

HUMAN EYE AND COLORFUL WORLD

1) What is a human eye?

A) Eye is a sense organ helpful for vision.

2) Explain the working of different parts of human eye.

A) **Cornea**: A thin membrane covering the surface of eye ball through which light enters into the eye by refraction. It acts as a primary lens.

Iris: A dark muscular diaphragm located just behind the cornea. It controls the size of pupil with respect to intensity of the light.

Pupil: A black opening of eye which allows the light to the eye lens. It regulates and controls the amount of light entering the eye.

Ciliary Muscles: The muscles hold the eye lens in position are called Ciliary muscles. They adjust the focal length of eye lens with respect to object distance by the action of contract and relax.

Eye Lens: It is a convex lens composed of fibrous jelly like material. It focuses incident rays from object on the retina.

Retina: A delicate membrane having enormous number of light sensitive cells acts like a screen is Retina. A real inverted image is formed by the lens on it.

Optic Nerve: A nerve from the retina to brain carries electrical impulses of image for interpretation of the image formed on retina.

3) What is the image distance in human eye?

A) The distance between eye lens and retina is 2.5cms. Therefore, the image distance is 2.5cms.

4) What is the power of accommodation?

A) The adjustment of focal length of eye lens with respect to object distance is called power of accommodation.

5) What is the range of power of accommodation of human eye?

A) The minimum focal length of human eye is 2.27cms to 2.5cms.

6) Define far point and near point of healthy human eye.

A) **Far point**: The maximum distance of an object can able to see very clearly with naked eye is called "Far point". The far point of healthy human is infinite distance.

Near point (or) Least Distance of Distinct vision: The minimum distance between the object and human eye to see clearly is called "Near point" or "Least distance of distinct vision". For healthy human eye Least distance of distinct vision is 25cms.

7) Explain the key role of ciliary muscles in the power of accommodation.

- A) 1. The adjustment of focal length of eye lens with respect to object distance is called the power of accommodation.
2. It is caused by ciliary muscles hold the eye lens.
3. When we see nearby objects, the focal length of eye lens decreases due to eye lens become thicker by contract of ciliary muscles.
4. When we see distinct objects, the focal length of eye lens increases due to eye lens become thinner by relax of ciliary muscles.

8) What are rods and cones? Explain their functioning.

- A) 1. Rods and cones are sensitive cells present in retina.
2. Cones respond to the colours.
3. Where as rods respond to intensity of light.

9) Compare the similarities and dissimilarities between camera and human eye.

A) Similarities:

Human Eye	Camera
1. Image formed by eye lens made of fibrous jelly matter	1. Image formed by convex lens made of glass
2. A real and inverted image is formed on retina .	2. A real and inverted image is formed on photo film.
3. Time of exposure is controlled by eye lids	3. Time of exposure is controlled by shutter.
4. Amount of light Entering into the eye is controlled by pupil in the iris.	4. Amount of light entering into the camera is controlled by its diaphragm.

Differences:

Human Eye	Camera
1. Focal length of eye lens can be changed with respect to object distance .	1. Focal length of camera lens is fixed.
2. Image on eye lens retain for about $1/16^{\text{th}}$ of second	2. Image on photographic film is retained permanently .

10) What is cataract?

- A) 1. The crystalline lens of human eye becomes cloudy and milky at old age is called "Cataract".
2. It causes partial or complete loss of vision.

3. To restore the vision by a surgery called “cataract surgery”.

11) What is night blindness and colour blindness ?

A) **Night Blindness:** Some of the persons cannot able to see at nights, But can see in day time , such defect is called “Night blindness” .It is caused by lack of rods.

Colour Blindness: Some of the persons cannot able to identify colours , such defect is called “Colour Blindness” .It is caused by lack of cones.

12) Write a short notes on defect of vision Myopia.

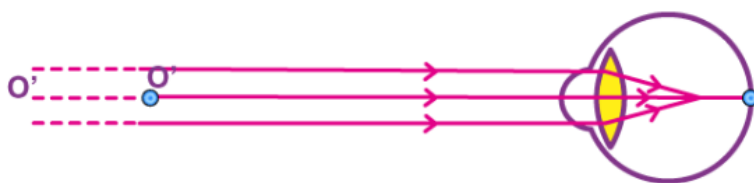
A) 1. Some of the persons can able to see near by objects clearly but not distant object clearly. Such defect is called “Myopia” or “Short sightedness”.

2. For a myopic person distant vision is restricted to a limited extent from infinite distance, such limited extent is called far point of myopic eye.

3. Because his maximum focal length decreases from 2.5cms by

- i. excessive curvature of the eye lens or
- ii. elongation of the eye ball

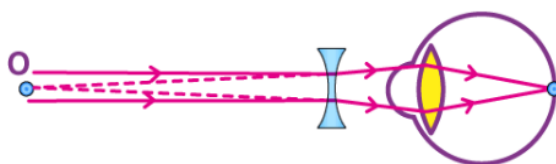
4. Due to this, object is beyond far point whose image is formed before the retina. Hence not able to see objects clearly.



(b) Myopic Eye

Here 'o' is far point

5. Myopia can be corrected by using concave lens of suitable focal length.



(b) Correction for Myopic Eye

13) What is the focal length of concave lens using to correct Myopia?

A) The focal length of concave lens using to correct Myopia = $-D$ m.

Where D is, Far point of Myopic eye.

14) A person cannot able to see the objects beyond 20m. What is his far point ? Name the defect of vision he is suffering from? Give solution for his defect.

A) 1. His far point (D) is = 20m.

2. He is suffering from Myopia.

3. Using concave lens of focal length (f) = -20m.

4. The power of lens (p) = $1/f$
 $= 1/-20$
 $= -0.05 \text{ D}$

15) A person with a Myopic eye cannot see objects beyond 1.2m distinctly . What should be the type of the corrective lens used to restore proper vision?

A) Given:

Far point (D) = 1.2m

Using concave lens of focal length 1.2m with power(p) = $1/-1.2$
 $= -0.83 \text{ D}$

16) A student has difficulty in reading the black board while sitting in last row. What could be the defect the child is suffering from? How can it be corrected?

A)1. He can able to see near by objects but not distant . So, he is suffering with "Myopia".

2.It can be corrected by using concave lens .

17) The far point of Myopic person is 80cms in front of the eye. What is the nature and power of the lens required to correct the problem ?

A) Myopia can be corrected by using concave lens.

Given :

Far point (D) = 80cms

There fore Focal length (f) = -80cms

There fore power (p) = $100/f$ (where f is in cms)
 $= 100/-80$
 $= -1.25 \text{ D}$

18) Write a short notes on defect of vision "Hypermetropia" .

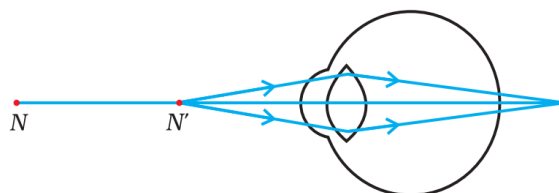
A)1. Some of the persons can able to see distant objects but not near by objects is called " Hypermetropia" (or) " Long sightedness".

2. For a Hypermetropic person ,near vision is shifted away from least distance of distinct vision i.e 25cms .Such shifted distance is called near point of Hypermetropic eye.

3. Because his minimum focal length increases from 2.27cms by

- i. The focal length of focal lens is too long or
- ii. The eye ball has become too small .

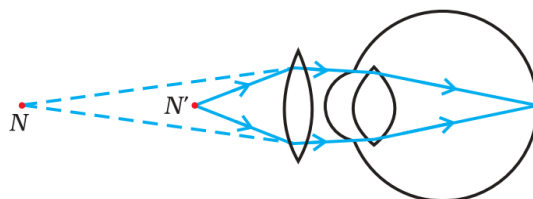
4. Due to this, object between near point and least distance of distinct vision whose image is formed beyond retina. Hence not able to see objects clearly.



(b) Hypermetropic eye

Here N is near point and N' is Least distance of distinct vision.

5. Hypermetropia can be corrected by using convex lens of suitable focal length.



(c) Correction for Hypermetropic eye

19) What is the focal length of convex lens used to correct Hypermetropia?

A) The focal length of eye lens using to correct Hypermetropia

$$f = 25d / d - 25$$

Where, d is near point of Hypermetropic eye.

20) A boy cannot see objects within 50cms from his eye. What is the defect of vision he is suffering from? Give solution for his defect.

A) 1. He is suffering from "Hypermetropia".

2. Used to correct convex lens.

3. Focal length of convex lens is $(f) = 25d / d - 25$

Given :

$$d = 50\text{cms}$$

$$f = 25 \times 50 / 50 - 25$$

$$= 25 \times 50 / 25$$

$$= 50\text{cms}$$

$$\begin{aligned} \text{4. power of lens (p)} &= 100/f \\ &= 100/50 \\ &= +2 \text{ D} \end{aligned}$$

(Where f is in cms)

21) List the persons who are suitable and not suitable for eye donation.

A) **Suitable for eye donation:**

1. Belongs to any age group and any sex.
2. People who use spectacles or operated for cataract
3. People who are diabetic, have hyper tension, asthma patients without Communicable diseases.

Not Suitable for eye-donation:

1. Persons who infected with or died because of aids, hepatitis B or C , rabbis, acute leukemia, tetanus, cholera, meningitis.

22) Why is a normal eye cannot see the objects clearly when an object is placed less than 25cms?

A) The ciliary muscles cannot make the eye lens more convex to increase its converging power to see the objects less than 25cms.

23) What happens to the image distance in the eye when we increase the distance of an object from the eye?

- A) 1. Where ever the object, the image is formed on retina. Hence there is no change in image distance in human eye with respect to object distance.
2. Because eye lens changes its focal length with respect to object distance.

24) What is presbyopia? How can you correct it?

- A) 1. The power of accommodation of the eye usually decreases with ageing.
2. The find it difficult to see near by objects comfortably and distinctly without corrective glasses, this defect is called 'Presbyopia'.
3. It is caused due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens.
4. It is corrected by using bifocal lenses.

Note: i. Bifocal lens is the combination of both concave and convex lenses.
ii. The upper portion of the bifocal lens is 'Concave lens' for distant vision.
iii. The lower part is 'Convex lens ' for near vision.

25) What is a 'Prism'?

A) A transparent medium with two triangular bases and three rectangular lateral surfaces inclined to each other at a certain angle is called a 'Prism'.

26) Define angle of Prism.

A) The angle between inclined rectangular surfaces of a prism is called angle of 'Prism'.

27) Define angle of deviation.

A) The angle between emergent ray and incident ray is called angle of Deviation.

28) What is a 'Spectrum'?

A) The group of colored components of a light beam is called 'spectrum'.

29) What is white light?

A) White light is the spectrum of seven colors.

30) What is dispersion of light?

A) The splitting up of a white light into its seven component colors "VIBGYOR" is called dispersion of light.

31) Why a white light is splits into seven colors? (Or) Why a white light is dispersed when it is incident on a prism?

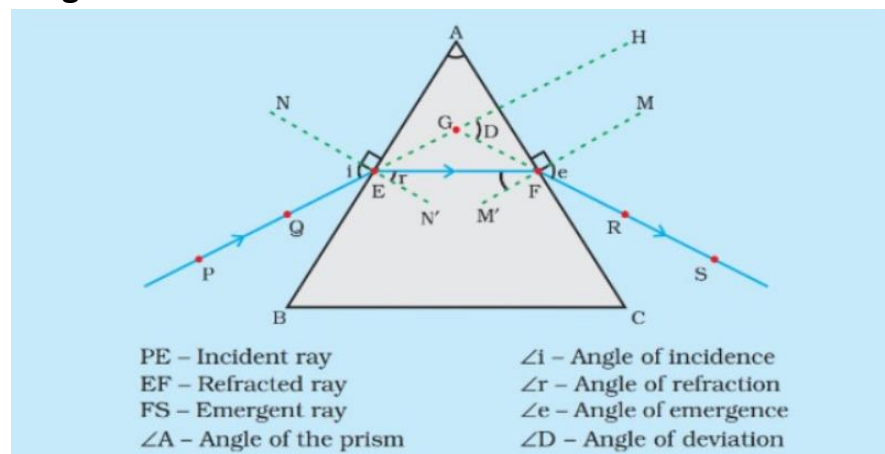
- A) 1. The refractive index of the material is changes with wavelength of a light.
2. White light is a spectrum of seven different colors, each color is having its own frequency and wavelength.
3. Therefore, Each color bends through different angle with respect to incident ray.
4. Hence, white color undergoes dispersion and splits into seven colors.

32) Explain refraction of light through a prism.

A) **Aim:** To study about refraction of light through a prism.

Apparatus: Drawing board, White paper, Prism, Pencil, Drawing pins and Protractor.

Diagram:



Procedure:

1. Fix a sheet of paper on a drawing board by using drawing pins.
2. Place triangular base of prism on the paper, trace the outline of the prism using pencil and remove it.
3. Draw a straight line 'PE' inclined to surface 'AB' and fix two pins 'P', 'Q' on line 'PE'.
4. Now again place the prism on the outline and observe the images of 'P', 'Q' through the surface 'AC'.
5. Fix two more pins 'R' and 'S' collinear with images of 'P' and 'Q'.
6. Now remove the pins 'R', 'S' and draw a straight line through 'R' and 'S' to meet surface 'AC' at 'F'.
7. Draw normal at 'E' of surface 'AB' and at 'F' of surface 'AC' and then join 'EF'.
8. Now mark the angle of incidence $\angle i$, the angle of refraction $\angle r$ and the angle of emergence $\angle e$.

Explanation:

1. Here 'PE' is the incident ray, refracted at point 'E' at the air-glass interface 'AB'.
2. 'EF' is the refracted ray of incident ray 'PE'.
3. Now 'EF' is the incident ray refracted at point 'F' at the glass-air interface 'AC'.
4. 'FS' is the emergent ray i.e refracted ray of 'EF' at 'AC'.
5. Like this light is deviated twice through the prism.

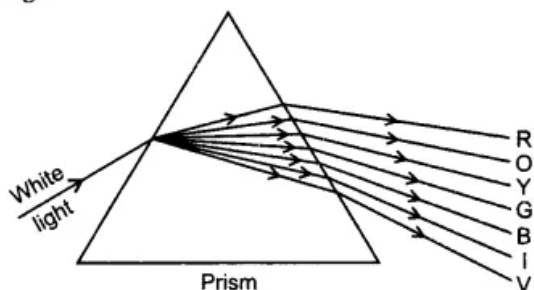
Note: i. Extend incident light ray 'PE' up to point 'H' and extend emergent ray 'FS' up to point 'O'.

ii. These two rays make an angle at point 'O' is ' $\angle D$ ' is called angle of deviation.

33) Explain dispersion of white light with an activity.

A) **Aim:** To study the dispersion of white light by a glass prism.

Apparatus: Glass prism, source of white light, screen.

Diagram:

Procedure:

1. Focus a white light at one surface of the prism, and place a screen opposite to direction of white light behind prism.

Observation:

1. A colour pattern is obtained
2. The colour sequence is Violet, Indigo, Blue, Green, Yellow, Orange and Red. i.e. "VIBGYOR".

Conclusion:

1. The ray of white light passing through the prism splits into its seven constituent colours.
2. The different colours of light having different wavelengths, bend through different angles because refractive index depends on wavelength and speed of light.
3. Red colour deviates least and Violet colour deviates most.

Note:

1. Frequency of a colour never changes while refraction.
2. Red colour deviates least because it has least frequency and highest wavelength among all colours.
3. Violet colour deviates most because it has highest frequency and least wavelength among all colours.

34) Describe an activity to show that recombination of the spectrum of white light.

A) **Aim:** Study about recombination of the spectrum of white light.

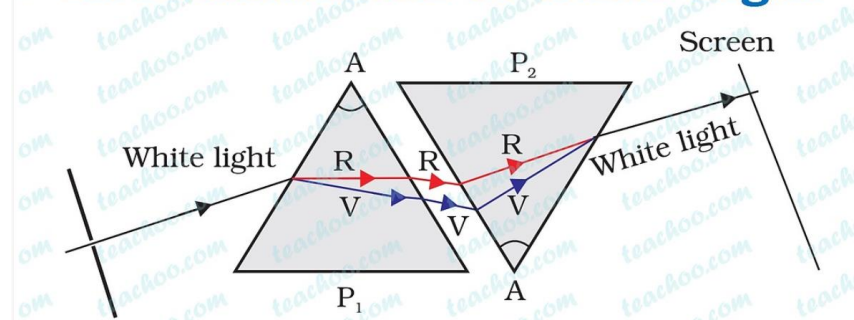
Apparatus: Source of white light, two identical prisms, a screen.

Procedure:

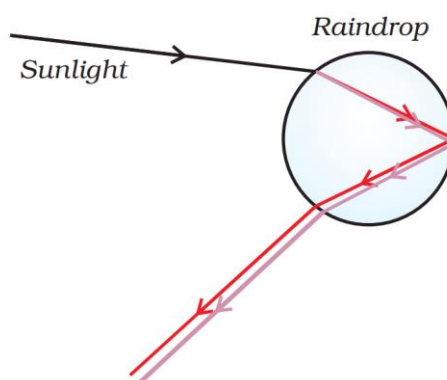
1. A triangular prism P1 is placed on its base, allow the white light through it.
2. We are observed that its dispersed colours at the other side of prism.
3. Now take two prisms P1 and P2 and arrange them as shown in the diagram and place a screen behind the prism P2.
4. Now allow the white light through the prism P1, the constituent colours of white light incident on the inverted prism P2.
5. The prism P2 recombines them into a beam of white light and emerges from the other side of the prism P2 and falls on the screen.

Diagram:

Recombination of White Light



35) Explain the formation of Rainbow?



Formation of Rainbow

- A) 1) A rainbow is a natural spectrum of sunlight in the form of bows appearing in the sky when the sun shines on rain drops.
- 2) It is combined result of reflection, refraction and dispersion of sunlight from water droplets, in atmosphere.
- 3) It always forms on the direction opposite to the sun.
- 4) To see a rainbow, the sun must be behind us and the water droplets fall in front of us.
- 5) When a sunlight enters into a spherical rain drop, it is refracted and dispersed. The different colours of light are bent in different angles.
- 6) When different colours of light fall on the back inner surface of drop, it reflects internally (total internal reflection).
- 7) The water drops again refract the different colours, when it comes out from the raindrop.
- 8) After leaving these different colours from the raindrop as rainbow, reach our eye. Thus, we see a rainbow.

36)What is atmospheric refraction?

- A)1. Density of air decreases gradually from the surface of the Earth to higher altitudes.
2. Therefore, there is a gradual change in the refractive indices of air (Atmosphere) layers.
3. When the light from stars enters into the Earth's atmosphere, refracts multiple times due to change in refractive indices of air.
4. This is called atmospheric refraction.
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37)Why do stars twinkle?

- A)1. The twinkling of stars due to atmospheric refraction of star light.
2. When the light from the stars enters into Earth's atmosphere, undergoes continuous refraction of light due to continuous change in refractive indices of air by gradual change in air density.
3. Due to this the apparent position of stars is higher than its original position and appear to twinkle.
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38)Explain why planets do not twinkle?

- A) 1. The planets are nearer to us than stars.
2. They are appeared larger in size than the stars.
3. Therefore, planets cannot be considered as point source.
4. Hence they are not to twinkle.
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39)Discuss the advanced sunrise and delayed sunset.

- A)1. The sun is visible to us about 2mins before the actual sunrise and about 2mins after the actual sunset because of atmospheric refraction.
2. Actual sunrise means, the actual crossing of the horizon by the sun.
3. Due to atmospheric refraction, the apparent position of the sun is above its actual position with respect to horizon.
4. The time difference between actual sunset and apparent sunset is about 2mins.
5. The apparent flattening of the sun at sunrise and sunset is also due to the same phenomenon.
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40)What is scattering of light?

- A) The re-emission of light in all directions by a particle in a medium collided with light due to vibration of the particle is called Scattering of light.
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48) Why does the sky appear dark instead of blue to an astronaut ?

A) This is because there is no atmosphere containing in the outer space to scatter a light. Since, there is no light can reach our eyes in outer space. Therefore, the sky looks dark and black.

49) Explain why, if we look at objects through the hot air over a fire, the objects appear to be swaying(or) flickering?

A) 1. density of air is not same due to difference in temperature between observer and the object.

2. Due to this between the object and the observer, air is having different refractive indices.

3. As a result light undergoes multiple refraction between the observer and the object.

4. Therefore, the objects another side of the hot air are flickered.

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