Ch-10

Thursday

Page No.: YOUVA
Date:

HUMAN EYE AND THE COLOURFUL WORLD

Parts & Functions of Human Eye (8 onwards cont.. behind)

1. Cornea – The transparent part of the eye, bulged outwards. Most of the light enters through cornea.

2. Iris – Has muscles and coloured pigments. The colour of the eye depends on the colour of these pigments. It controls and regulates the amount of light entering the eye by adjusting the size of the pupil.

3. Pupil – The hole in the centre of iris. When intensity of outside light is high, the pupil contracts. When intensity of outside light is low, the pupil expands.

4. Eye lens – Double-convex lens behind the pupil. This lens is made up of fibrous jelly-like material and held in the position of ciliary muscles.

5. Aqueous humour – The space between cornea and eyelens filled with viscous liquid. It is used to produce vitamins.

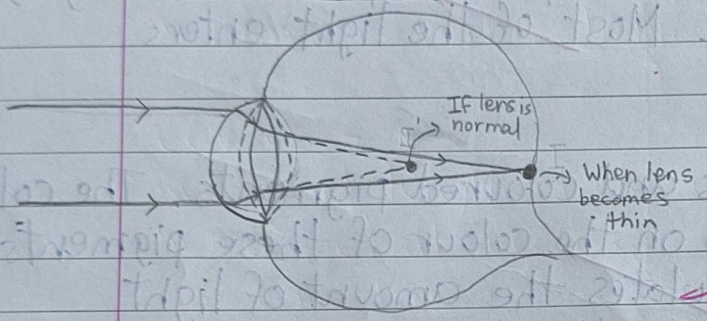
6. Vitrous humour – The space between eye lens and retina, a transparent jelly.

7. Retina – Behind the eyelens, screen on which image of the object is formed. It contains large number of light-sensitive cells in the form of rods and cones. The rod-type cells respond to intensity of light and cone-type cells respond to the colour of light.

POWER OF ACCOMMODATION

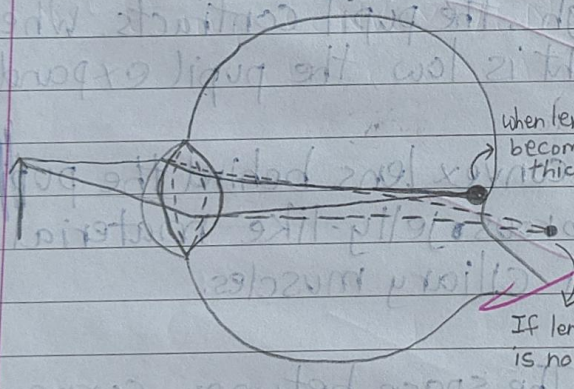
» Ciliary muscles – control the shape of the eye lens

When the object is far (distant)



Ciliary muscles relax
↓
Eye lens becomes thin
↓
Focal length increasing
↓
Image formation on retina

When the object is near



Ciliary muscles contract
↓
Eye lens becomes thick
↓
Focal length decreases
↓
Image formation on retina

» Power of Accommodation – Capacity of eye lens to adjust its focal length to see far and near objects clearly.

» Near point of healthy adult (normal eye) – 25 cm
» Far point of healthy adult (normal eye) – Infinite

DEFECTS OF VISION AND THEIR CORRECTION

1. Myopia (shortsightedness)

» Can see near objects clearly

» Cannot See distant / far objects clearly

Why?

» Image does not form on retina

» Image forms before retina

Causes -

» excessive curvature of the eye lens

» elongation of the eyeball

(The lens is not able to become thinner, and focal length does not increase)

Correction -

» Using CONCAVE LENS (diverging lens)

(to increase the focal length)

2. Hypermetropia (farsightedness)

- Can see far objects clearly
- Cannot see near objects clearly

Why?

- Image does not form on retina
- Image forms behind the retina

Causes -

- Focal length of the eye lens is too long
- eyeball becomes short
  (The lens is not able to become thicker, so focal length does not decrease)

Correction -

- Using CONVEX LENS (converging lens)
  (to decrease focal length)

3. Presbyopia
- occurs mostly in ~~old~~ old people
- can neither see far objects, nor near. (both myopia & hypermetropia)

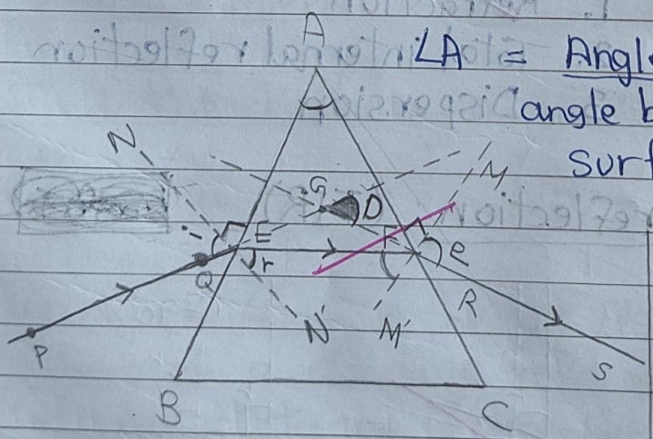
~~Why?~~ Causes –
- Weakening of ciliary muscles
- Eye lens lose flexibility

~~Causes~~ – Why?
- Power of accommodation decreases
- Near point recedes away

Correction –
- Using BI-FOCAL LENS

REFRACTION THROUGH PRISM (how much extent light ray has bent)

~~Prism~~ Prism –
2 triangular faces, 3 rectangular faces
to properly see how refraction takes place — refraction takes place here actually



∠A = Angle of prism
angle between 2 rectangular surfaces

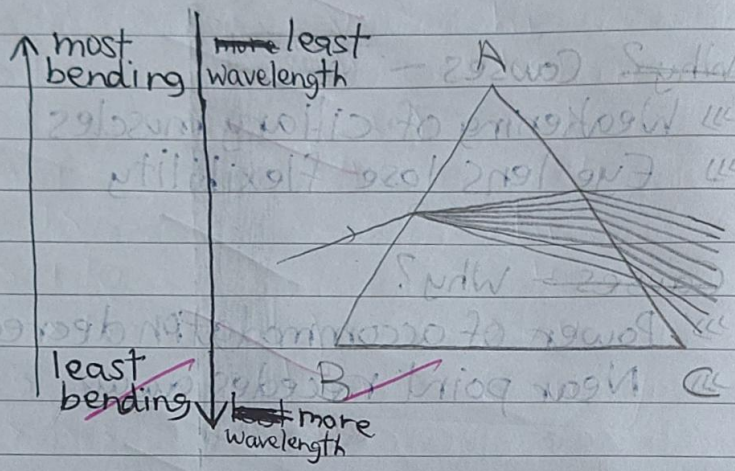
∠D = Angle of deviation
The angle between incident ray and emergent ray

PQ = incident ray
EF = refracted ray
RS = emergent ray
NN' = Normal 1
MM' = Normal 2
Li = Angle of incidence
Lr = Angle of refraction
Le = Angle of emergence

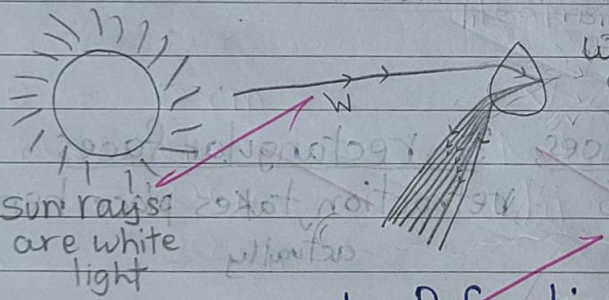
DISPERSION OF WHITE LIGHT THROUGH PRISM

» Splitting of white light into 7 constituent colours

Violet
Indigo
Blue
Green
Yellow
Orange
Red

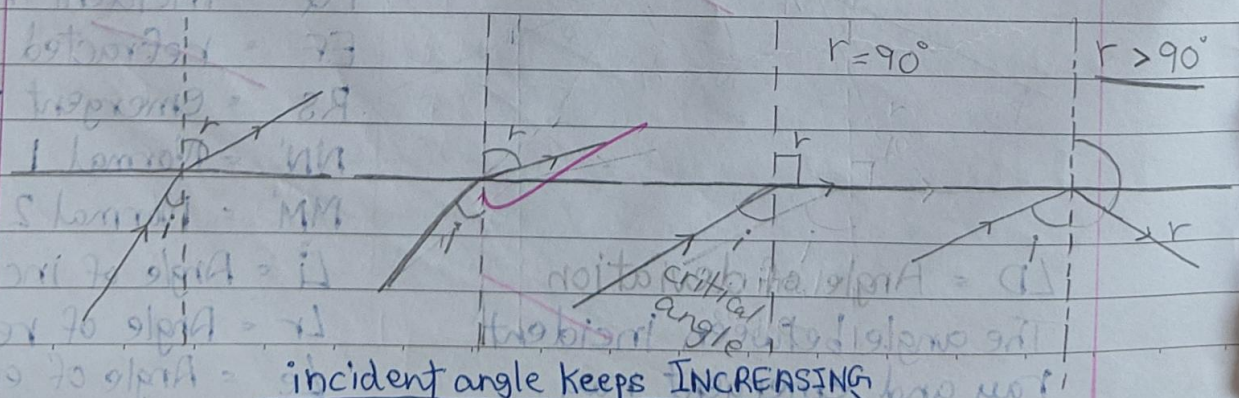


Formation of Rainbow



1. Refraction
2. Total internal reflection
3. Dispersion

Total internal reflection (TIR)

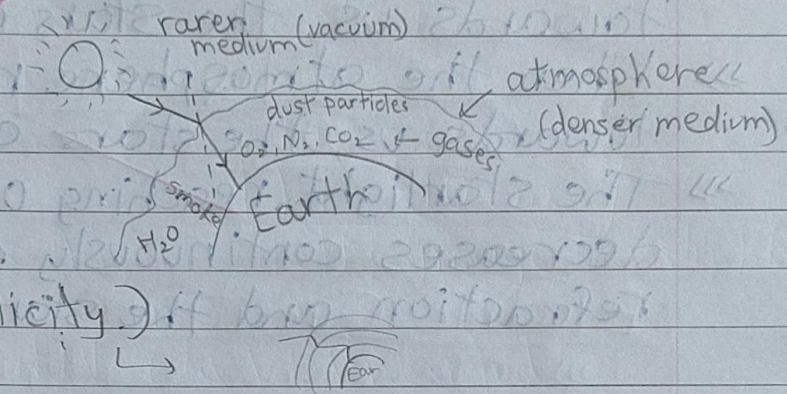


incident angle keeps INCREASING

ATMOSPHERIC REFRACTION

When light rays pass through through the atmosphere, they undergo refraction while travelling from one layer to another layer of different optical densities.
(refractive index.)

This type of refraction is known as atmospheric refraction.



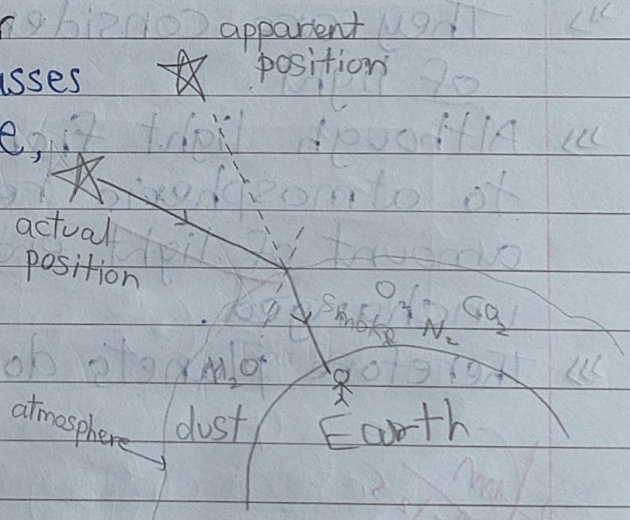
(The atmosphere has many layers where refraction takes place. This is just for simplicity.)

PHENOMENA

1. Apparent position of star

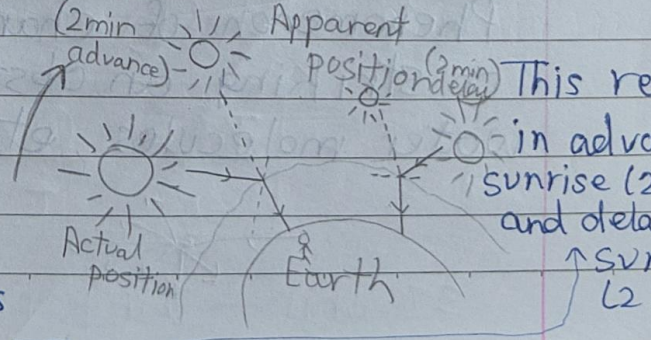
When the starlight passes through the atmosphere, it bends towards the normal due to the atmospheric refraction.

As a result, star appears higher than its actual position.



2. Advanced sunrise and delayed sunset (2 min)

When the sun rays passes through the atmosphere, the light rays bend towards the normal due to atm. refraction. ∴ The sun appears higher



This result in advanced sunrise (2 min) and delayed sunset (2 min)

3. Stars twinkle but planets do not

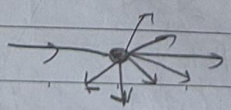
- Stars emit own light, and is a single point source
- The intensity of light changes continuously.
- One movement it is bright, and another moment it becomes dim.
- The twinkling of stars is due to atmospheric refraction, because of varying of optical densities of air.
- When the atmosphere refracts more starlight towards us, the stars appear to be bright.
- When the atmosphere refracts less starlight towards us, the stars appear to be dim.
- The starlight reaching our eyes increases or decreases continuously due to the atmospheric refraction and the stars appear to twinkle.

- Planets are closer to the Earth.
- They are considered as many point sources of light.
- Although light from each point flickers due to atmospheric refraction, yet the total amount of light entering our eye remains unchanged.
- Therefore, planets do not twinkle.

[redacted]

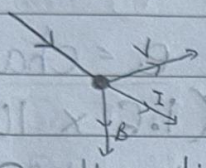
Scattering of light

Phenomenon of change in the direction of light on striking an obstacle like atoms, dust particles, water molecules, etc.

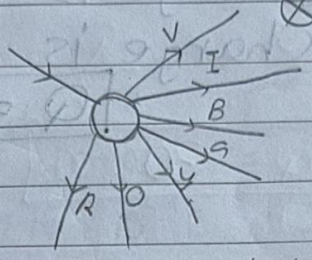


$1\text{Å} = 10^{-10}\ m$

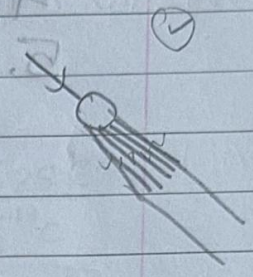
Colour	Wavelength(λ)	~~Frequency~~ ($v = \frac{c}{\lambda}$)
V	4000 Å	~~7.5 × 10^14 Hz~~
I	4500 Å	
B	4800 Å	
G	5400 Å	
Y	5800 Å	
O	6000 Å	
R	6900 Å	



Small particle
(scatters only least wavelength colours)



large particles
(scatters all colours)



PHENOMENA

1. Why is the sky blue?
Air molecules present in the atmosphere are very small and thus, scatters the light of least wavelength. Our eyes, being sensitive to see blue colour, cannot sense violet and indigo colours. Hence, sky appears blue in colour.

2. Why are the clouds white?
White light strikes large particles like water droplets and thus, scatters all seven colours (VIBGYOR). All seven colours merge to become white light. Thus, clouds appear white.