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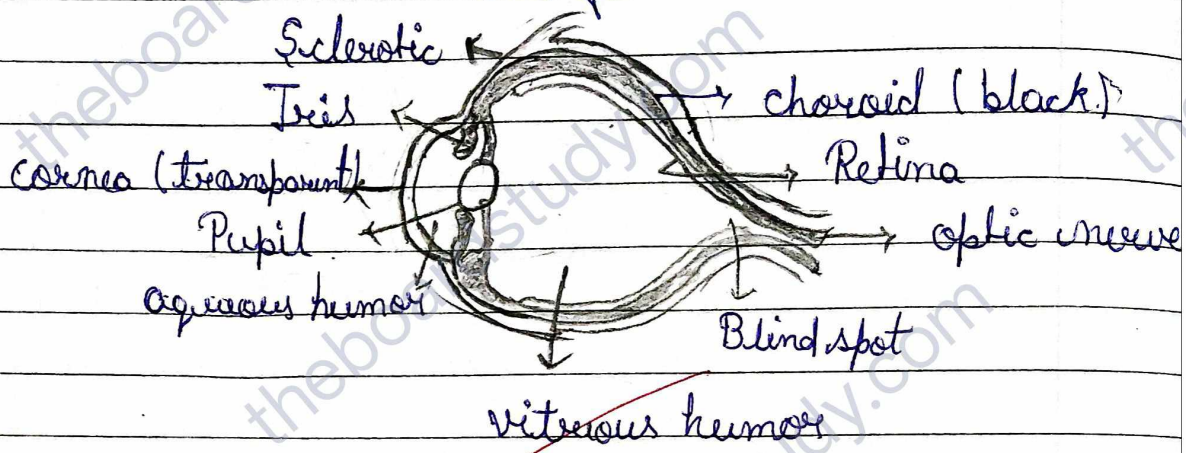
chapter 2

The Human Eye And The Colorful World.



Structure of human eye.

Diagram shows the section of a human eye by a horizontal plane. It is a spherical ball of diameter about 2.5 cm. Its essential parts are described below:

Cornea: Cornea is the transparent spherical membrane that covers the front of the eye.
Iris: Iris is the coloured region. It control the size of pupil.
Pupil: It regulates the light entering. It is the black circle center of the iris.
Crystalline lens: It is a double convex lens immediately behind this iris. It formed real & Inverted Im
ciliary muscles: Adjust the focal length of eye lens
Aqueous Humor: Pressure balancing inside & outside the e
Vitreous Humor: Honey like, Maintance the shape of e
optic Nerve: optical signals converted to electrical Impulses and sent to brain
Retina: Photosensitive cells, Image is formed on it
① Red cells: Intensity sensing ② cone cells: Colour sensing

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Power of Accommodation.

The ability of the eye lens to adjust its focal length by the ciliary muscles as the distance is called power of accommodation.

* When ciliary muscls relaxed when lense is thin so the Power of lense is more and and focal length is less.
* when lense is thick then ciliary muscles contract so the power of is less and focal length is more.

far point is ∞, near point is 25cm.

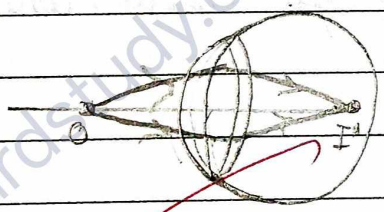
Deffects : Myopia (Near Sightdness) Far → Dandhlapan

It is kind of difect in the human eye due to which a person can see near objects clearly but he cannot see the distant objects clearly. The image forms before the retina. Myopia is due to.

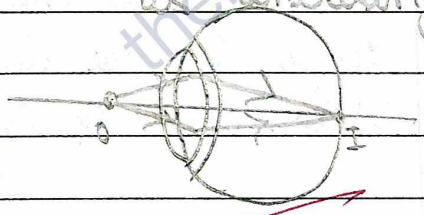
(i) Excessive curvature of the eye lens. [Becas of its short focal length]

(ii) Elongation of eyeball. → More

Power of lens is increasing

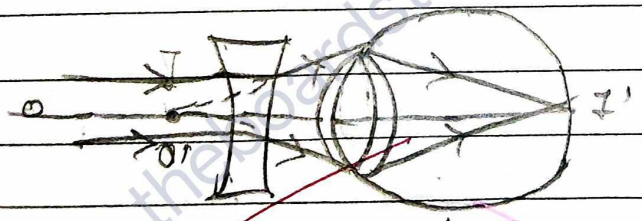


Deffected eye



Healthy eye

Correction :-



Concave lens / diverging lense is go used

It is corrected by using spectacles containing concave lenses.

* The concave lens used for correcting myopia

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should be of such a focal length that it produces a virtual image of the distant object at the far point of the myopic eye.

* The whole purpose of using concave lense there is to reduce the converging power of the eye lens.

Keys for calculation.

object is taken to be infinity & ~~Negative~~. Negative focal length is always negative

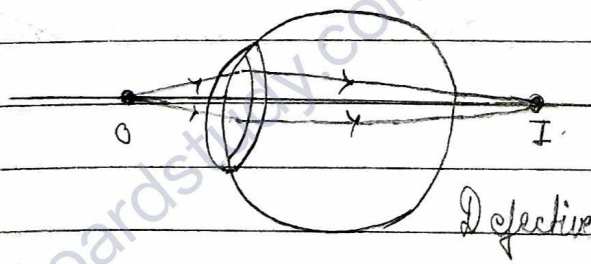
$$\frac{1}{\infty} = 0$$

Image is taken in negative.

2. Hypermitropia [or Far-sightedness] Pass ka Dhundhlapan. It is a kind of defect in the human eye due to which a person can see distant objects properly but cannot see the nearby objects clearly. It happen due to.

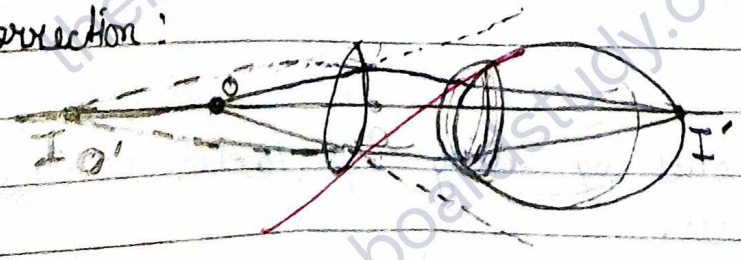
(i) Decrease in the power of eye lens ie. increase in focal length of eye lens.

(ii) Shortening of eyeball.



Defective eye.

Correction:



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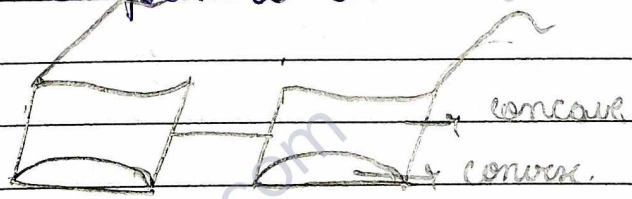
* The convex lense used for correcting hypermetropia should be of such a focal length that it forms a virtual image of the object (at the normal near point D (of 25 cm), at the near point D' of the hypermetropic eye.
* The purpose of using convex lens here is to increase the converging power of the eye lens.

Keys for calculation
object is taken to be 25 cm (-Negative)
Image is taken in negative
focal length taken in positive.

3) Presbyopia (old age Hypermetropia)
Y It is a kind of defect in human eye which occurs due to ageing. It happens due to the following reason.
(i) Decrease in flexibility of eye lens.
(ii) Gradual ~~weaking~~ weakening of ciliary muscles. In this a person may suffer from both Myopia and hypermetropia
Correction :- use Bi focal lenses.



4) Astigmatism [Cylindrical problem]
Y In this defect a person cannot focus on both horizontal as well as vertical lines at the same time so the person can see objects clearly only in one plane.
causes :- Astigmatism is ~~cas~~ caused by an irregulary shaped cornea or distorted lens.
correction :- this defect can be corrected using cylindrical lens.

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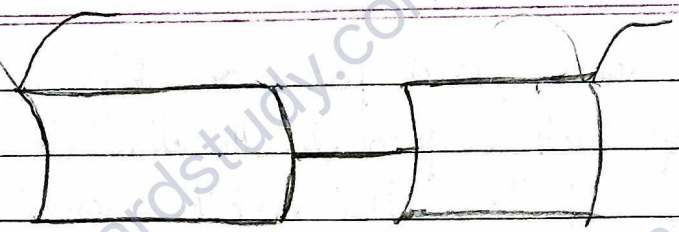

5) Cataract [Milkiness of eye lens]

The medical condition in which the lens of the eye of a person becomes progressively cloudy resulting in blurred vision is called cataract.

correction :- surgery and lasik.

opaque lense removed & artificial cellulose lense place in it

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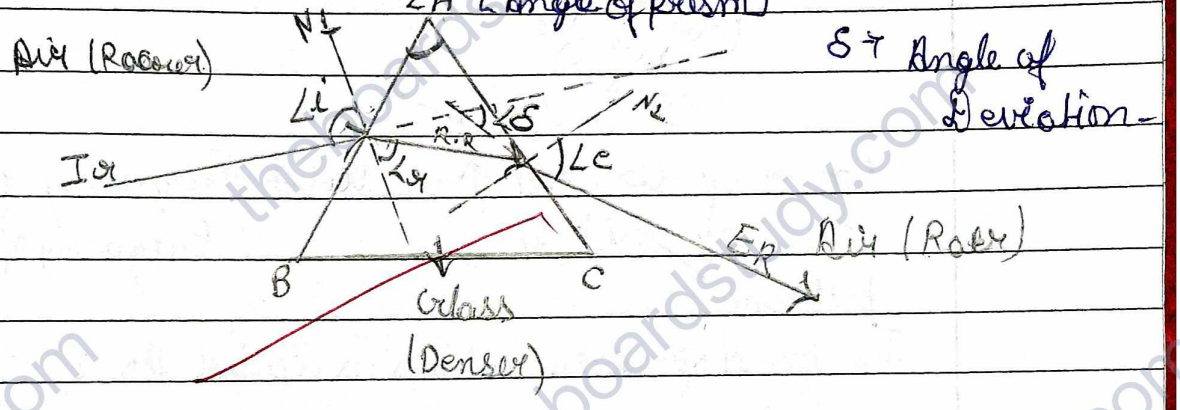
Glass Prism

It Prism is triangular shaped
It has 3 rectangular faces & two triangular.

Refraction Trough Prism

Using monochromatic light [one colour light] :-



Electromagnetic Spectrum

Increasing wavelength →

cm
10^{-11} → 10^{-9} → 10^{-7} → 10^{-5} → 10^{-2} → 10 → 10^{5}

Gamma Rays	X-Rays	UV Rays	VISIBLE	Infrared	Micro wave	Radio

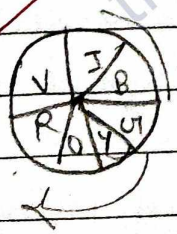
→ Tubelight, LED, CFL → Artificial Producer

V	I	B	U	Y	O	R

↓ Increasing Energy
Increasing Frequency.

Newton Disc Experiment

White colour → Mixture of all visible colours [VIBGYOR]
Black colour → Absence of all colours.



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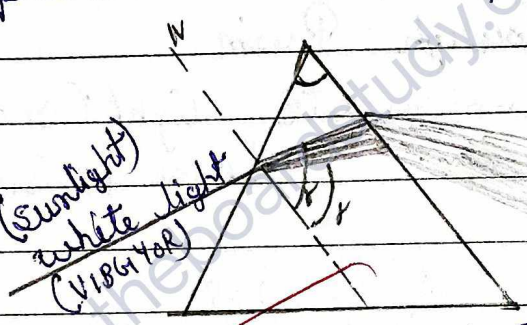
Dispersion of light through Prism

The Phenomenon of splitting of white light into its seven constituent colours when it passes through a glass prism is called dispersion of white light.



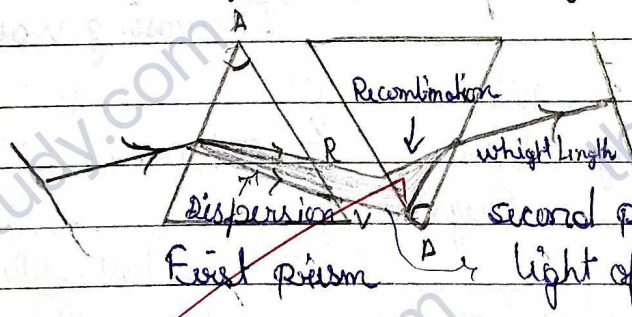
$\frac{\sin i}{\sin r} = n = \frac{c}{v} = \frac{\lambda_{air}}{\lambda_{glass}}$

Sin r of Red ↑ Frequency of Red ↑
Sin r of Violet ↓ Frequency of Violet ↓

Spectrum

The band of seven colours is called the spectrum [visible]

Recombination of Dispersed light



* The Rainbow formation

The Rainbow is an arch of seven colours visible in the sky which is produced by the dispersion of sun's light by raindrops in the atmosphere.

* The water droplets act like small prism.
* They refract and disperse the incident sunlight then reflect it internally and refract again when it comes out of the raindrop.
* Due to Dispersion of light and internal reflection

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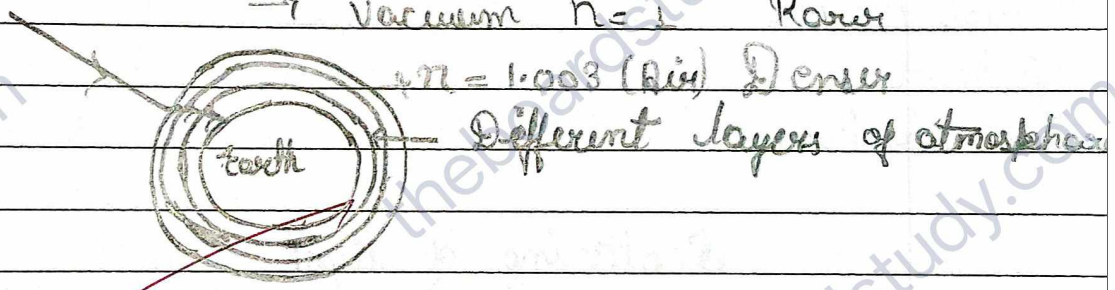
different colours reach the observer eye.

* Red colour appears on top and violet at the bottom of rainbow.

* A Rainbow is always formed in a direction opposite to that of sun.

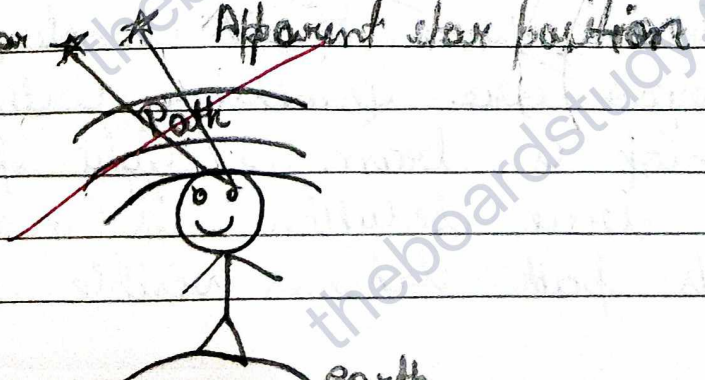
Atmospheric refraction

The refraction of light caused by the Earth's atmosphere (having air layers of varying optical densities) is called Atmospheric Refraction.



× Why do stars twinkle ?

It is due to atmospheric refraction. Distant star act like a point source of light. As the beam of starlight keeps deviating from its path, the apparent position of stars keeps on changing because physical condition of earth atmosphere is not stationary. Hence, the amount of light enters our eyes fluctuate sometimes bright and sometime dim this is the twinkling effect of star.



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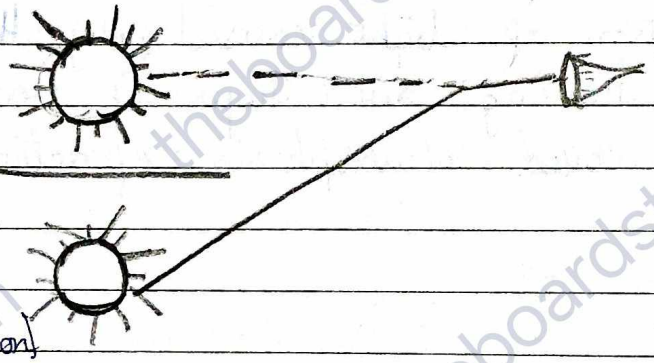
note:

★ **Advance Sunrise and Delayed sunset**

We can see the sun about 2 minutes before the actual sunrise and 2 minutes after the actual sunset because of atmospheric refraction.

* The time from sunrise to sunset is increased by about 2+2 = 4 minutes because of atmospheric refraction.



Scattering of light

Scattering of light means to throw light in various random directions.

* This happens because light is absorbed by the particles in the form of energy. Then the particles reflect and emit the light again in all directions. This phenomenon is called the scattering of light

For example :-

The blue colour of the sky, colour of water in deep sea, the reddening of the sun at sunrise and sunset are some of the wonderful phenomena we are familiar with.

* The path of a beam of light passing through a true solution is not visible. However, its path becomes visible through a

colloidal solution where the size of the particle is relatively larger.

Why does the sky appear blue at daylight?
Because of the phenomenon of scattering. Sunlight gets scattered by small air molecules and other fine particles in the atmosphere during its passage. Scattering is inversely proportional to wavelength. i.e. Blue with the shortest wavelength will scatter more compared to the red. Therefore, this greater scattering of blue light by the air molecules in all directions make the atmosphere appear blue during cloudless daytime.

Tyndall Effect

In Sodium Thiosulphate solution

When a beam of light strikes, the minute particles of earth's atmosphere suspended particles of dust and molecule or air the path of beam become visible.

The phenomenon of scattering of light by the colloidal particles give raise to Tyndall effect. It can be observed when sunlight passes through a canopy of a dense forest. The colour of the scattered light depends on the size of the scattering particles.

Thursday
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