of light is reversible. The figure below shows how light gets refracted from medium 1 to medium 2.

REFRACTION OF LIGHT THROUGH A GLASS SLAB

Place a rectangular glass slab on a white sheet of paper fixed on a drawing board.

VERIFICATION OF SNELL'S LAW

Place a rectangular glass slab on a white sheet of paper fixed on a drawing board.

TOTAL INTERNAL REFLECTION

Critical angle is that angle of incidence for which a ray of light while moving from a denser to a rarer medium just grazes over the surface of separation of the two media (that is, angle of refraction = 90^o).

MIRAGE AND LOOMING

The mirage is caused by the total internal reflection of light at layers of air of different densities. In a desert, the sand is very hot during day time and a result the layer of air in contact with it gets heated up and becomes lighter. The lighter air rises up and the denser air from above comes down.

LENSES

A lens is a portion of a transparent refracting medium bounded by two surfaces which are generally spherical or cylindrical or one curved and one plane surface.

TERMINOLOGY USED IN OPTICS

It is the center of a lens. It is denoted by the letter O. A ray of light passing through the optical center of a lens does not suffer any deviation. It is also referred to as optic center.

FORMATION OF IMAGE BY A CONVEX LENS

A ray of light passing through the optical center of the lens travels straight without suffering any deviation. This holds good only in the case of a thin lens.

FORMATION OF IMAGE BY A CONCAVE LENS

An incident ray of light coming from the object parallel to the principal axis of a concave lens after refraction appears to come from its focus.

SIGN CONVENTION FOR LENSES

The distances measured in the direction of incident rays are positive and all the distances measured in the direction opposite to that of the incident rays are negative.

LENS FORMULA

The relationship between distance of the object (u), distance of the image (v) and focal length (f) of the lens is called lens formula or lens equation.

DERIVATION OF LENS FORMULA (CONVEX LENS)

Let AB represent an object placed at right angles to the principal axis at a distance greater than the focal length f of the convex lens. The image A^1B^1 is formed beyond $2F_2$ and is real and inverted.

DERIVATION OF LENS FORMULA (CONCAVE LENS)

Let AB represent an object placed at right angles to the principal axis at a distance greater than the focal length f of the convex lens. The image A^1B^1 is formed between O and F_1 on the same side as the object is kept and the image is erect and virtual.

MAGNIFICATION

Magnification is the ratio of the size of the image (h_I) to the size of the object (h_o)

POWER OF A LENS

Whenever a ray of light passes through a lens (except when it passes through the optical center) it bends. The bending of light rays towards the principal axis is called convergence and bending of light rays away from the principal axis is called divergence.

THE EYE

Our eye is the most important natural optical instrument. The eye is nearly spherical in shape with a slight bulge in the front part.

WORKING OF AN EYE

The light coming from an object enters the eye through cornea and pupil. The eye lens converges these light rays to form a real, inverted and diminished image on the retina.

POWER OF ACCOMMODATION

A normal eye can see both the distant and the nearby objects clearly. In the case of the eye, the image distance (v) is fixed as the distance between the eye lens and retina remains the same but the object distance (u) varies.

RANGE OF VISION

The range of distance over which the eye can see clearly is called its range of vision. The range of vision of a normal healthy eye is from infinity to 25cm from the eye.

DEFECTS OF VISION

A normal eye can see all objects over a wide range of distances i.e., from 25 cm to infinity. But due to certain abnormalities the eye is not able see objects over such a wide range of distances and such an eye is said to be defective.

HYPERMETROPIA

You must have seen middle aged people holding a book away from their eyes to read properly. This is because they are not able to see the nearby objects clearly. We say that those people are suffering from hypermetropia (long sightedness).

MYOPIA

You must have seen some people holding books very close to their eyes. This is because they suffering from myopia (short sightedness). A myopic person cannot see distant objects clearly because the far point of his eye is less than infinity.

ASTIGMATISM

At times the eye is not able to focus the light coming from the horizontal and vertical planes. As a result, the horizontal and vertical views of an object will not be the same. Such a defect of the eye is called astigmatism.

CONCLUSION

Thus, this chapter on refraction helps us understand many natural phenomena like the twinkling of stars, the sparkling of diamonds, mirage etc. It also throws light on the working of the human eye and the defects of vision.