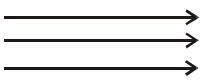
Chapter 5

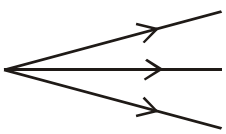
Light-Its Phenomenas and Human Eye

- **Light :** It may be defined as the radiant energy which produces in us the sensation of sight. Light itself is invisible but makes other objects visible.
- **Properties of Light :**
  1. Light is a form of energy which does not require any medium to travel.
  2. Light can travel in all the 3 media, viz, solid, liquid and gas.
  3. Light travels fastest in vacuum. It's speed is 3×10^8 m/sec.
  4. The wavelength of light (visible light) is 400 nm to 700 nm.
  5. Light consists of small packets of energy called photons.
- **Ray of Light :** A line drawn in the direction of propagation of light is called a ray of light.
- **Beam of Light :** A group of rays of light emitted by a source of light is called a beam of light. A light beam is of three types.

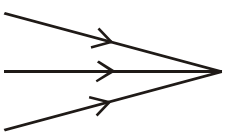
  (i) **Parallel beam :-** A group of light rays parallel to each other is known as parallel beam of light



  (ii) **Divergent beam :-** A group of light rays spreading out from a source of light is called divergent beam of light.



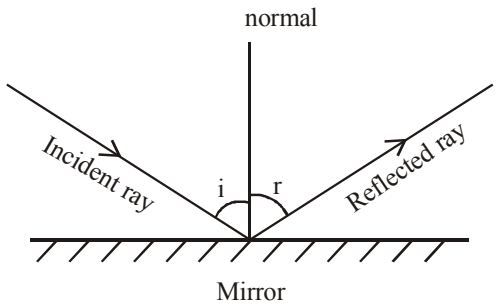
  (iii) **Convergent beam :-** A group of light rays meeting at a point is called convergent beam of light.



- **Reflection of Light :** There are some surfaces which have ability to send the light back in the same medium when light strikes it. This phenomena of sending the light back in the same medium by a surface is called **reflection of light**.
- **Laws of Reflection :**

1. The incident ray, the reflected ray and the normal at the point of incidence, all lie in a same plane.

2. The angle of incidence is always equal to the angle of reflection, $\angle i = \angle r$.



$\angle i$ = Angle of incidence

$\angle r$ = Angle of reflection

- Any smooth, highly polished reflecting surface is called a mirror. A plane mirror is a highly polished plane surface.
- The image formed by a plane mirror is erect and virtual. It is a laterally inverted image. The image formed is of the same size as that of the object. Also, the image and the object are equidistant from the mirror.
- A spherical mirror is that mirror whose reflecting surface is the part of a hollow sphere of glass. In case of a concave mirror, the reflecting surface is inside while in a convex mirror, the reflecting surface bulges out.
- The centre of a spherical mirror is called its pole. The centre of the imaginary sphere to which the mirror belongs is called the centre of curvature. The centre of curvature of a concave mirror is in front of it but the centre of curvanture of a convex mirror is behind it.
- The radius of the imaginary sphere of which the mirror is a part is called the radius of curvature.
- The straight line passing through the pole and centre of curvature is called the principal axis.
- The principal focus of a spherical mirror is a point on the principal axis of the mirror.
- If r is radius of curvature of the mirror of focal length f, we can write

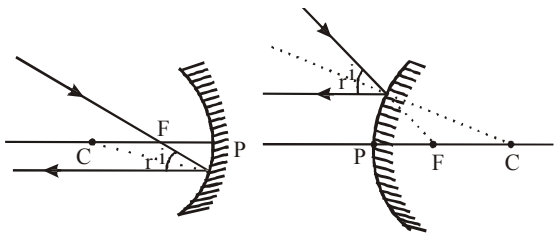
$$r = 2f$$

- Mirror formula is the relation between the focal length f of the mirror, the distance u of the object from the pole of the mirror, and the distance v of the image from the pole.

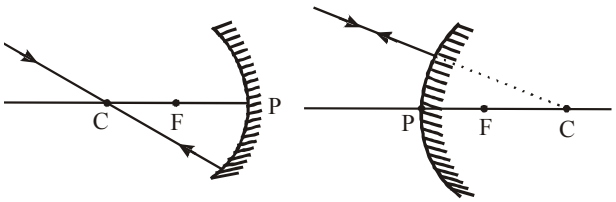
- **Representation of Images Formed by Spherical Mirrors Using Ray Diagrams**

(i) *A ray parallel to the principal axis,* after reflection, will pass through the principal focus in case of a concave mirror or appear to diverge from the principal focus in case of a convex mirror.

(ii) *A ray passing through the principal focus* of a concave mirror or *a ray which is directed towards the principal focus of* a convex mirror, after reflection, will emerge parallel to the principal axis.



(iii) *A ray passing through the centre of curvature* of a concave mirror or directed in the direction of the centre of curvature of a convex mirror, after reflection, is reflected back along the same path.



- **Image Formation By Concave Mirrors**

(i) Object is between C and F

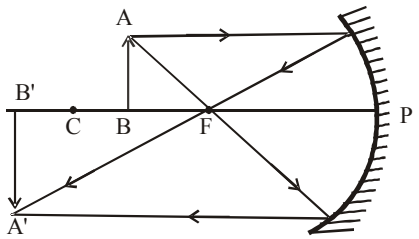


Image is real, inverted and beyond C.

(ii) Object is at F

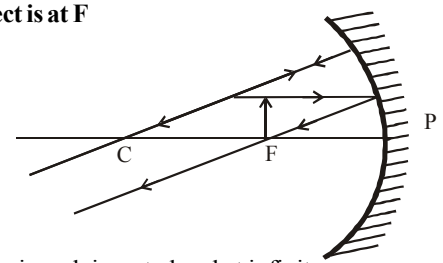


Image is real, inverted and at infinity.

(iii) Object is between F and P :

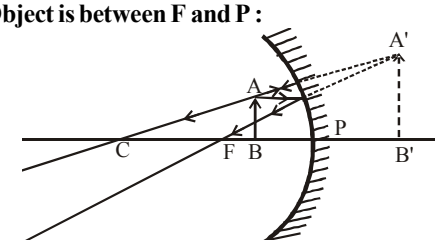
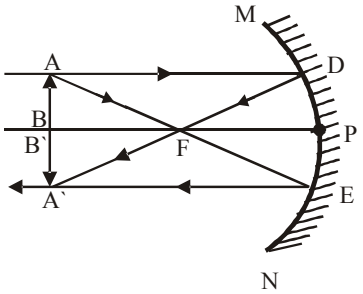


Image is virtual, erect and behind the mirror.

(iv) Object is at C:

Image is real, inverted and at C.



(v) Object is at infinity :

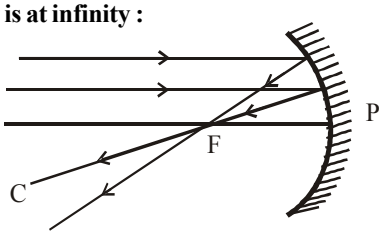


Image is real, inverted and at F.

(vi) Beyond C

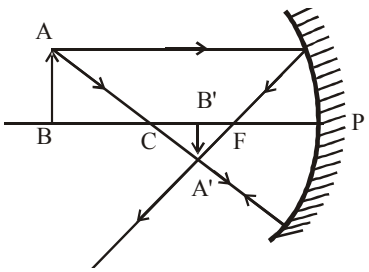


Image is real, inverted and between C & F.

- **Image Formation by Convex Mirrors**

(i) Object is any where between pole and infinity :

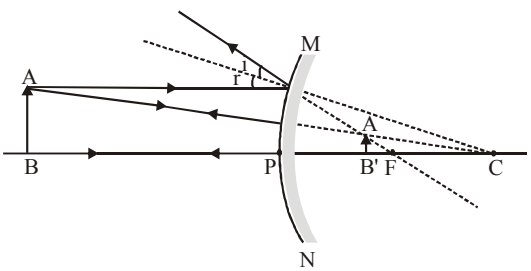


Image is formed between P and F which is virtual, erect and diminished.

(ii) Object is at infinity :

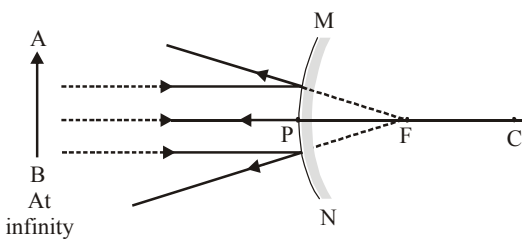


Image is formed at focus behind the mirror which is virtual, erect and highly diminished.

- **Uses of Concave Mirror :**

(i) It is used as a shaving mirror.

(ii) It is used in solar heating devices like solar cooker.

(iii) It is used as reflectors in headlights of vehicles, search light, torch, etc.

(iv) It is used by doctors to examine body parts by focusing the light over that part.

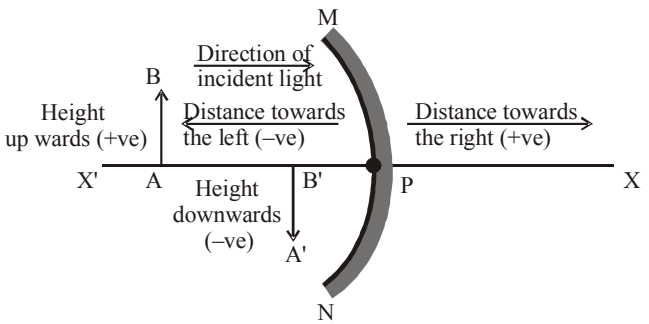
- **Uses of Convex Mirror :**

(i) It is used as rear view mirror in automobiles.

(ii) It is also used in street lights.

- **Sign Conventions :**

The new sign convention is described as follows :



1. All distances are measured from the pole.
2. All distances which are measured in the direction of incident ray are taken as positive.
3. All distances which are measured in the direction opposite to incident ray are taken as negative.
4. Upward direction which is perpendicular to principal axis is taken as positive and downward as negative.

Results :

1. Distance of object i.e., 'u' is always negative.

2. Focal length of concave mirror is always negative whereas focal lenght of convex mirror is always positive.

3. Size of object is always taken as positive.

4. If image is real, v is negative and if image is virtual, v is positive.

- **Mirror Formula :** It is a relation between distance of object, distance of image from the pole of the mirror and it's focal length, i.e., relation between 'u', 'v' and 'f '. It is given by

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

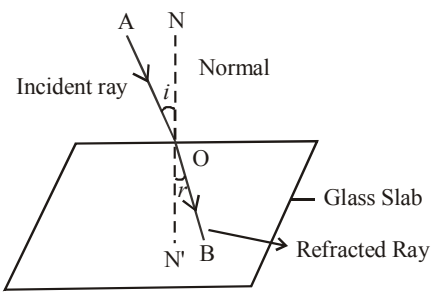
- **Magnification :** It is defined as the ratio of height of image to the height of the object. It is denoted by letter m.

$$m = \frac{\text{height of image (I)}}{\text{height of object (O)}}$$

m = + ve for virtual images

m = – ve for real images

- **Refraction of Light :** The bending of ray of right when it passes from one medium to another is called refraction of light.



When a ray of light goes from an optically less dense medium to a more dense medium, it bends towards the normal. On the other hand, a ray of light going from an optically more dense medium to a less dense medium, will bend away from the normal.

- **Laws of Refraction :**

(i) The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.

(ii) When a ray of light undergoes refraction then the ratio of sine of angle of incidence to the sine of angle of refraction is constant i.e., for two particular media, $\frac{\sin i}{\sin r}$ is always constant. This law is known as Snell's law. This constant is also known as refractive index of the second medium with respect to the first i.e., $\mu = \frac{\sin i}{\sin r}$

- If c is velocity of light in air or vacuum and v that in the medium, then

$$\mu = \frac{\text{Velocity of light in vacuum or air}}{\text{Velocity of light in the medium}} = \frac{c}{v}$$

The refractive index of a medium c with respect to a medium a, when the refractive index of medium b with respect to a and that of c with respect to b are given, can be found by the following relation :

$${}^{a}\mu_{c} = {}^{a}\mu_{b} \times {}^{b}\mu_{c}$$

- **Principle of Reversibility**

$${}^{a}\mu_{\omega} = \frac{1}{{}_{\omega}\mu_{a}} \text{ and } {}^{g}\mu_{\omega} = \frac{{}^{a}\mu_{\omega}}{{}^{a}\mu_{g}}$$

- **Critical Angle (c) :** It is the angle of incidence in a denser medium corresponding to which the refracted ray just grazes the surface of separation (angle of refraction is 90°)

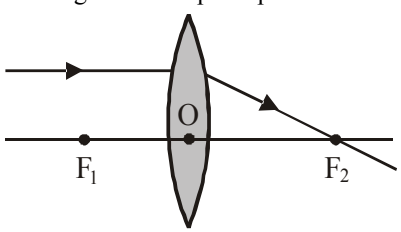
$${}^{\text{denser}}\mu_{\text{rarer}} = \frac{\sin c}{\sin \pi/2} = \sin c \quad \text{or} \quad \mu = \frac{1}{\sin c}$$

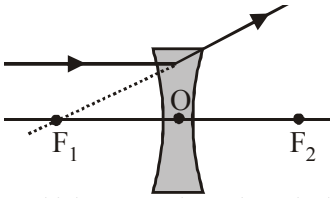
- A lens is a piece of transparaent glass which isn bounded by two spherical surfaces. A convex lens is thick at the centre but thinner at the edges.
- The lens formula or lens equation is given by

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

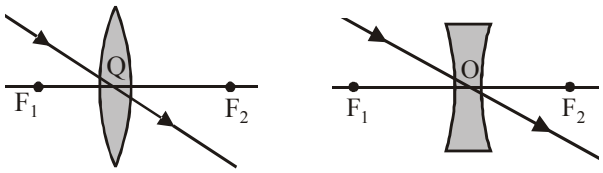
- **Image formation in lenses using ray diagrams :**

(i) A ray of light which is parallel to principal axis, passes through focus after refraction in case of a convex lens or concave lens appears to diverge from the principal focus.

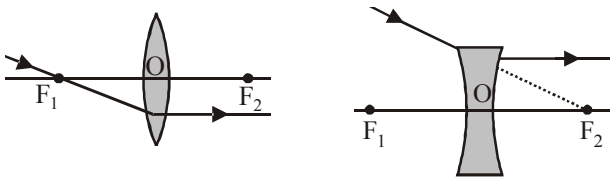




(ii) A ray of light which passes through optical centre, goes undeviated.

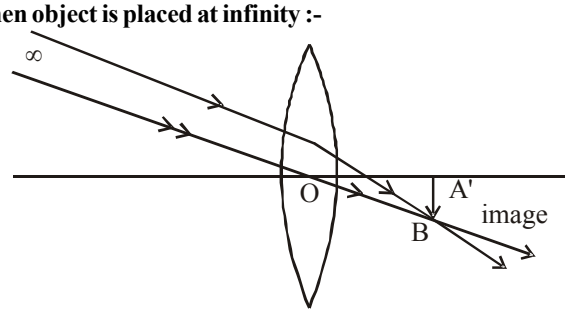


(iii) A ray of light which passes through focus or appears to meet at the principal focus becomes parallel to the principal axis after refraction.



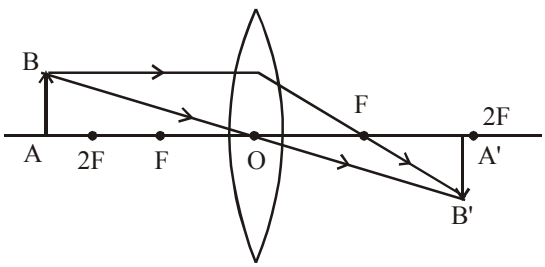
- **Image Formed By A Convex Lens :**

(i) When object is placed at infinity :-



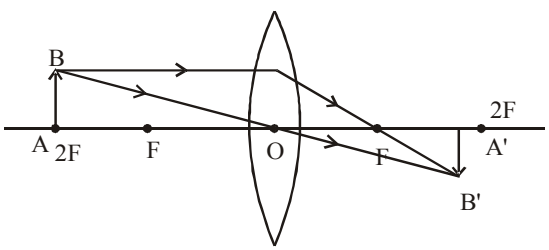
real, inverted, diminished at F

(ii) When object is placed beyond 2F :-



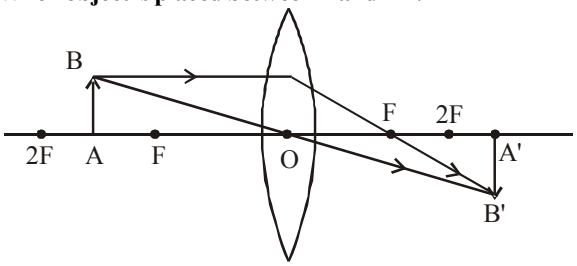
real, inverted diminished between F and 2F

(iii) When object is placed at 2F :-



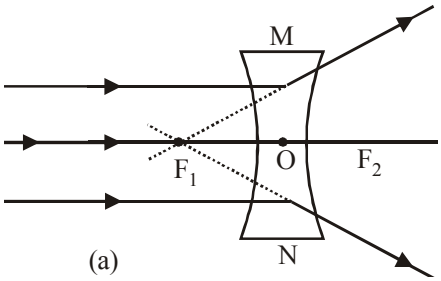
real, inverted, same size and at 2F

(iv) When object is placed between F and 2F :-

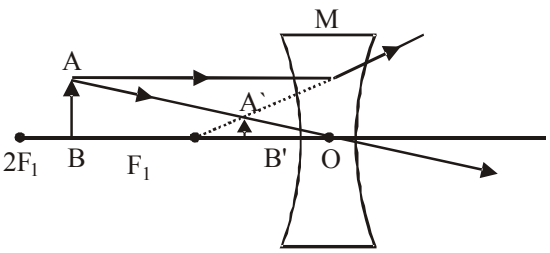


real, inverted, enlarged and beyond 2F

- **Image Formed by a Concave Lens :**

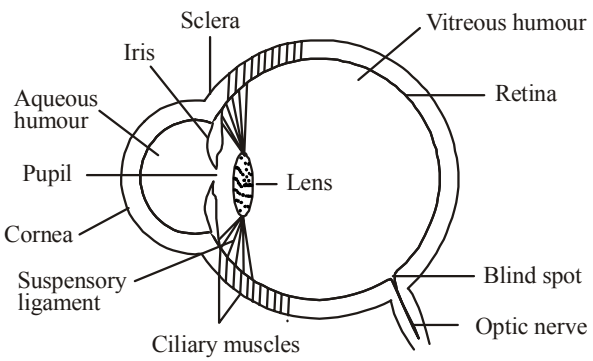


(a)



(b)

- **Magnification :** Magnification, $m = \frac{h_2}{h_1}$ i.e., Ratio of height of image to the height of object. It is also given by $\frac{v}{u}$ i.e., Ratio of distance of image to the distance of object.
- **Power of a lens :** The ability of lens to converge or diverge a beam of light is known as the **power of lens**. It is the degree of measure of converging or diverging ability of a lens. Power of lens is also defined as reciprocal of focal length i.e., P = 1/f where f is in metre. The SI unit of power of a lens is dioptre. It is denoted by *D*.
- **The Human Eye :** It is a natural optical instrument which is used to see the objects by human beings. It is like a camera which has lens and screen system.



THE EYE

- **Working of human eye :** When you look at an object, light rays from the object enter into the eye through cornea by aqueous humour which also acts as lens to refract maximum light. This light then passes through pupil which allows the required amount of light to pass through it. This light falls on eye lens which makes an image on retina. This is a real and inverted image. This image is sent to the brain through optical nerves in the form of electric signal and brain interpret the image into erect image.
- **Accomodation power :** The ability of eye to change the focal length of eye lens with the help of ciliary muscles to get the clear view of nearby objects (about 25 cm) and far distant objects (at infinity).
- **Near and far point of human eye :** Near point is Minimum Distance at which objects seen most distinctly without strain. For a young adult normal vision, it is about 25cm. Far point is the maximum distance at which eye can see the things clearly. It is infintiy.
- **Persistence of vision :** Image formed at retina is not permanent. Its sensation remains on the retina for about 1/16th of a second even after removal of object. This continuance of sensation of the eye is called persistence of vision.
- **Colour blindness :** Some people do not possess some cone cells that respond to certain specific colours due to genetic disorder. The persons who can not distinguish between colours but can see the objects clearly are said to be colour blind.
- **Defects of vision :** Human eye with normal vision can accomodate for all distance from 25cm to infinity. Some times the eye of person gradually loses its power of accomodation. In such conditions he cannot see the objects clearly and comfortably. The vision becomes defective due to optical defects of eye.

(i) Myopia (Short sightedness) : It is a kind of defect in human eye due to which a person can see near objects clearly but he can not see the distant objects clearly. Myopia is due to

(i) excessive curvature of cornea.

(ii) elongation of eye ball.

Due to these two reasons focal length of eye lens decreases and so the power increases so that image is formed in front of retina i.e., object is not visible properly.

This defect can be corrected by using a diverging lens i.e., a concave lens.

(ii) Hypermetropia (Long sightedness) : It is a kind of defect in human eye due to which a person can see distant objects properly but cannot see the nearby objects clearly. It happens due to

(i) decrease in power of eye lens i.e., increase in focal length of eye lens.

(ii) shortening of eye ball.

Due to these two reasons, light rays coming from nearby objects get less converged and the image is formed behind the retina i.e., object is not visible properly.

This defect can be corrected by using a converging lens i.e., a convex lens due to which the converging power (combined) increases as the image is formed at retina.

(iii) Presbyopia : It is a kind of defect in human eye which occurs due to ageing. It happens due to

(i) decrease in flexibility of eye lens.

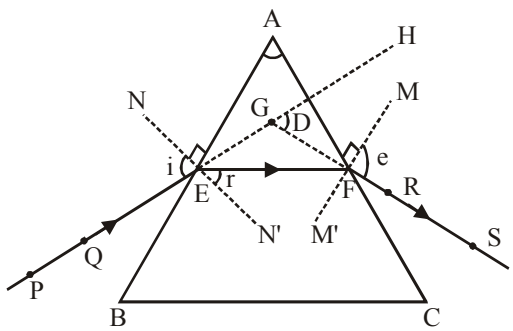
(ii) gradual weakening of cilliary muscles.

Due to this defect, the person cannot read comfortably and clearly without eye glasses. Sometime a person may suffer from both myopia and hypermetropia which is corrected by using bi-focal lens. The lower portion of these bio-focal lens is convex which is used for reading purpose and the upper portion is a concave lens which is used to see the far distant objects.

(iv) Astigmatism : It is a kind of defect in human eye due to which a person cannot see (focus) simultaneously horizonatal and vertical lines both. This defect occurs due to irregularities in surface of cornea which is not perfectly spherical. That's why it has different radii of curvature in different direction i.e., vertical and horizontal plane due to which if he tries to focus one plane (horizontal or vertical) the other becomes out of focus.

This defect can be corrected by using cylinderical lenses.

- **Refraction of light through a prism :** A glass prism is a transparent surface made up of glass. A triangular prism has two triangular bases and three rectangular lateral surfaces. The angle between its two lateral surfaces is called the angle of the prism. The refraction of light through a triangular prism can be studied with the help of the following diagram.



Here,

PE –	Incident ray	$\angle i$ –	Angle of incidence
EF –	Refracted ray	$\angle r$ –	Angle of refraction
FS –	Emergent ray	$\angle e$ –	Angle of emergence
$\angle A$ –	Angle of the prism	$\angle D$ –	Angle of deviation

- **Dispersion of white light by a glass 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. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red. The sequence of colours remember as VIBGYOR.
- **Atmospheric Refraction :** The refraction of light caused by the earth's atmosphere (having air layers of varying optical densities) is called atmospheric refraction.

- **Twinkling of stars**: The twinkling of star is due to atmospheric refraction of star light. The light of star undergoes refraction when it enters in the earth's atmosphere. Because of the changing refractive index in the medium, the star light bends towards the normal so that the apparent position of the star is slightly different from its actual position. The star appears slightly higher than its actual position.
- **Advance sunrise and delayed sunset :** Actual sun rise happens when it is below the horizon in the morning. The rays of light from the sun below the horizon reach our eyes because of refraction of light. These rays appear to come from the apparent position of the sun which is above the horizon, hence we can see the sun for few minutes (2 min.) before actual sun rise. Similarly, the sun can be seen about 2 minutes after the actual sun set. Thus the duration of day time will increase by 4 minutes.
- The molecules of air and other fine particles in the atmosphere have size smaller than the wavelength of visible light. These are more effective in scattering light of shorter wavelengths at the blue end than light of longer wavelengths at the red end. The red light has a wavelength about 1.8 times greater than blue light. Thus, when sunlight passes through the atmosphere, the fine particles in air scatter the blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes. If the earth had no atmosphere, there would not have been any scattering. Then, the sky would have looked dark.
- **Colour of the Sun at sunrise and sunset :** Light from Sun near the horizon passes through thicker layers of air and larger distance in the earth's atmosphere before reaching our eyes. At noon, the light of sun travels relatively shorter distance appears white as only a little of blue and violet colours are scattered . Near the horizon, most of the blue light and shorter wavelengths are scattered and sun appears red.

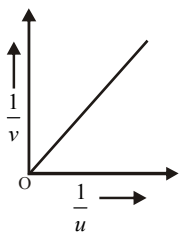
Exercise 1

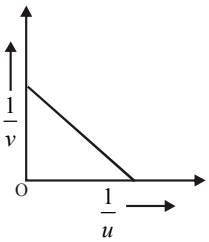
DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which only one is correct.

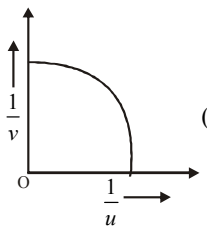
1. Rays from the sun converge at a point 15 cm in front of a concave mirror. Where should an object be placed so that size of its image is equal to the size of the object?
   (1) 15 cm in front of the mirror
   (2) 30 cm in front of the mirror
   (3) between 15 cm and 30 cm in front of the mirror
   (4) more than 30 cm in front of the mirror.
2. Under which of the following conditions a concave mirror can form an image larger than the actual object?
   (1) When the object is kept at a distance equal to its radius of curvature
   (2) When object is kept at a distance less than its focal length
   (3) When object is placed between the focus and centre of curvature
   (4) When object is kept at a distance greater than its radius of curvature
3. For an object at infinity, a concave mirror produces an image at its focus which is
   (1) enlarged
   (2) virtual
   (3) erect
   (4) real, inverted and diminished
4 According to the laws of reflection
   (1) angle i = angle r
   (2) sine i = sine r
   (3) sine i / sine r = constant
   (4) All of these
5. An inverted image can be seen in a convex mirror,
   (1) under no circumstances
   (2) when the object is very far from the mirror
   (3) when the object is at a distance equal to the radius of curvature of the mirror
   (4) when the distance of the object from the mirror is equal to the focal length of the mirror
6. Which of the following statements is true?
   (1) A convex lens has 4 dioptre power having a focal length 0.25 m
   (2) A convex lens has – 4 dioptre power having a focal length 0.25 m
   (3) A concave lens has 4 dipotre power having a focal length 0.25 m
   (4) A concave lens has – 4 dioptre power having a focal length 0.25 m
7. In case of a concave mirror, when the object is situated at the principal focus, the image formed is
   (1) real and inverted (2) of infinite size
   (3) lies at infinity (4) All of these
8. An object placed at F of a concave mirror will produce an image
   (1) at infinity (2) highly enlarged
   (3) real and inverted (4) All of these
9. The relation between u, v and R for a spherical mirror is
   (1) $R = \frac{2uv}{u+v}$ (2) $R = \frac{2}{u+v}$
   (3) $R = \frac{2(u+v)}{(uv)}$ (4) None of these
10. A 10 mm long awlpin is placed vertically in front of a concave mirror. A 5 mm long image of the awl pin is formed at 30 cm in front of the mirror. The focal length of this mirror is
   (1) – 30 cm (2) – 20 cm
   (3) – 40 cm (4) – 60 cm
11. A child is standing in front of a magic mirror. She finds the image of her head bigger, the middle portion of her body of the same size and that of the legs smaller. The following is the order of combinations for the magic mirror from the top.
   (1) Plane, convex and concave
   (2) Convex, concave and plane
   (3) Concave, plane and convex
   (4) Convex, plane and concave

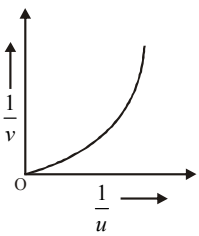
12. An object placed at infinity of a concave mirror will produce an image
(1) at focus (2) highly diminished
(3) real and inverted (4) All of these

13. The linear magnification for a mirror is the ratio of the size of the image to the size of the object, and is denoted by m. Then, m is equal to (symbols have their usual meanings):
(1) $\frac{f}{f-u}$ (2) $\frac{f-u}{f}$
(3) $\frac{f}{f+v}$ (4) $\frac{f+v}{f}$

14. Which of the following correctly represents the variation of 1/μ versus 1/v for a concave mirror?
(1) 

(2) 

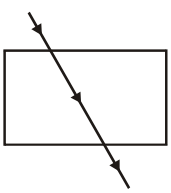
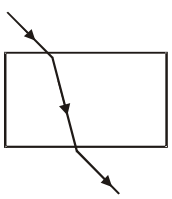
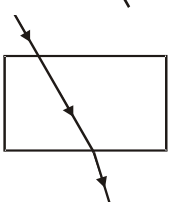
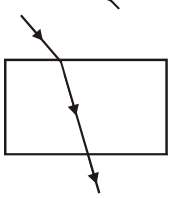
(3) 

(4) 

15. Magnification produced by a rear view mirror fitted in vehicles
(1) is less than one
(2) is more than one
(3) is equal to one
(4) can be more than or less than one depending upon the position of the object in front of it.

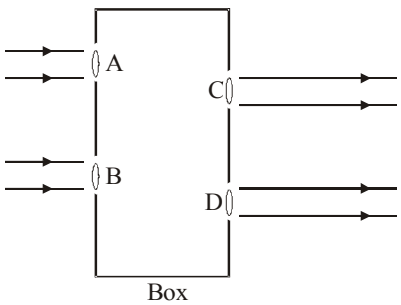
16. An object placed at F of a convex mirror will produce an image
(1) Behind the mirror (2) Diminished
(3) Virtual and erect (4) All of these

17. When a ray of light passes from an optically denser medium to a rarer medium, it
(1) goes undeviated
(2) bends away from the normal
(3) bends towards the normal
(4) None of these

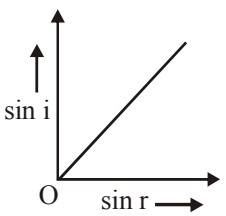
18. The path of a ray of light coming from air passing through a rectangular glass slab traced by four students are shown as 1, 2, 3 and 4 in the figure. Which one of them is correct?
(1) 
(2) 
(3) 
(4) 

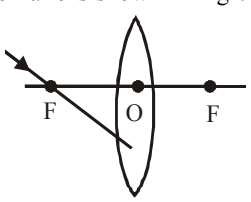
19. In torches, search lights and headlights of vehicles the bulb is placed
(1) between the pole and the focus of the reflector
(2) very near to the focus of the reflector
(3) between the focus and centre of curvature of the reflector
(4) at the centre of curvature of the reflector

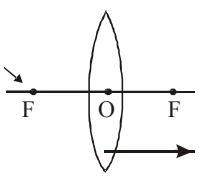
20. An object placed at 2F of a convex lens will produce an image
(1) at 2F (2) same size
(3) real and inverted (4) All of these

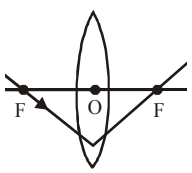
21. Beams of light are incident through the holes A and B and emerge out of box through the holes C and D respectively as shown in the figure. Which of the following could be inside the box?


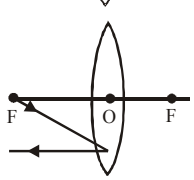
(1) A rectangular glass slab
(2) A convex lens
(3) A concave lens
(4) A prism

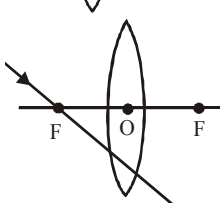
22. A straight line graph is obtained by plotting sine of angle of incidence versus sine of angle of refraction. The slope of this graph represents
(1) velocity of light
(2) refractive index
(3) gravitational constant
(4) None of these


23. Which of the following ray diagrams is correct for the ray of light incident on a lens shown in Fig ?


(1) 

(2) 

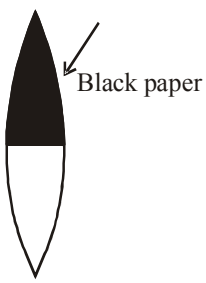
(3) 

(4) 

24. An object placed between F and 2F of a convex lens will produce an image
(1) beyond 2F (2) enlarged
(3) real and inverted (4) All of these

25. A swimming pool looks shallower than it really is, when seen by a person standing outside near it, because of the phenomenon of
(1) refraction of light (2) reflection of light
(3) dispersion of light (4) None of these

26. How will the image formed by a convex lens be affected if the upper half of the lens is wrapped with a black paper?
(1) The size of the image is reduced to one-half
(2) The upper half of the image will be absent
(3) The brightness of the image is reduced
(4) There will be no effect



27. The middle vascular coat that darkens the eye chamber and prevents refraction by absorbing the light rays is
(1) choroid (2) sclera
(3) retina (4) cornea

28. Refractive index of a substance is
(1) speed of light in vacuum / speed of light in the medium
(2) speed of light in water / speed of light in the medium
(3) speed of light in the medium / speed of light in air
(4) All of these

29. The eyelens ..... light rays to form real, inverted and highly diminished image on the .....
(1) converges, retina (2) diverges, retina
(3) converges, pupil (4) diverges, pupil

30. The surface of retina has about 125 million light sensitive
(1) rods only (2) cones only
(3) rods and cones (4) neither rods nor cones

31. While looking at nearby objects, the ciliary muscles ..... the eyelens so as to ..... its focal length.
(1) contract, increase (2) contract, decrease
(3) expand, increase (4) expand, decrease

32. Negative value of focal length of a spherical mirror indicates that it is
(1) Concave mirror (2) Convex mirror
(3) Plane mirror (4) None of these

33. A student sitting on the last bench can read the letters written on the blackboard but is not able to read the letters written in his textbook. Which of the following statements is correct?
(1) The near point of his eyes has receded away
(2) The near point of his eyes has come closer to him
(3) The far point of his eyes has come closer to him
(4) The far point of his eyes has receded away

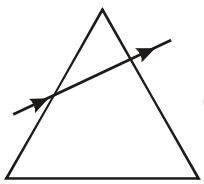
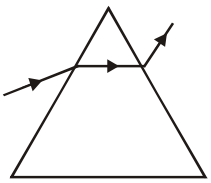
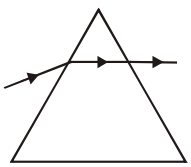
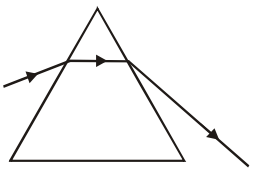
34. A person cannot see distinctly objects kept beyond 2 m. This defect can be corrected by using a lens of power
(1) + 0.5 D (2) – 0. 5 D
(3) + 0. 2 D (4) – 0. 2 D

35. Which of the following statement is correct?
(1) A person with myopia can see distant objects clearly
(2) A person with hypermetropia can see nearby objects clearly
(3) A person with myopia can see nearby objects clearly
(4) A person with hypermetropia cannot see distant objects clearly

36. A ray of light propagates from an optically denser medium to an optically rarer medium.
(1) It will bend towards the normal after refraction.
(2) It will bend away from the normal after refraction.
(3) It will continue to go on the same path after refraction.
(4) It will refract making an angle of refraction = angle of incidence.

37. Which of the following statements is correct regarding the propagation of light of different colours of white light in air?
(1) Red light moves fastest
(2) Blue light moves faster than green light
(3) All the colours of the white light move with the same speed
(4) Yellow light moves with the mean speed as that of the red and the violet light

38. Which of the follow ing figures correctly shows the bending of a monochromatic light inside the prism?

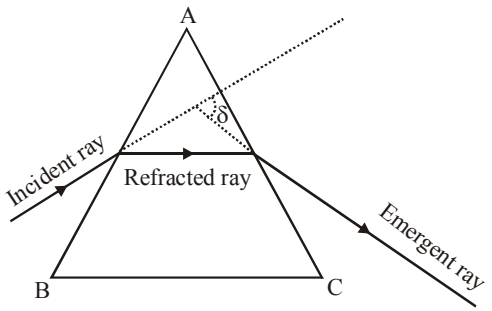
(1) 
(2) 
(3) 
(4) 

39. At a particular minimum value of angle of deviation, the refracted ray becomes
(1) parallel to the base of the prism
(2) perpendicular to the base of the prism
(3) inclined at 45° w.r.t. base of the prism
(4) None of these

40. The distance between a spherical lens and the image is – 15 cm. The lens is
(1) concave lens
(2) convex lens
(3) either of the two irrespective of the object distance
(4) either concave lens or convex lens with object between O and F.

41. Which of the following phenomena of light are involved in the formation of a rainbow?
(1) Reflection, refraction and dispersion
(2) Refraction, dispersion and total internal reflection
(3) Refraction, dispersion and internal reflection
(4) Dispersion, scattering and total internal reflection

42. A ray of light passes through a prism as shown in the figure given below:



The angle δ is known as

(1) angle of deviation
(2) angle of dispersion
(3) angle of emergence
(4) angle of refraction

43. The clear sky appears blue because
(1) blue light gets absorbed in the atmosphere
(2) ultraviolet radiations are absorbed in the atmosphere
(3) violet and blue lights get scattered more than lights of all other colours by the atmosphere
(4) light of all other colours is scattered more than violet and blue colour lights by the atmosphere

44. Dispersion of light by a glass prism takes place because of
(1) difference in wavelengths of the constituents of light
(2) difference in speeds of various constituents of white light.
(3) scattering of light by the surface of the glass prism
(4) only b and a are correct

45. The danger signals installed at the top of tall buildings are red in colour. These can be easily seen from a distance because among all other colours, the red light
(1) is scattered the most by smoke or fog
(2) is scattered the least by smoke or fog
(3) is absorbed the most by smoke or fog
(4) moves fastest in air

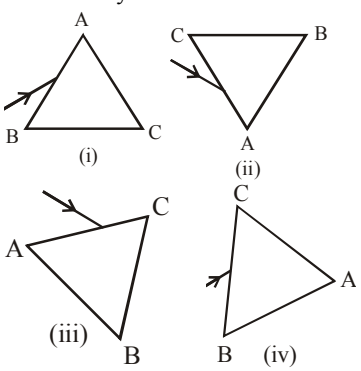
46. Which of the following phenomena contributes significantly to the reddish appearance of the sun at sunrise or sunset?
(1) Dispersion of light
(2) Scattering of light
(3) Total internal reflection of light
(4) Reflection of light from the earth

47. The bluish colour of water in deep sea is due to
(1) the presence of algae and other plants found in water
(2) reflection of sky in water
(3) scattering of light
(4) absorption of light by the sea

48. The colour of an object is determined by
(1) the colour of light reflected by it
(2) the colour of light absorbed by it
(3) the colour of light incident on it only
(4) None of the above

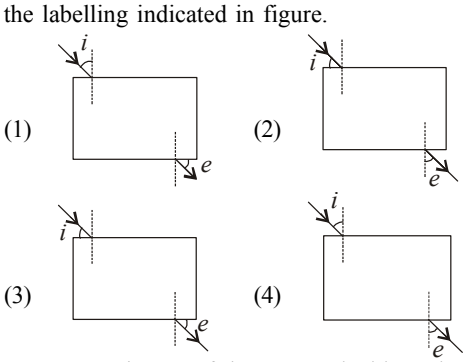
49. You are given water, mustard oil, glycerine and kerosene. In which of these media a ray of light incident obliquely at same angle would bend the most?
(1) Kerosene (2) Water
(3) Mustard oil (4) Glycerine

50. A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in Fig. In which of the following cases, after dispersion, the third colour from the top corresponds to the colour of the sky?



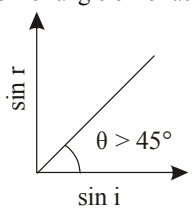
(1) (i) (2) (ii)
(3) (iii) (4) (iv)

51. A student does the experiment on tracing the path of a ray of light passing through a rectangular glass slab for different angles of incidence. He can get a correct measure of the angles of incidence and angle of emergence by following the labelling indicated in figure.



52. Human eye is one of the most valuable and sensitive organ that
(1) enables us to see the wonderful world and colours around us
(2) can identify the objects
(3) is like a camera
(4) All of these

53. A ray of light travels from medium I to medium II. The figure given shows the variation of sin of angles of incidence (sin i) in medium I with sin of angle of refraction (sin r) in medium II.



Consider the following statements
(a) Speed of light in medium I > Speed of light in medium II.
(b) Speed of light in medium I < Speed of light in medium II.
(c) Light travels from denser medium to rarer medium.
Which of the statement given above is/are correct ?
(1) (a) only (2) (b) only
(3) (a) and (c) (4) (b) and (c)

54. Three student measured the focal length of a convex lens using parallel rays from a distant object. All of them measured the distance between the lens and the inverted image on the screen.
Student A saw a sharp image on the screen and labelled the distance as f_1.
Student B saw a slightly larger blurred image on the screen and labelled the distance as f_2.
Student C saw slightly larger blurred image on the screen and labelled the distance as f_3.
The relation between the three measurement would most likely be :
(1) $f_1 = f_2 = f_3$ (2) $f_1 < f_2$ and f_3
(3) $f_1 < f_2$ and $f_1 = f_3$ (3) None of these

55. A person is suffering from myopia. He is advised to use concave lens but by mistake the optician give him spectacle having convex lens which of the following ray diagram correctly shows the image formation in his eye.

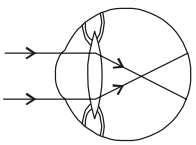
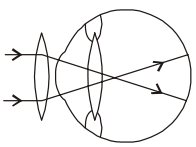
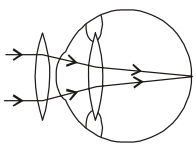
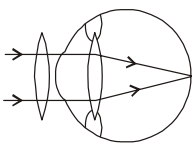
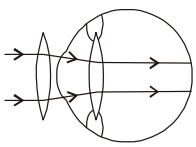


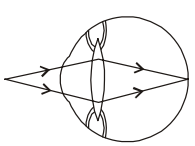
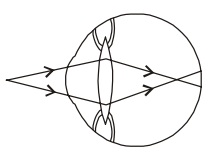
Image formation without using lens

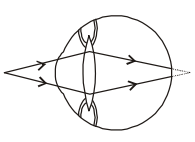
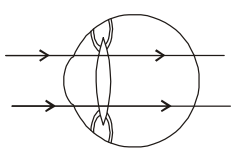
(1)  (2) 

(3)  (4) 

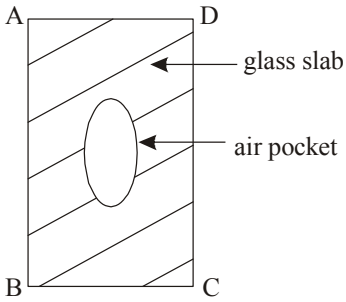
56. Which of the following does not describe working of the human eye?
(1) The lens system forms an image on a light sensitive screen called the retina.
(2) Light enters the eye through a thin membrane called the cornea
(3) Rainbow is formed due to splitting of white light
(4) Iris is a dark muscular diaphragm that controls the size of the pupil for regulating the amount of light entering into the eye

57. Which of the following ray diagram is correct for image formation in a hypermetropic eye ?

(1)  (2) 

(3)  (4) 

58. During the fabrication of a glass slab an air pocket is left in the slab as shown in fig.



For a parallel beam of light incident on face AB of slab the emergent beam through face CD will be a :
(1) Parallel beam (2) Converging beam
(3) Diverging beam (4) None of these

59. Light sensitive cells get activated on
(1) illumination
(2) seeing the different colours
(3) facing opaque objects
(4) receiving message from the brain

60. Iris contracts the pupil
(1) In bright light
(2) To allow less light to enter
(3) In darkness
(4) Only (1) and (2)

61. A person is not able to see near objects clearly, because
(1) image is formed behind the retina
(2) focal length of the eye lens is too great
(3) use of convex lens has been ignored, though it was advised
(4) All of the above

62. Hypermetropia is also known as far sightedness because
(1) the person is not able to see clearly the distant objects, but can see near objects clearly
(2) the person is able to see clearly the distant objects, but not near objects
(3) the person is not able to see clearly the distant or near objects
(4) the person is able to see clearly the distant or near objects

63. Presbyopia can be corrected by
(1) Using bifocal lenses
(2) Using microscopes
(3) Using binoculars
(4) Using sunglasses

64. The shape of the triangular prism
(1) Makes the emergent ray bend at angle to the direction of the incident ray
(2) Angle of deviation is the angle between the incident ray produced and the emergent ray produced
(3) Both (1) and (2)
(4) Neither (1) nor (2)

65. Dispersion of white light takes place because
(1) different colours of light bend through different angles with the incident ray
(2) the red light bends the least and the violet light bends the most
(3) both (1) and (2)
(4) refractive index of glass is not uniform in the prism

66. Placement of another identical prism in an inverted position with respect to the first and allowing the colours of spectrum to pass through it will
(1) change the spectrum into white light
(2) change the spectrum into a black band
(3) keep the spectrum as before
(4) split into more colours

67. Twinkling of a star is due to
(1) atmospheric refraction of sunlight
(2) atmospheric refraction of starlight
(3) lightening in the sky
(4) none of these

68 The path of light passing through a clear solution is not visible, but becomes visible through a colloid
(1) because light is scattered by relatively larger particles
(2) because light is getting refracted
(3) because light is getting refracted as well reflected
(4) All of these

69. The sky appears blue because
(1) molecules of air and other particles in the atmosphere are smaller than wavelength of visible light
(2) light of shorter wavelengths at the blue end are scattered more than the red light whose wavelength is 1.8 times
(3) the scattered blue light enters our eyes
(4) All of these

Exercise 2

Matching Based MCQ

DIRECTIONS(Qs.1 to 5) : Match Column-I with Column-II and select the correct answer using the codes given below the columns.

1.

Column-I (Position of the object)	Column-II (Nature and size of image formed by a convex lens)
(A) At infinity	(p) At C
(B) Beyond C	(q) At infinity
(C) At C	(r) At the focus F
(D) Between C and F	(s) Behind the mirror
(E) At F	(t) Between F and C
(F) Between P and F	(u) Beyond C

(1) (A) – (t); (B) – (r); (C) – (p); (D) – (u); E – (q); F – (s)
(2) (A) – (r); (B) – (t); (C) – (p); (D) – (u); E – (q); F – (s)
(3) (A) – (r); (B) – (t); (C) – (p); (D) – (u); E – (s); F – (q)
(4) (A) – (r); (B) – (t); (C) – (u); (D) – (p); E – (q); F – (s)

2.

Column-I (Position of the object)	Column-II (Position of the image formed by a concave mirror)
(A) At infinity	(p) Real, inverted, same size
(B) Beyond 2F	(q) Real, inverted, highly enlarged
(C) At 2F	(r) Real, inverted, point-sized
(D) Between F and 2F	(s) Real, inverted, diminished
(E) At focus F	(t) Virtual, erect, enlarged
(F) Between F and O	(u) Real, inverted, enlarged

(1) (A) – (r); (B) – (s); (C) – (p); (D) – (u); E – (q); F – (t)
(2) (A) – (s); (B) – (r); (C) – (p); (D) – (u); E – (q); F – (t)
(3) (A) – (r); (B) – (s); (C) – (u); (D) – (p); E – (q); F – (t)
(4) (A) – (r); (B) – (s); (C) – (p); (D) – (u); E – (t); F – (q)

3.

Column-I	Column-II
(A) Myopia	(p) Bifocal lens
(B) Hypermetropia	(q) Cylindrical lens
(C) Presbyopia	(r) Concave lens
(D) Astigmatism	(s) Convex lens

(1) (A) – (s); (B) – (r); (C) – (p); (D) – (q)
(2) (A) – (r); (B) – (p); (C) – (s); (D) – (q)
(3) (A) – (r); (B) – (s); (C) – (p); (D) – (q)
(4) (A) – (r); (B) – (s); (C) – (q); (D) – (p)

4.

Column-I	Column-II
(A) Power of convex mirror	(p) Positive power
(B) Power of concave mirror	(q) Negative power
(C) Power of plane mirror	(r) Zero power

(1) (A) – (r); (B) – (p); (C) – (q)
(2) (A) – (q); (B) – (p); (C) – (r)
(3) (A) – (q); (B) – (r); (C) – (p)
(4) (A) – (p); (B) – (q); (C) – (r)

5.

Column I	Column II
(A) Speed	(p) No unit
(B) Focal length	(q) Dioptre
(C) Power of a lens	(r) ms^{-1}
(D) Refractive index	(s) cm.

(1) (A) – (q); (B) – (p); (C) – (r); (D) – (s)
(2) (A) – (s); (B) – (q); (C) – (p); (D) – (r)
(3) (A) – (r); (B) – (q); (C) – (p); (D) – (s)
(4) (A) – (r); (B) – (s); (C) – (q); (D) – (p)

Statement Based MCQ

6. Consider the following statements:
(a) Light has transverse wave nature.
(b) Light cannot travel in vacuum.
(c) No particle can ever move at a speed greater than the speed of light in vacuum.
Which of these statement(s) is/are correct?
(1) (a) and (b) (2) (a) and (c)
(3) (b) and (c) (4) All are correct

7. Consider the following statements:
   (a) The focal length of a spherical mirror has a smaller magnitude than that of its radius of curvature.
   (b) A spherical mirror cannot form an image whose size is the same as that of the object.
   (c) A ray of light incident parallel to the principal axis of a spherical mirror retraces its path after reflection.
   Which of these statement(s) is/are correct ?
   (1) (a) and (b) (2) (a) and (c)
   (3) Only (a) (4) Only (c)
8. Consider the following statements:
   (a) The laws of reflection are valid for plane mirrors and not for spherical mirrors.
   (b) A real image of a point object can be formed only by a concave mirror.
   Which of these statement(s) is/are correct?
   (1) (a) only (2) (b) only
   (3) Both (a) and (b) (4) Neither (a) nor (b)
9. Consider the following statements:
   (a) The speed of light is higher in a rarer medium than in a denser medium.
   (b) When a ray of light travels from air to water, its speeds up.
   Which of these statement(s) is/are correct?
   (1) (a) only (2) (b) only
   (3) Both (a) and (b) (4) Neither (a) nor (b)
10. Consider the following statements:
   (a) The values of u and f for a concave lens are always negative by convention.
   (b) The power of a convex lens is negative and that of a concave lens is positive.
   (c) A concave lens always forms a virtual, erect and smaller image.
   Which of these statement(s) is/are correct?
   (1) (a) and (b) (2) (a) and (c)
   (3) (b) and (c) (4) All are correct
11. Consider the following statements:
   (a) When light rays are incident on the eye, maximum deviation takes place at the cornea.
   (b) The ciliary muscles adjust for changing the intensity of light entering the eye.
   Which of these statement(s) is/are correct?
   (1) (a) only (2) (b) only
   (3) Both (a) and (b) (4) Neither (a) nor (b)
12. Consider the following statements:
   (a) The near point of a hypermetropic eye is farther away than normal nearpoint (25 cm).
   (b) Presbyopia is corrected by using concave lens.
   (c) Myopia can be corrected by using spectacles made from convex lenses of suitable focal lengths.
   Which of these statement(s) is/are correct?
   (1) Only (b) (2) Only (a)
   (3) (a) and (b) (4) (b) and (c)
13. Consider the following statements:
   (a) The sun looks red at sunset because most of the blue light in sunrays is scattered leaving behind red and yellow lights.
   (b) Clouds look white because water droplets of clouds scatter all colours of light equally.
   Which of these statement(s) is/are correct?
   (1) (a) only (2) (b) only
   (3) Both (a) and (b) (4) Neither (a) nor (b)
14. Consider the following statements:
   (a) Astigmatism is a defect in which an eye cannot view all the directions with equal clarity.
   (b) Colour blindness can be cured.
   Which of these statement(s) is/are correct?
   (1) (a) only (2) (b) only
   (3) Both (a) and (b) (4) Neither (a) nor (b)
15. Consider the following statements :
   (a) For a normal eye, the far point is at infinity.
   (b) Focal length of eye lens is fixed.
   (c) The change in focal length of eyelens to focus image at varying distance is done by the action of pupil.
   Which of these statement(s) is/are correct ?
   (1) Only (b) (2) Only (a)
   (3) (a) and (b) (4) (b) and (c)

Passage Based MCQ

DIRECTIONS (Qs. 16 to 23) : Read the passage(s) given below and answer the questions that follow.

PASSAGE - 1

A convex mirror, fish eye mirror or diverging mirror, is a curved mirror in which the reflective surface bulges toward the light source. Convex mirrors reflect light outwards, therefore, they are not used to focus light. Such mirrors always form a virtual image, since the focus (F) and the centre of curvature (2F) are both imaginary points "inside" the mirror, which cannot be reached. Therefore, images formed by these mirrors cannot be taken on screen. (As they are inside the mirror) concave mirror, or converging mirror, has a reflecting surface that bulges inward (away from the incident light). Concave mirrors reflect light inward to one focal point, therefore, they are used to focus light. Unlike convex mirrors, concave mirrors show different image types depending on the distance between the object and the mirror. These mirrors are called" converging" because they tend to collect light that falls on them, refocusing parallel incoming rays toward a focus. This is because the light is reflected at different angles, since the normal to the surface differs with each spot on the mirror.

16. The centre of the sphere of which the spherical mirror forms a part is called ———.
   (1) centre of curvature (2) focus
   (3) pole (4) vertex
17. The focus of a concave mirror is _____
   (1) real (2) virtual
   (3) undefined (4) at the pole
18. A converging mirror is known as _____
   (1) convex mirror (2) plane mirror
   (3) concave mirror (4) cylindrical mirror
19. An image formed by a convex mirror is always
   (1) virtual, erect and diminished
   (2) virtual, real and magnified
   (3) real, inverted and diminished
   (4) real, erect and magnified

PASSAGE - 2

Human eye is spherical in shape and has diameter of about 2.5 cm. Sclerotic is a tough, opaque and white substance forming the outermost coating of the eyeball. The front portion is sharply curved and covered by a transparent protective membrane called the 'cornea'. Inner to the sclerotic there is a layer of black tissue called as choroids consisting of a mass of blood vessels, which nourishes the eye. The black colour does not reflect the light and hence rules out the blurring of image by reflection within the eyeball.

Behind the cornea, the space is filled with a liquid called the aqueous humour and behind that a crystalline lens. 'Iris' is a muscular diaphragm lying between the aqueous humour and the crystalline lens. Iris has an adjustable opening in the middle called the pupil of the eye. The pupil appears black because all the light entering is absorbed by the 'retina', which covers the inside of the rear part of the ball. Iris controls the amount of light emerges because the retina absorbs nearly all the light, which falls upon it. This is done by varying the aperture of the pupil with the help of the iris. In dim light the iris dilates the pupil so that more light can enter in. When the light is bright the pupil contracts.

The crystalline lens divides the eyeball into two chambers. The chamber between the cornea and the lens is called the anterior chamber filled with a fluid called aqueous humour while the chamber between the lens and the retina is called the posterior chamber which is filled with a transparent gelatinous substance called vitreous humour.

The refractive indices of the cornea, pupil lens and fluid portion of the eye are quite similar. So, when a ray of light enters the eye, it is refracted at the cornea. This refraction produces a real inverted and diminished image of distant objects on the retina.

When the object is kept at diffeent distances then, we may expect the image to be formed at different distances from the lens. It means, it may not form on the retina always.

But in reality it is not so. Image is always formed on the retina. This is possible because the curvature of the crystalline lens is altered by ciliary muscles. When the eye is focused on infinity the muscles are relaxed and the eye lens remains thin. If the object is brought near by, the curvature increases so that the image can be formed on the retina. This property of the eye lens is called accommodation.

20. The change in focal length of an eye lens to focus the image of objects at varying distances is done by the action of _____
(1) pupil
(2) ciliary muscles
(3) retina
(4) blind spot

21. The fluid between the retina and the lens is called _____
(1) aqueous humour (2) vitreous humour
(3) aqua (4) humus

22. The part of the eye where optic nerves enter the eye
(1) pupil (2) ciliary muscles
(3) retina (4) blind spot

23. The inner back surface of the eyeball is called
(1) pupil (2) ciliary muscles
(3) retina (4) blind spot

Assertion Reason Based MCQ

DIRECTIONS (Qs. 24 to 31) : Following questions consist of two statements, one labelled as the **'Assertion'** and the other as **'Reason'**. You are to examine these two statements carefully and select the answer to these items using the code given below.

Code :
(1) Both A and R are individually true and R is the correct explanation of A:
(2) Both A and R are individually true but R is not the correct explanation of A.
(3) A is true but R is false
(4) A is false but R is true.

24. **Assertion :** Ladies use concave mirrors for doing make up.
Reason : Concave mirror makes a real and diminished image of an object.

25. **Assertion :** Convex mirror is used as a rear view mirror in vehicles.
Reason : Image of an object formed by a convex mirror is inverted and diminished.

26. **Assertion :** Convex mirror used is street lights.
Reason : Convex mirror diverges light over a small area than the plane mirror.

27. **Assertion :** Light bends from its path, when it goes from one medium to another medium.
Reason : Speed of light changes, when it goes from one medium to another medium.

28. **Assertion :** Wavelength of light decreases, when it travels from air to water.
Reason : Wavelength of light in water.

$$= \frac{\text{Wavelength of light in air}}{\text{Refractive index of water}}$$

29. **Assertion :** Convex lens is used in terrestrial telescope.
Reason : When an object is placed at 2F (F = focus of the lens) of a lens, its real and inverted image of the same size as that of the object is formed.

30. **Assertion :** Convex lens of a small focal length is used as a magnifying glass.
Reason : Convex lens forms an enlarged image of an object, when the object is placed beyond the focus of the lens.

31. **Assertion :** There exists two angles of incidence for the same magnitude of deviation (except minimum deviation) by a prism kept in air.
Reason : In a prism kept in air, a ray is incident on first surface and emerges out of second surface. Now if another ray is incident on second surface (of prism) along the previous emergent ray, then this ray emerges out of first surface along the previous incident ray. This particle is called principle of reversibility of light.

Correct Definition Based MCQ

32. Dispersion of light is defined as
(1) spliting of white light into seven colours
(2) spliting of white light into five colours
(3) spliting of white light into six colours
(4) spliting of white light into any number of colours

33. Total internal reflection is defined as :
(1) returning back of the light, coming from densar medium and incidented at an angle greater than the critical angle, in the same medium
(2) returning back of the light coming from densar medium and incidented at an angle less than the critical angle, in the same medium.
(3) returning back of the light coming from densar medium and incidented at critical angle in the same medium.
(4) Bending of light at the edge of the of obstacles.

34. Snell's law is defined as
(1) $\frac{\sin i}{\sin r} = {}^1\mu_2$ (2) $\frac{\sin r}{\sin i} = {}^1\mu_2$
(3) $\frac{\sin i}{\sin r} = {}^2\mu_1$ (4) $\frac{1}{\sin i} = \mu$

35. The mirror formula :
(1) is a relationship among u, v & f
(2) is a relationship among u, v & m
(3) is a relationship among f, m & u
(4) is a relationship among f, m & v

Feature Based MCQ

36. On the basis of following features identify the correct option.
(I) Image formed is virtual and erect
(II) Size of image formed is equal to size of object
(III) The right side of the object appears as the left of its image and vice-versa.
(1) Concave mirror (2) Convex mirror
(3) Plane mirror (4) Both (1) and (2)

37. On the basis of following features identify the correct option.
(I) It is also known as diverging lens.
(II) This lens diverges rays of light.
(1) Convex lens (2) Concave lens
(3) Both (1) and (2) (4) Neither (1) nor (2)

38. On the basis of following features identify the correct option.
(I) It is curved lens
(II) It has lens forula $\frac{1}{f} = -\frac{1}{u} + \frac{1}{v}$
(1) Convex lens (2) Concave lens
(3) Both (1) and (2) (4) Neither (1) nor (2)

39. On the basis of following features identify the correct option.
(I) A person not able to see the near objects clearly.
(II) This defect is corrected by using convex lens.
(1) Hypermetropia (2) Myopia
(3) Presbyopia (4) Astigmatism

40. On the basis of following features identify the correct option.
(I) This defect arises when the cornea of the eye has different curvatures in different directions.
(II) This defect is corrected by using a cylindrical lens.
(1) Hypermetropia (2) Mypopia
(3) Presbyopia (4) Astigmatism

Hints & SOLUTIONS

Exercise 1

1. (2) **2. (3)** **3. (4)**
4. (1) Angle of incidence is equal to the angle of reflection.
5. (1) **6. (1)** **7. (4)**
8 (4) An object placed at F of a concave mirror produces a highly enlarged, real & inverted image at infinity.
9. (1) **10. (2)** **11. (3)**
12. (4) A point-sized object placed at infinity of a concave mirror will produce a real & inverted, highly diminished image at its focus.
13. (1) **14. (2)** **15. (1)**
16. (4) A convex mirror always produces a diminished, virtual and erect image behind the mirror.
17. (2) **18. (2)** **19. (2)**
20. (3) A convex lens will produce a diminished, real and inverted image between F and 2F if the object is placed at 2F.
21. (1) **22. (2)** **23. (1)**
24. (3) A convex lens will produce an enlarged, real and inverted image beyond 2F if the object is placed between F and 2F.
25. (1) **26. (3)** **27. (1)**
28. (1) Absolute refractive index of a medium = speed of light in vacuum / speed of light in the medium.
29. (1) **30. (3)** **31. (1)**

32. **(1)** Focus of a concave mirror is towards the left, so focal length is negative.

33. **(1)** **34.** **(1)** **35.** **(3)**

36. **(2)** A ray of light traveling from optically denser to the optically rarer medium will bend away from the normal.

37. **(3)** **38.** **(4)** **39.** **(1)**

40. **(4)** Negative value of image distance signifies that the image is formed on the same side of the object. It is possible only when the image formed is virtual and erect. Such image is formed when the object is between focus and optical center in case of convex or any position of the object in case of concave lenses.

41. **(3)** **42.** **(1)** **43.** **(3)**

44. **(4)** Different constituents of white light have different wavelengths. So, they travel with different speeds after refraction, though they are traveling with the same speed in air.

45. **(2)** **46.** **(2)** **47.** **(3)**

48. **(1)** Colour of an object is determined by the colour of light reflected by it. The reflected light causes the sensation of the colour in the eye.

49. **(4)** **50.** **(2)** **51.** **(4)**

52. **(4)** Working of the human eye as a camera makes it one of the most valuable and sensitive organ of the body. It is only because of the eye that we are able to see the wonderful world and colours around us.

53. **(4)** **54.** **(2)** **55.** **(1)**

56. **(3)** Atmospheric refraction cause splitting of white sunlight when refracting through water droplets.

57. **(3)** **58.** **(3)**

59. **(1)** Light sensitive cells get activated on illumination enabling formation of image.

60. **(4)** Iris is the muscle that contracts the pupil in bright light so as to allow less light to enter.

61. **(4)** The focal length of the eye lens is too great or the eye ball has shrunk. The image is formed behind the retina and the person faces difficulty in seeing the near objects clearly. Use of convex lens is advised for correcting the defect.

62. **(2)** Hypermetropia is also known as far sightedness because the person is able to see clearly the distant objects, but not near objects.

63. **(1)** Presbyopia is a condition in which a person is suffering from both myopia and hypermetropia. It can be corrected by using bifocal lenses in which upper portion is a concave lens and the lower portion is a convex lens.

64. **(3)** The inclined surfaces of the triangular prism makes the emergent ray bend at angle to the direction of the incident ray. The angle between the incident ray produced and the emergent ray produced is called the angle of deviation.

65. **(3)** Dispersion of white light takes place because different colours of light travel with different speeds in the same medium. They bend at different angles with the incident ray. The red light bends the least and the violet light bends the most.

66. **(1)** Placement of another identical prism in an inverted position with respect to the first and allowing the colours of spectrum to pass through it will change the spectrum into white light.

67. **(2)** The star is considered to be a point source of light for its distance from the earth. Apparent change in position of its image due to atmospheric refraction causes twinkling of stars.

68. **(1)** The path of light passing through a clear solution is not visible because of small particle size do not come its way. But the path of light becomes visible through a colloid because light is scattered by relatively larger particles.

69. **(4)** The sky appears blue because molecules of air and other particles in the atmosphere are smaller than wavelength of visible light. Light of shorter wavelengths at the blue end are scattered more than the red light whose wavelength is 1.8 times. The scattered blue light enters our eyes.

Exercise 2

1. **(2)** **2.** **(1)** **3.** **(3)** **4.** **(2)** **5.** **(4)**

6 **(2)** Yes light can travel through vacuum. It is because light waves consists of magnetic field which is perpendicular to electric field which results in creation of potential difference between two points and light wave propagates.

7. **(3)**

8 **(2)** The law of reflection is exactly the same for curved mirrors as for plane (flat) mirrors i.e. 'The angle of reflection equals the angle of incidence'

9. **(1)** Ray of light while travelling from air to water slows down because velocity of light is slower in water than in air.

10. **(2)** **11.** **(1)** **12.** **(2)** **13.** **(3)**

14. **(1)** There is no cure for colour blindness at present. There are coloured lenses that can be used to help distinguish certain colours, but they are impractical for daily use.

15. **(2)**

16. **(1)** **17.** **(2)** **18.** **(3)** **19.** **(1)**

20. **(2)** **21.** **(2)** **22.** **(4)** **23.** **(3)**

24. **(3)** Ladies use concave mirrors for doing make up because the image formed by concave mirror is enlarged when the object (say a face) is in between the pole and faces of the concave mirror.

25. **(3)** Convex mirror forms an erect and diminished image of an object.

26. **(3)** Convex mirror diverges light over a large area than by the plane mirror.

27. **(1)** **28.** **(1)** **29.** **(1)**

30. **(3)** Convex lens forms an enlarged image of an object if the object is placed between the focus and optical centre of the lens.

31. **(1)** **32.** **(1)** **33.** **(1)** **34.** **(1)** **35.** **(1)**

36. **(3)** **37.** **(2)** **38.** **(3)** **39.** **(1)** **40.** **(4)**