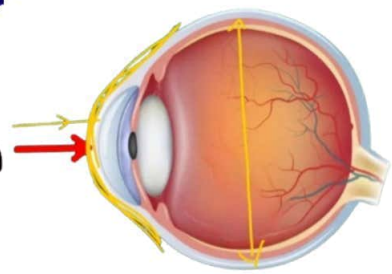
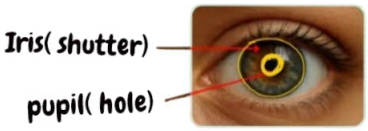
HUMAN EYE &
THE COLOURFUL WORLD

Functions of Different parts of Eye



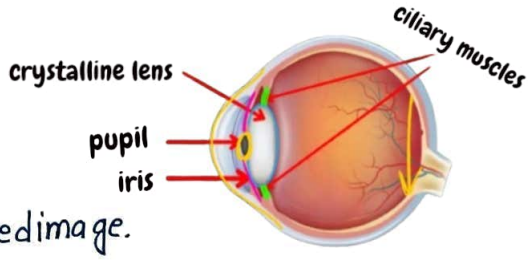
(1) Eyeball :-
- Approximately spherical
- Diameter → 2·3 cm

(2) Cornea :-
- Thin transparent bulging membrane.
- light enters the eye through cornea.
- Most of the refraction happens here (lens ka kaam) (80% refraction).
- Protects from dust, germs.



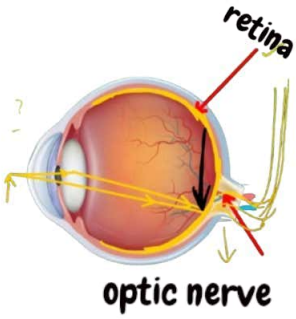
(3) Pupil :-
- Regulates and controls the amount of light entering the eye. [Hole]

(4) Iris :-
- controls the size of pupil.



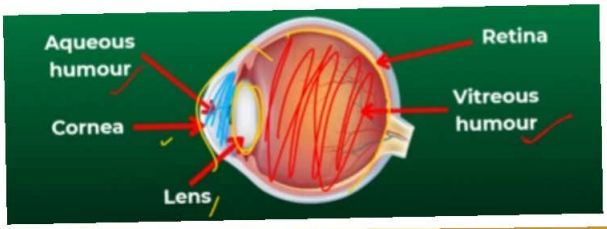
(5) Crystalline lens :-
- Convex lens.
- flexible focal length.
- forms real and inverted image.

(6) Ciliary muscles :-
- Adjust the focal length of eye lens to some extent.



(7) Retina :- (Screen)
- Real and inverted image is formed on retina.
- Has lots of light sensitive cells.
- Cells get activated when light falls on them and generates electrical signal.
- Rod → vision in low light (light intensity)
- cones → vision in high light + colour vision.

(8) Optics Nerve :-
- sends electrical signal to the brain.
- Nerve fibre.



Aqueous Humour	Vitreous Humour
Water like fluid	Gel like substance
It is present between lens & cornea	Present between lens and retina
Nutrition	Support & strength, helps the eye to keep its shape.

POWER OF ACCOMODATION :- P↑ f↓

The Ability of eye lens to adjust / changes its focal length.

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

D m

To view closer objects	To view distant objects
Ciliary muscles contract ↓ Lens becomes thick (curvature increases) ↓ Power increases & Focal length decreases	Ciliary muscles relaxes ↓ Lens becomes thin (curvature decreases) ↓ Power decreases & Focal length increases

P↑ f↓ P↓ f↑

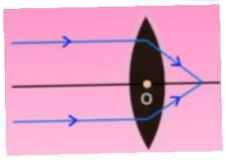
Near point :-

- The minimum distance from eye at which an object can be seen clearly and distinctly.
- it is also called least Distance of Distinct vision.
- For normal vision (young adults) → 25cm.

Far Point :-

- The farthest point upto which the eyes can see objects clearly.
- for normal eyes → infinity

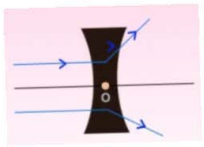
Convex Lens



- converging lens
- f → +ve
- P → +ve

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

Concave Lens



- Diverging lens
- f → -ve
- P → -ve

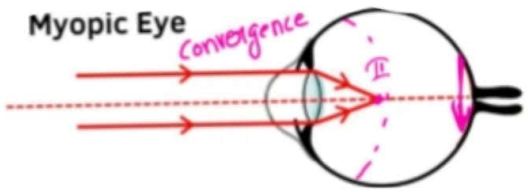
Defects in Human Eye :- (Myoni)

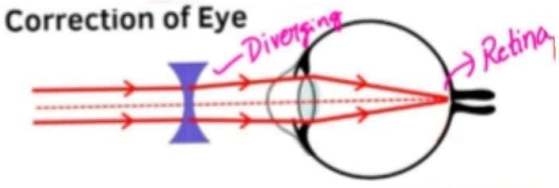
Myopia - Near Sightedness

1. can see nearby objects clearly.
2. cannot see distance objects clearly.
3. Near sightedness.
4. far point is less than infinity.
5. Image of distant object is formed in front (before) of Retina.

Reasons →

1. Excessive curvature of eye lens (lens becomes thick - more power)
2. Elongation of eye ball.





correction: Concave lens (Negative power lens)

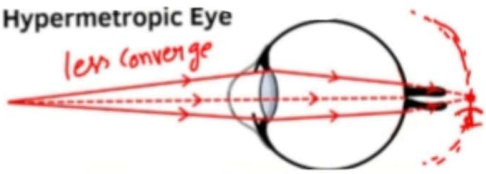
MyoNi (Myopia, Near Sightedness) **makes** **Elon** (Elongated of eyeball) **Thick, (Fat)** went **CAVE** (Concave Lens)

Lens Thick fat
f → less

Concave Lens
f → -ve
P → -ve

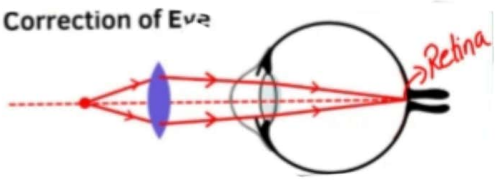
Hypermetropia - far Sightedness

1. Can see distant (far) objects clearly.
2. cannot see nearby objects distinctly (clearly).
3. far sightedness
4. Near point is more than 25 cm.
5. Image of nearby object is formed at a point behind Retina.



Reasons →

1. lens cannot get thick enough (focal length of eye lens is too long).
2. Eyeball has become too small.



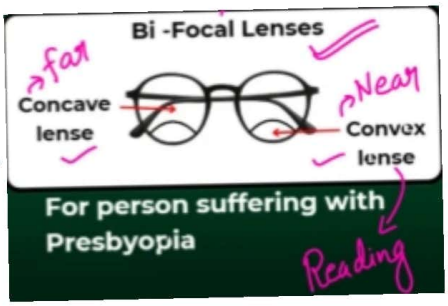
Corrections →

1. convex lens (positive power lens).

FaST (Far Sightedness) **Metro** (Hyper Metropia) **makes** **eye small,** (Eyeball small, shrink) **Face Large** (Focal length large, thin) **like Wax** (Convex lens)

Defect: Presbyopia (H+M)

- Presbyopia is a common defect of vision that usually occurs with ageing. it is difficult to read or see nearby objects clearly.
- Many elderly people hold books at a distance while reading.



Reasons →

- Weakening of ciliary muscles.
- less flexibility of eye lens.

Defect : Cataract

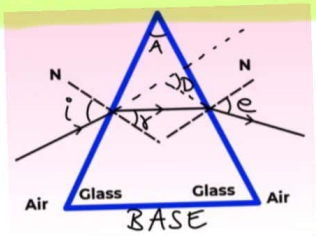
lens become opaque.
sometimes at old age crystalline lens becomes milky and cloudy
→ partial or complete loss of vision.

correction - Cataract surgery.

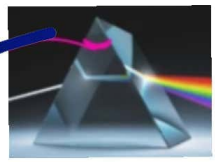
PRISM

A glass prism is a transparent refracting medium.
it has + 2 triangular + 3 rectangular surfaces.

Refraction of Light and Deviation through a prism



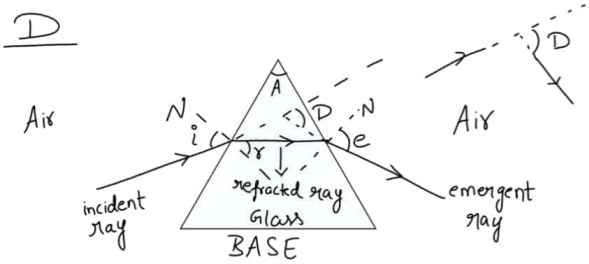
∠i → angle of incidence
∠r → angle of refraction
∠e → angle of emergence
∠D → angle of deviation

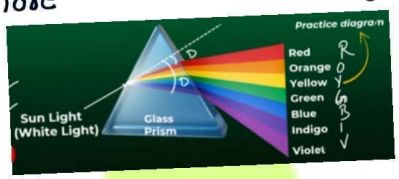


A prism bends a ray of light towards its Base

1. A prism bends a ray of light - Angle of deviation (∠D). ✓
2. We know that white light is made up of seven colors. ✗
3. ∠D is different for different colours of Light → some colours bend more than other.

Red Bends least
Violet bends most





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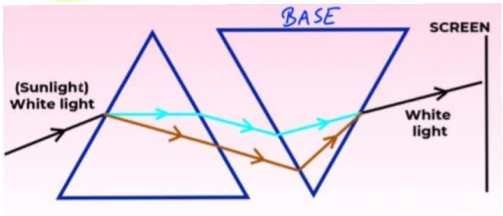
Dispersion

The splitting of white light into its component colours.

Spectrum

The band of colour components of light (obtained on screen).

Newton's prism Experiment (inverted Prisms)



Newton's Experiment demonstrated the :-

1) White light is made up of spectrum of colours.
2) The prism itself does not produces these colours.

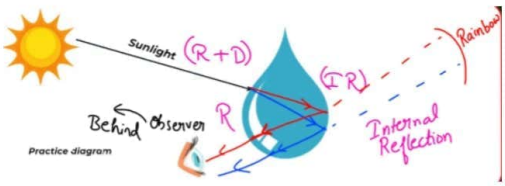
Rainbow - The Natural Spectrum

1. A rainbow is a natural spectrum appearing in the sky after a rain shower.
2. it is formed by dispersion of sunlight by tiny water droplets, Which acts like small prism.

3. A rainbow is always formed in a direction opposite to that of the sun.
4. A rainbow can also be seen on a sunny day if we look at the sky through a waterfall or through a water fountain with the sun behind.

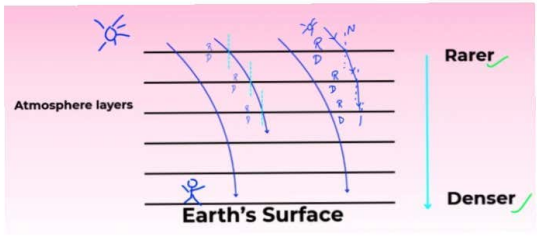
Conditions:-

1. Presence of Raindrop in air.
2. The Sun should be behind the observer.
3. sky with raindrops should be in front of observer.

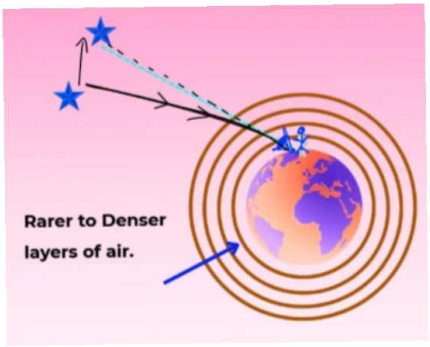


Atmospheric Refraction :-

1. light from stars, the sun, or the moon enters the Earth's atmosphere.
2. The atmosphere acts like a series of transparent layers of varying density.
3. When light travels from a rarer layer (less dense air, higher altitude) to a denser layer (closer to earth's surface), it slows down and bends towards the normal.

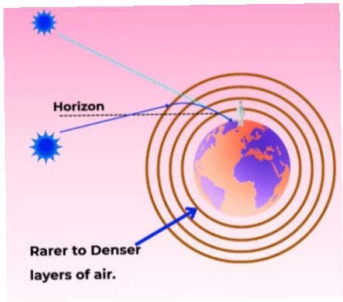


Apparent position of stars :-

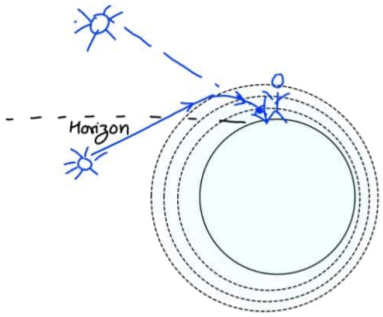


1. Atmosphere has many transparent layers of different densities.
2. Light bends towards the normal when it enters denser layers near the earth.
3. Our eyes trace the bent rays back in a straight line, so we see the star at a position slightly higher than its true position.

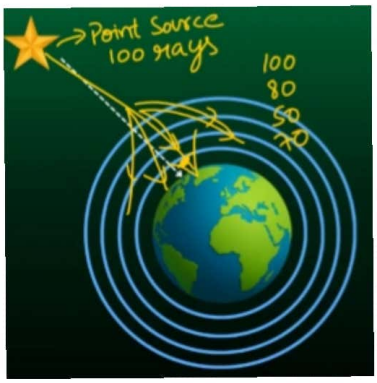
Advance Sunrise and Delay Sunset CBSE 2023



1. sun is visible 2 minutes before actual sunrise.
2. sun is visible for 2 extra minutes after actual sunset.



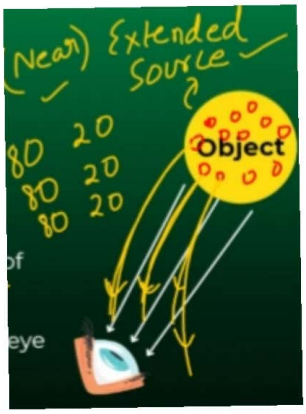
Twinkling of stars :-



1. stars are very far so they behave like point source of light.
2. The physical conditions like Temperature, pressure of Earth's atmosphere keeps on varying. Due to this density of layers also keep changing.
3. The path of ray of light coming from star keeps changing. Sometimes it bends more, sometimes less.
4. The apparent position of the star and the amount of starlight entering the eye keeps on changing the star sometimes look more bright, other times less bright.

Why planet do not Twinkle ?

1. Planets are near to Earth as compared to stars.
2. Planets behave as Extended Source of Light. (at tiny disk, not a point).
3. Extended source can be imagined as collection of Millions of point source of light.
4. Now, the total variation in the amount of light entering our eye averages out to zero and brightness remains same.



Scattering of light

Light changes its direction from its straight path when it strikes tiny particles (like dust, water droplets, air molecules, etc) present in any medium, causing it to spread out in multiple directions.

Tyndall Effect

1. The phenomenon of scattering of light by the colloidal particles.
2. A colloidal is a hetrogenous mixture. The size of particles of a colloid is too small to be individually seen with naked eyes.
   Example - Milk, smoke, Dust in air.
3. The path of a beam of light passing through a true solution is not visible.
4. But in colloidal solutions, colloids are big enough is scatter a beam of light passing through it and make its path visible.

Beam of sunlight enters a smoke-filled room through a small hole, dust particles scatter the light

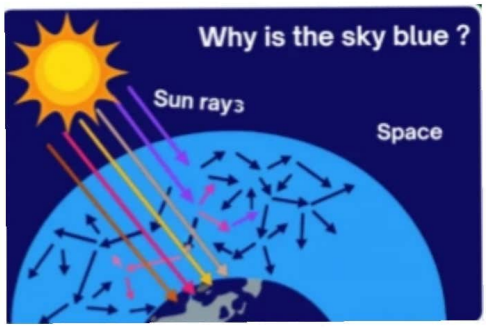
sunlight : passes through a canopy of a dense forest. Tiny water droplets in the mist scatter light.

The colour of the scattered light depends on the size of the scattering particles:

1. Very small particles scatter mainly blue light (smaller wavelength). V<R B<R
2. Very large particles scatter all colours of light equally.

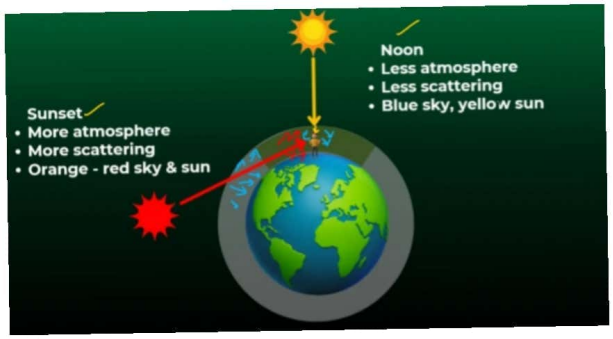
The red light has a wavelength about 1.8 times greater than blue light.

Blue Colour of Sky :-



1. The molecules of air and other fine particles in the atmosphere have very small size. (smaller than wavelength of visible light).
2. Scattering is more for blue colour (shorter wavelength) for very small particles than red colour.
3. Thus, scattered blue light enters our eyes and sky appears blue.

Reddening of the Sun at Sunrise & Sunset :-



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4. If the earth had no atmosphere, there would not have been any scattering. Then, the sky would have looked dark.
5. The sky appears dark to passengers flying at very high altitudes. Explain?
   At high altitude due to the absence of atmosphere scattering of light do not take place and hence sky appears dark to passengers flying at high altitude.
6. Danger signal lights are red in colour. Explain?
   Red light is least scattered by fog or smoke. Therefore, it can be seen in the same colour at a distance.

PYQ QUESTIONS

Q 1. In the human eye, most of the refraction for the light rays entering the eye occurs at the surface of : CBSE 2025, 2023, 2017

A. Cornea ~ 90%
B. Crystalline lens
C. Pupil
D. Aqueous humor

Q 2. The part of the human eye which can modify the curvature of the eye lens to some extent is : CBSE 2025, 2023, 2017

A. Pupil
B. Cornea
C. Ciliary muscles
D. Aqueous humour

Q 4. The lens system of human eye forms an image on a light sensitive screen, which is called as CBSE 2024

A. cornea
B. ciliary muscles
C. optic nerves
D. retina

Comment

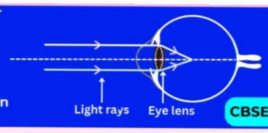
Q 5. When we focus our eyes on a distance object, the ciliary muscles of our eyes are relaxed. In this case the eye lens becomes CBSE 2025,2016

A. thin and its curvature is maximum.
B. thin and its curvature is minimum.
C. thick and its curvature is minimum.
D. thick and its curvature is maximum.

Thin curvature ↓ P ↓ f ↑

Q 6. Observe the following diagram and answer the questions following it :

a. Identify the detect of vision shown.
b. List its two causes.
c. Name the types of lens used for the correction of this defect.

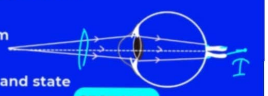


CBSE 2020

a) Myopia or Near Sightedness
b) Two Causes
1. Excessive curvature of eye lens (lens becomes thick - more Power)
2. Elongation of eye ball
c) Concave lens

Q 7. Study the diagram given below and answer the questions that follow .

a. Name the defect of vision depicted in this diagram
b. List two causes of this defect.
c. Name the type of lens used to correct this detect and state its role in this case.



CBSE 2024

a) Hypermetropia
b) Two Causes →
1. lens cannot get thick enough (Focal length of eye lens is too long)
2. Eyeball has become too small.
c) Convex lens , it converges the rays coming from naerby object on retian

Q 8. A student has difficulty in reading his textbooks but can read the blackboard clearly while sitting in the last row. Name the defect of vision the student is suffering from. List two reasons due to which this defect arises. Write the nature of the lenses required to correct this defect.

Far Sightedness → Hypermetropia CBSE 2025, 2017, 2014

The student is suffering from Far Sightedness / Hypermetropia ,as he can see far objects clearly but has difficulty in reading nearby textbooks.
Two reasons forthis defect-

- Lens cannot get thick enough (Focal length of eye lens is too long)
- Eyeball has become too small.

A Convex lens of appropriate Focal length is required for correction

Q 9. The power of a lens 'X' is –2.5 D. Name the lens and determine its focal length in cm. For which eye defect of vision will an optician prescribe this type of lens as a corrective lens? CBSE 2025, 2017

-ve power → focal length
i) Concave lens

$P = \frac{1}{f(m)}$ (D)

$-2.5 = \frac{1}{f}$

$f = -\frac{1}{2.5}$ m

$f = -\frac{1}{2.5} \times 100$ cm $= -40$ cm

Myopia

Q 10. In bifocal lenses used for the correction of presbyopia: CBSE 2025, 2024, 2023

A. the upper portion is of convex lens for the near vision and lower part is of concave lens for the distant vision.
B. the upper portion is of convex lens for the distant vision and lower part is of concave lens for the near vision.
C. the upper portion is of concave lens is for the near vision and lower part is of convex lens for the distant vision.
D. the upper portion is of concave lens for the distant vision and lower part is of convex lens for the near vision.

→ Concave → far
→ Convex → Reading / Near

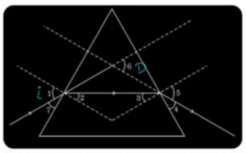
Q 11. Person suffering from cataract has CBSE 2020

A. elongated eyeball
B. excessive curvature of eye lens
C. weakened ciliary muscles
D. opaque eye lens

Comment

Q 12. In the given figure the angle of incidence and the angle of deviation respectively are. CBSE 2025, 2016

A. 1 and 5
B. 7 and 6
C. 7 and 4
D. 1 and 6



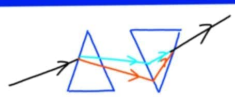
Q 13. The white light entering a glass prism, gets split into its constituent colours. It is observed that: CBSE 2025, 2024, 2023

A. Red light deviates the most.
B. Violet light deviates the least.
C. Yellow light deviates more than the blue light.
D. Green light deviates more than the orange light.

Q 14. Why is the cause of Dispersion ? CBSE 2024

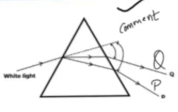
A prism bends a ray of light. Different colours of Light bends through different Angle. For Violet light , Refractive index of glass is slightly more than for red colour. So Violet bends more. This separates different colours of light and we see dispersion. D ↑

Q 15. Explain with the help of a labelled ray diagram, an experimental arrangement to show the recombination of the spectrum of white light. CBSE 2025, 2023



Q 16. In the following diagram showing dispersion of white light by a glass prism, the colours 'P' and 'Q' respectively are CBSE 2024

A. red and violet
B. red and blue
C. violet and red
D. orange and green



Comment

Q 17. The phenomena of light involved in the formation of rainbow are

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A refraction, reflection and dispersion

B refraction, dispersion and internal reflection

C reflection, dispersion and internal reflection

D refraction, dispersion, scattering and total internal reflection

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Q 18. Assertion (A): The rainbow is a natural spectrum of sunlight in the sky.
Reason (R): Rainbow is formed in the sky when the sun is overhead and water droplets are also present in air.

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A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)

B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A)

C Assertion (A) is true, but Reason (R) is false

D Assertion (A) is false, but Reason (R) is true

Q 19. When a beam of white light passes through a region having very fine dust particles, the color of light mainly scattered in that region is

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A red

B orange

C blue

D yellow