Chapter - The Human eye and the Colourful world

Eye works on refraction of light, through a natural convex lens made of transparent living material & enables us to see things around us

The Human eye

→ The front part of the eye is called cornea
→ It is made up of transparent substance & is bulging outwards. The light enters through this cornea into the eyes. just behind cornea is Iris (or coloured diaphragm).
→ Iris is coloured, ring shaped membrane. Their is a hole in the middle of iris which is called pupil of the eye.
→ The pupil appears black because no light is reflected from it.
→ Eye lens is a soft, flexible jelly like material made of protein. Being flexible, eye lens can change it's shape.
→ Eye lens can change it's shape to focus light on retina.

Eye lens is held by suspensory ligament. One end of suspensory ligament is held by ciliary muscles.

Ciliary muscle change the thickness of eye lens.

Retina is the back part of eye. it is a delicate membrane having large number of photo sensitive cells called 'Rods & Cones' which respond to 'intensity of light' and 'colour of objects' respectively at junction of optic nerve and retina. there are no light sensitive cells, due to which no vision is possible at this spot. This is called blind spot.

The space between cornea & eye lens is filled with watery liquid called 'Aqueous Humour' & space between eye lens & retina is filled with transparent jelly like substance called Vitreous humour which supports the back of the eye.

Working of Eye

Light → cornea → pupil → eye lens (convex lens) → converges and produces real inverted image on retina → generate electrical signals (rods, cones) → via optic nerve → Brain → Sensation of vision

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* Cornea also converges the light rays coming into the eyes. Eye lens also only converges final rays.

* Mind interprets the final image as erect image.

Functions of :-

(i) Iris - Controls amount of light entering the eye. If amount of light is large, the iris contracts the pupil and if light is small, it will expand pupil. Adjustment of size of pupil takes some time. This is the reason for dazzling vision when we leave a dark room or enter a dark room.

(ii) Rods and cones

→ Rods are rod shaped cells present in retina, which are sensitive to dim light. ~~Not~~ nocturnal animals (animals which sleep during day & come out at night) like owls have a large number of rod cells in retina.

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→ cones are cone shaped cells present in retina, which are sensitive to bright light. These are more in number than the rod

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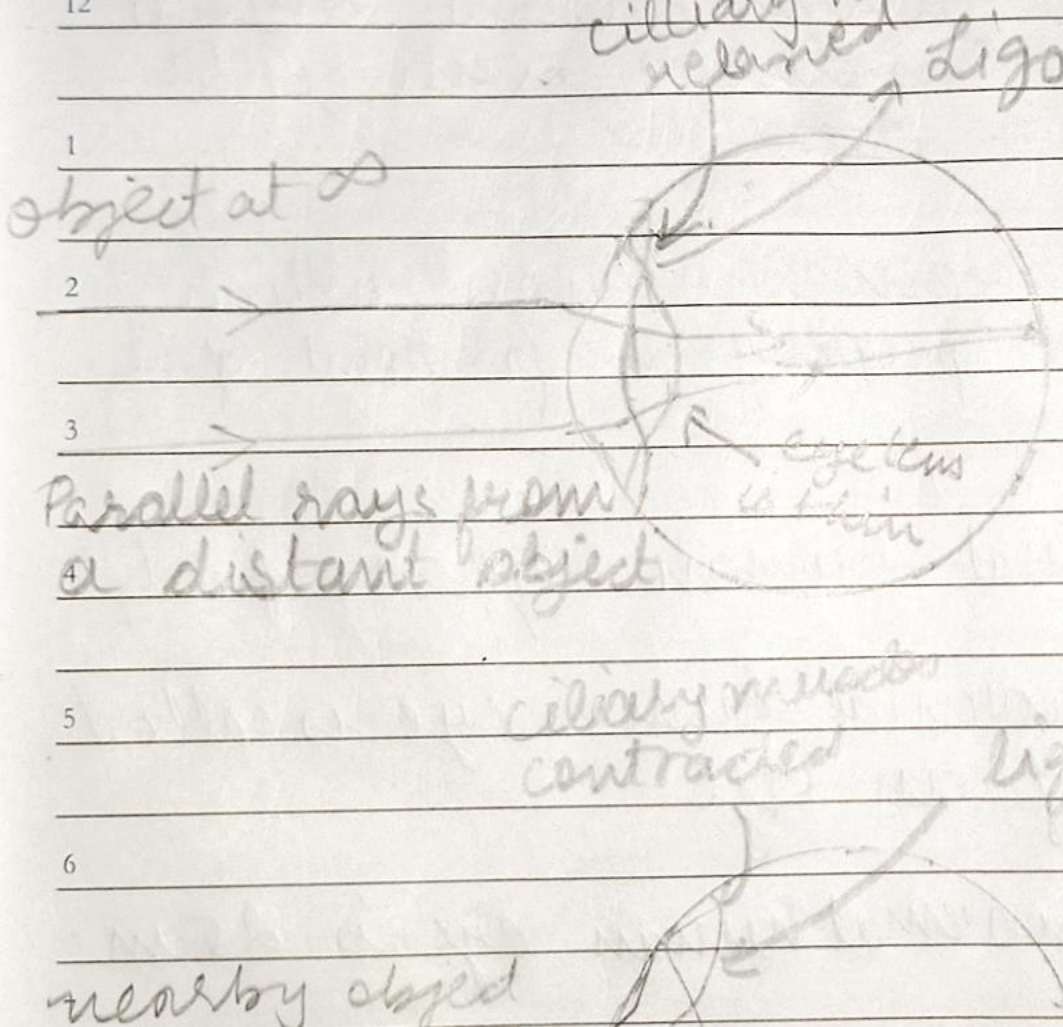
cells. Cone cells causes sensation of colour.

Accommodation

Normal eye can see distant objects as well as nearby objects due to it's power of accomodation.



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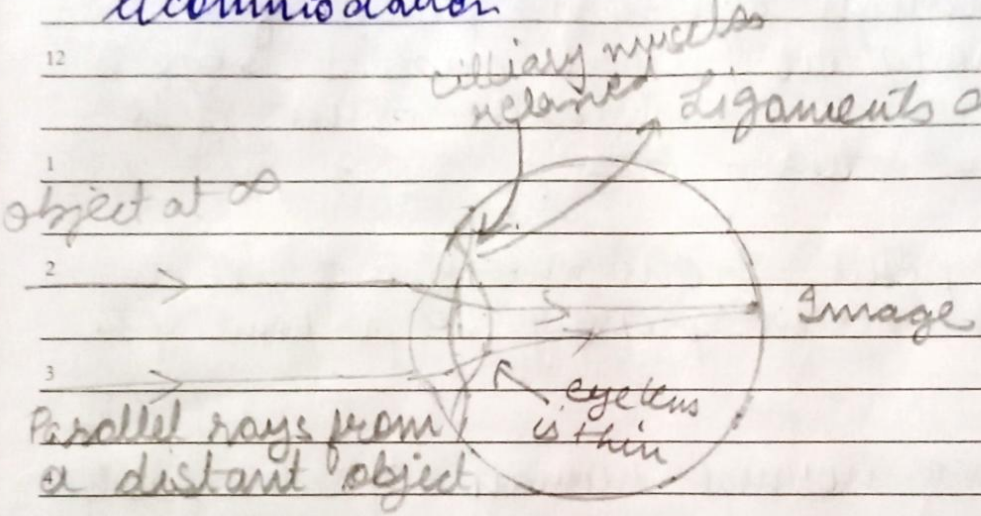
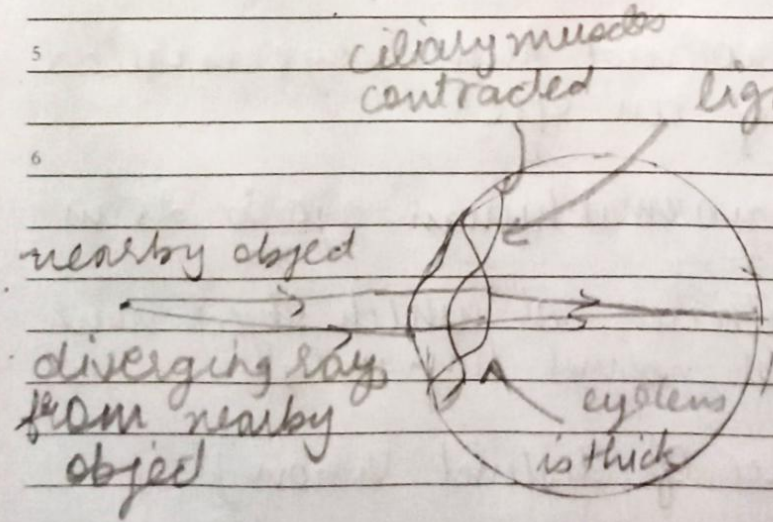




The ability of an eye to focus distant objects as well as nearby object by changing the focal length (or converging power) of a lens is called accomodation.

* Normal human eye has a power of accommodation which enables objects as far as infinity & as close as 25cm to be focused on retina.

* Farthest point from the eye at which object can be seen properly is 'far point' of the eye.

* Far point of normal human eye is infinity.

* Nearest point of normal human eye is called "near point" of an eye.

* Near point of a normal human eye is 25cm.

Minimum distance at which object must be placed, so that normal human eye

[least distance of distinct vision]

Defects of vision and their corrections

(i) Myopia (Near Sightedness/short sightedness)

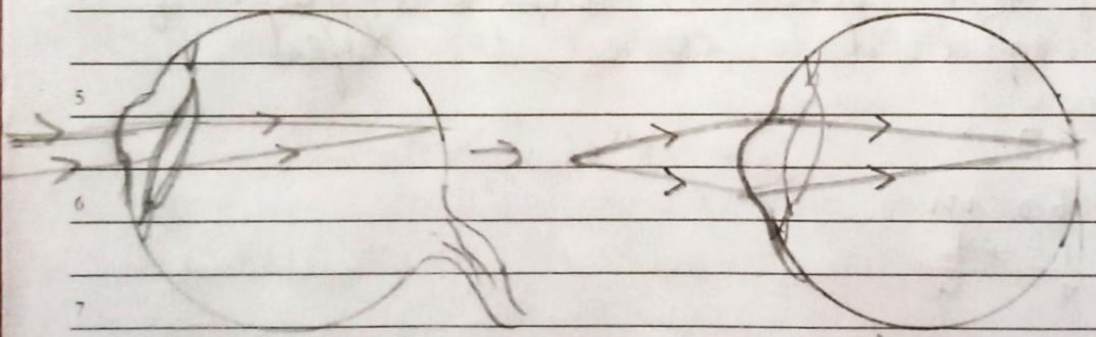
→ Myopia is that defect of vision due to which a person cannot see distant object but can see a nearby object.

→ Far point of an eye suffering from myopia is less than infinity.

→ It is caused by:-

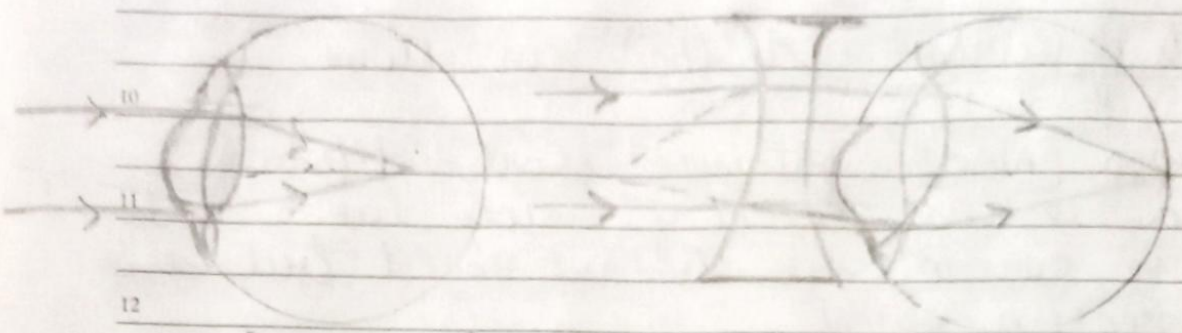
(a) Due to high converging power of eye lens or short focal length.

(b) Due to eye ball being long.



Normal eye

myopic eye with object at nearby point



myopic eye with distant position

corrected myopic eye

Myopia is corrected by using spectacles containing concave lens.

ones- Far point of a myopic eye is 80 cm in front of eye. What is nature & power of lens required to correct the defect.

$u = -\infty$

$v = -80\,cm$

$\frac{1}{F} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{F} = \frac{1}{-80} + \frac{1}{\infty}$

$\frac{1}{F} = -\frac{1}{80}$

Power $= \frac{1}{f(\text{in m})} = \frac{100}{f(\text{in cm})}$

$\frac{100}{80} = 1.25\ D$

$\boxed{f = 1.25\ D}$

(ii) Hypermetropia (Far sightedness / Long sightedness)

→ Hypermetropia is that defect of vision due to which a person cannot see the nearby objects clearly.

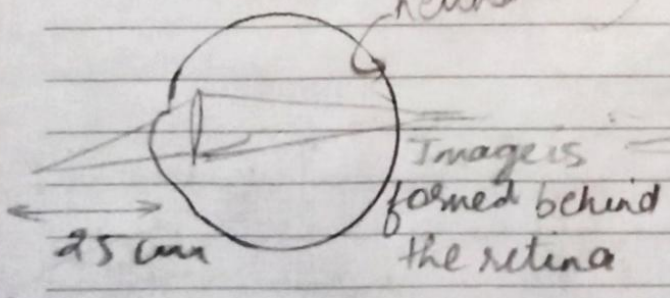
→ The near point of a hypermetropic eye is more than 25 centimetres away.

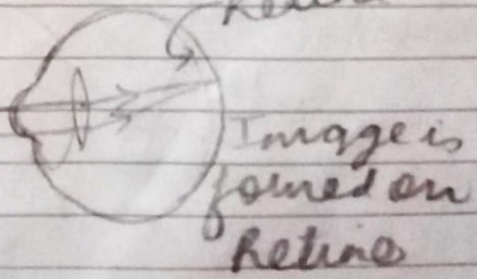
→ Hypermetropia is just the opposite of myopia.

Hypermetropia is caused by :-

(a) due to low converging power of eye-lens

(b) due to eye-ball being too short





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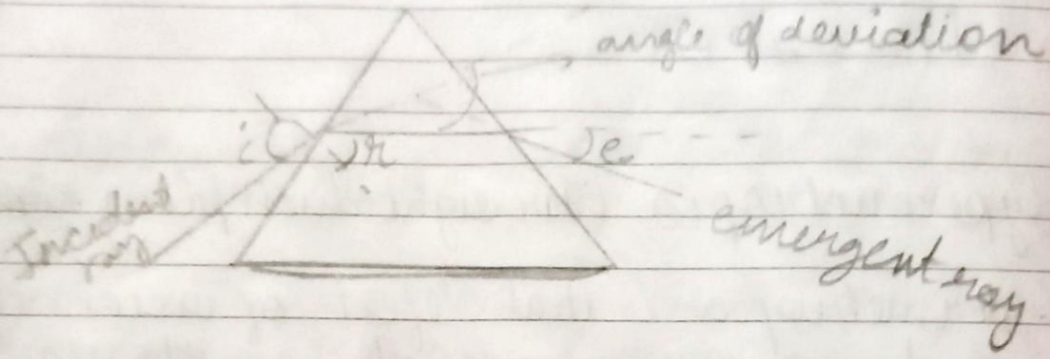
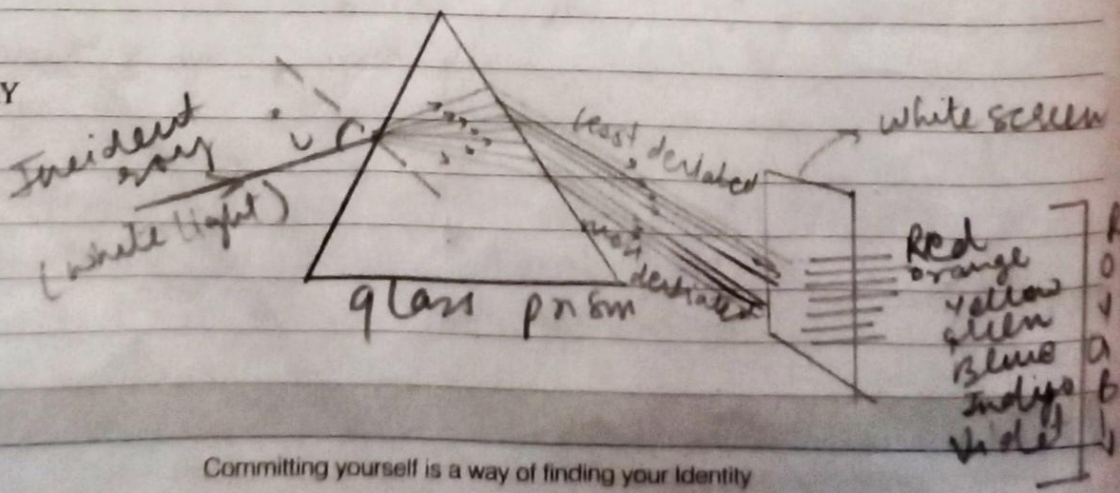
The angle between the initial path of the incident ray & emergent ray is called dispersion of light.



Dispersion of light
The band of seven colours ~~is called~~ formed on a white screen, when a beam of white light is passed through a glass prism is called spectrum of white light.



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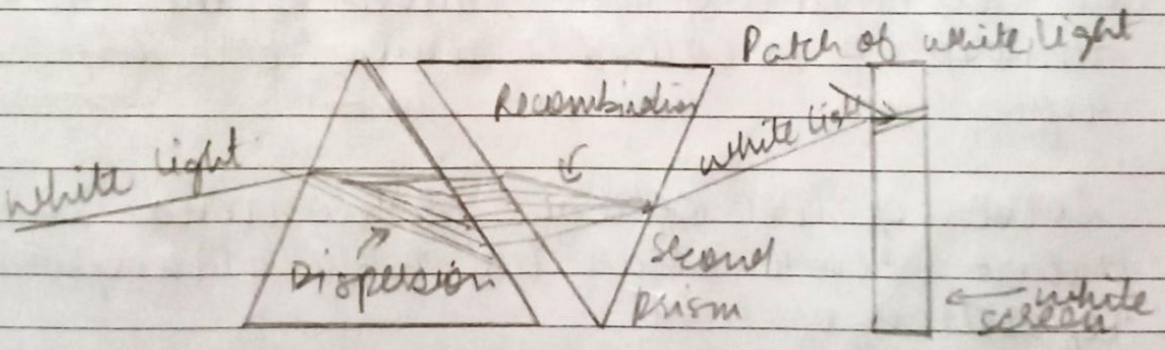
When white light consisting of seven colours falls on a glass prism, each colour in it is refracted by a different angle, with the result that seven colours are spread out to form a spectrum.

→ The red colour is deviated the least.
→ The violet colour is deviated the maximum.

Those colours in the order of increasing frequency differ only in their frequencies.

Recombination of spectrum colours to give white light:
These seven colours in the order of increasing frequency are to give back white light.



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The Rainbow

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.

A rainbow is produced by the dispersion of white light by the raindrops in the atmosphere. Each raindrop acts as a tiny glass prism splitting the sunlight into a spectrum.

Atmospheric Refraction

In the same atmosphere we have air layers having different optical densities.

The refraction of light caused by the earth's atmosphere is called atmospheric ~~dispersion~~ refraction.

Some of the optical phenomena in nature which occur due to the atmospheric refraction of light.

★ Twinkling of star

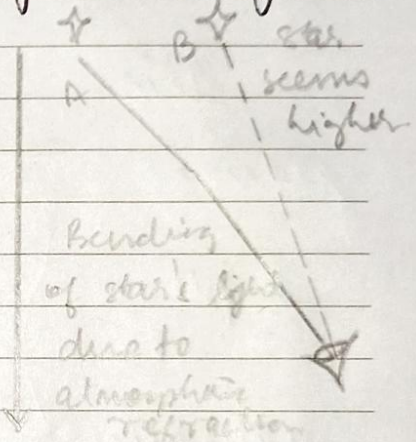
The twinkling of a star is due to the atmospheric refraction of star's light.

The continuously changing atmosphere is able to cause variations in light coming from a point sized star because of which the stars appears to be twinkling.

The stars seem higher than they actually are

Due to atmospheric refraction, the stars seem to be higher in the sky than they actually are.

Light from a star is refracted as it leaves space (a vaccum) and enters the earth's atmosphere. Air higher up in the sky is rarer but that nearer the earth's surface is denser.



Due to this refraction of star's light, the stars appears to be at a higher position.

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.

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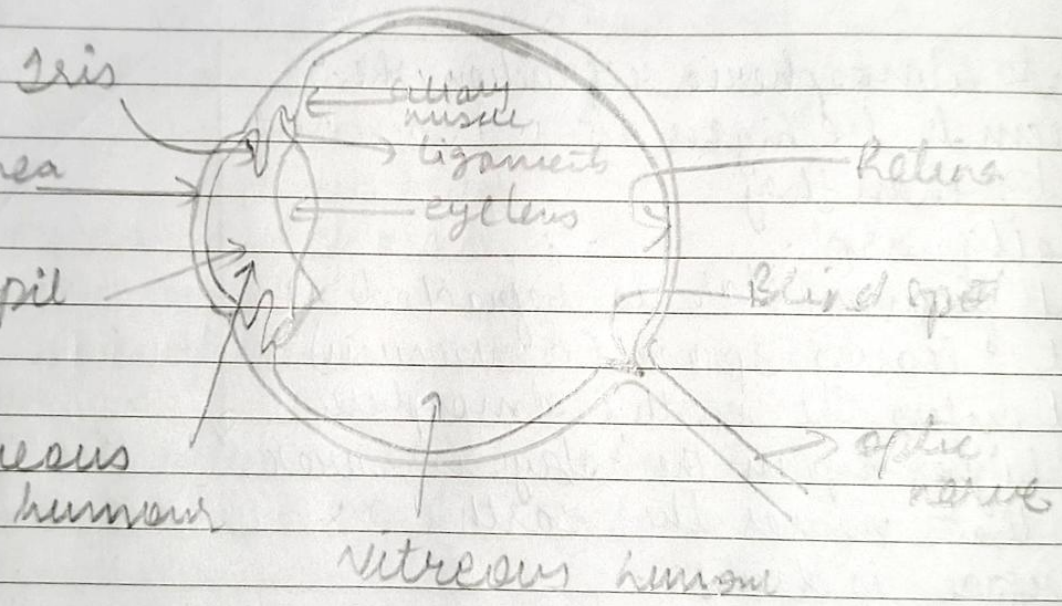
The time from sunrise to sunset is lengthened by about 2+2 = 4 minutes because of atmospheric refraction.

The human eye.



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