I. Tick (✔) the most appropriate answer.

1. During the dispersion of light, the least dispersed colour is:
   (a) violet (b) green (c) red (d) yellow

2. When a coin placed in a bowl of water is seen from above, it appears:
   (a) raised from its position (b) below its position
   (c) at the same position (d) none of these

3. In a compound microscope the objective lens is of:
   (a) smaller focal length than eye lens
   (b) larger focal length than eye lens
   (c) same focal length as eye lens
   (d) none of these

4. If \( v_c \) is the speed of light in vacuum and \( v_m \) is the speed of light in a given medium, then refractive index of medium is:
   (a) \( \frac{v_m}{v_c} \) (b) \( \frac{v_c}{v_m} \) (c) \( v_m \times v_c \) (d) none of these

5. The phenomenon of splitting white light into seven colours is called:
   (a) reflection (b) refraction
   (c) refractive index (d) dispersion

6. A defect in the human eye in which a person can see clearly the objects near the eye, but cannot see far off objects is called:
   (a) myopia (b) presbyopia
   (c) hypermetropia (d) none of these

7. A part of the eye which helps in changing the focal length of crystalline lens is:
   (a) iris (b) aqueous humour
   (c) cornea (d) ciliary muscles

8. A real, inverted and highly enlarged image is formed by a convex lens when the object is:
   (a) beyond 2F (b) between F and 2F (c) at 2F (d) at F

9. The velocity of light in vacuum is:
   (a) \( 3 \times 10^8 \) ms\(^{-1} \) (b) \( 5 \times 10^8 \) ms\(^{-1} \)
   (c) \( 3 \times 10^5 \) ms\(^{-1} \) (d) \( 6 \times 10^8 \) ms\(^{-1} \)
10. A ray of light travelling obliquely from denser to rarer medium:
(a) bends towards the normal
(b) bends away from the normal
(c) does not deviate from its path
(d) none of these

11. A ray of light going from an optically rarer medium to an optically denser medium:
(a) bends towards the normal
(b) bends away from the normal
(c) remains undeviated
(d) none of these

12. The angle between the normal and the refracted ray is called the:
(a) angle of reflection
(b) angle of incidence
(c) angle of refraction
(d) none of these

13. Rainbows are formed due to the:
(a) reflection of light
(b) dispersion of light
(c) refraction of light
(d) none of these

14. A piece of transparent refracting material bounded by two surfaces is called a:
(a) mirror
(b) lens
(c) microscope
(d) telescope

15. A real, inverted and highly diminished image is formed by a convex lens when the object is placed at:
(a) the focus
(b) infinity
(c) 2F
(d) none of these

16. The lens used in spectacles for the correction of short-sightedness is a:
(a) concave lens
(b) plano-convex lens
(c) convex lens
(d) concavo-convex lens

Ans. 1. (c) 2. (a) 3. (a) 4. (b) 5. (d) 6. (a)
7. (d) 8. (b) 9. (a) 10. (b) 11. (a) 12. (c)
13. (b) 14. (b) 15. (b) 16. (a)

II. Fill in the blanks:
1. The phenomenon due to which a ray of light ____________ from its path while travelling from one medium to another medium is called refraction.
2. The ____________ ray, the refracted ray and the normal lie in the same plane during refraction.

3. When a ray of light strikes the surface of separation ____________, it does not suffer any refraction.

4. The ratio between velocity of light in vacuum to the velocity of light in a given medium is called ____________.

5. When the refraction takes place through glass prism, the emergent ray always bends towards the ____________ of prism.

6. The phenomenon due to which light splits into seven colours, when passed through an equilateral prism is called ____________.

7. A ray of light passing through ____________ of a lens, passes undeviated.

8. When the convex lens acts as magnifying glass, the object is between ____________ and optical centre of lens.

9. The focal length of the objective lens of a compound microscope is always ____________ than the focal length of the eye lens.

10. The small, but very sensitive area on the retina is called ____________.

11. Light is a form of ____________ which produces the sensation of sight.

12. A ray of light ____________ when it travels from one medium to another.

13. Between air and water, ____________ is the denser medium.

14. The point on the boundary separating two mediums where the incident ray falls is called ____________.

15. A band of seven colours formed by the dispersion of white light by a prism is called ____________.

16. A rainbow is formed when tiny drop of water suspended in the air acts as ____________.

17. ____________ lens is a diverging lens.

18. A point on the principal axis at which parallel rays of light converge after passing through a lens is called its ____________.

19. ____________ lens is mainly used in spectacles for the correction of myopia.
Ans. 1. Deviates 2. incident 3. normally
4. refractive index 5. base 6. dispersion
7. optical centre 8. principal focus 9. smaller
10. yellow spot 11. energy 12. bends
13. water 14. point of incidence 15. spectrum
16. tiny prism 17. concave 18. focus
19. concave

III. Study the relation and fill up the blanks appropriately.
1. Converging lens : Convex lens :: Diverging lens : __________.
4. __________ : Myopia :: Long sightedness : Hypermetropia.
5. Telescope : Distant objects :: Microscope : __________.
4. Short sightedness 5. Tiny objects

IV. Write ‘true’ or ‘false’ for each statement given below.
1. Diaphragm in camera controls the time of exposure of film.
2. A ray striking normally on another medium does not suffer refraction.
3. A band of seven colours obtained on screen, when white light splits into colours is called spectrum.
4. Concave lens is thinner at edges and thicker in middle.
5. Convex lens always forms real images.
6. Blind spot in eye is found in the eyes of blind people.
7. Cornea acts as a window to the world.
8. The image formed by convex lens is virtual, erect an enlarged when object is between F and O.
10. Yellow spot on the retina is highly sensitive to eye.
V. Statements given below are incorrect. Write correct statements.

1. When a ray of light travels from denser to rarer medium, it always bends towards the normal.
   Ans. When a ray of light travels from denser to rarer medium, it always bends away from the normal.

2. A prism is a piece of glass having three triangular and two rectangular surfaces.
   Ans. A prism is a piece of glass having two triangular and three rectangular surfaces.

3. In an equilateral prism, \( \angle A + \angle i = \angle D + \angle e \).
   Ans. In an equilateral prism, \( \angle i + \angle e = \angle A + \angle D \).

4. The band of seven colours formed on the white screen when white light splits on passing through a prism, is called dispersion.
   Ans. The band of seven colours formed on the white screen when white light splits on passing through a prism, is called spectrum.

5. Convex lenses are always tapering in the middle and thicker at the edges.
   Ans. Convex lenses are always tapering at the edges and thicker in the middle.

6. The distance between principal focus and centre of curvature is called focal length.
   Ans. The distance between principal focus and optical centre is called focal length.

7. When a real, inverted and magnified image is formed by a convex lens, the object is between F and O.
   Ans. When a real, inverted and magnified image is formed by a convex lens, the object is between F and 2F.

8. A concave lens always form virtual, inverted and diminished images.
   Ans. A concave lens always form virtual, erect and diminished images.

9. In a telescope the focal length of eye lens is more than objective lens.
   Ans. In a telescope the focal length of eye lens is less than objective lens.

10. Sclerotic is grey membrane, which darken the eye ball from inside.
6. Choroid is grey membrane, which darken the eye ball from inside.

11. Light travels in a straight line path while passing through different mediums.

   Ans. Light deviates from its path while passing through different mediums.

12. Light travels at a lower speed in air than in water.

   Ans. Light travels at a higher speed in air than in water.

13. The incident ray, the normal and the refracted ray, lie in the different plane.

   Ans. The incident ray, the normal and the refracted ray, lie in the same plane.

14. When white light is dispersed by a prism, the deviation of red colour is the most.

   Ans. When white light is dispersed by a prism, the deviation of violet colour is the most.

15. Images are formed in a mirror by refraction.

   Ans. Images are formed in a mirror by reflection.

16. A convex lens always forms a virtual, erect and diminished image when the object is placed in front of it.

   Ans. A concave lens always forms a virtual, erect and diminished image when the object is placed in front of it.

17. A concave lens is used as a magnifying glass.

   Ans. A convex lens is used as a magnifying glass.

18. An astronomical telescope forms an erect image of an object.

   Ans. An astronomical telescope forms an inverted image of an object.

19. A camera uses a convex lens of long focal length.

   Ans. A camera uses a convex lens of short focal length.

VI. Find the odd one out, give a reason for your choice.

1. Yellow spot, dispersion, blind spot, cornea.

   Ans. Dispersion. Dispersion is a phenomenon due to which white light splits into seven colours, when passed through an equilateral prism, while yellow spot, blind spot and cornea are the parts of eye.

2. Myopia, hypermetropia, hypertension, presbyopia.
Ans. Hypertension. Myopia, hypermetropia and presbyopia are eye defects while hypertension is not.

3. A real, inverted and diminished image; a real, inverted and magnified image; a real, inverted and same size image and a real, erect and magnified image.

Ans. A real, erect and magnified image is the odd one because a real image is always inverted.

4. Formation of a rainbow, dispersion of light, a coin appears raised when placed in a trough filled with water, image formed by plane mirror.

Ans. Image formed by a plane mirror is due to the phenomenon of reflection while others are due to the phenomenon of refraction.

5. Magnifying glass, projector, camera, eyepiece in Galileo’s telescope.

Ans. A concave lens is used in the eyepiece in Galileo’s telescope while a convex lens is used in magnifying glass, projector and camera.

6. real, inverted and highly diminished image; real, inverted and enlarged image; virtual, erect and enlarged image; virtual erect and diminished image.

Ans. Virtual, erect and diminished image is formed by a concave lens while all other images are formed by a convex lens.

7. Myopia, hypermetropia, goitre, colour blindness

Ans. Goitre. Goitre is caused due to deficiency of iodine it is a swelling of throat, while others are eye defects.

VII. Match the statements in column A, with those in column B.

<table>
<thead>
<tr>
<th>(I)</th>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The phenomenon due to which bottom of tank filled with water appears raised</td>
<td>(a) dispersion</td>
</tr>
<tr>
<td>2.</td>
<td>The phenomenon of splitting up of white light</td>
<td>(b) shutter</td>
</tr>
<tr>
<td>3.</td>
<td>A device used for seeing germs and bacteria</td>
<td>(c) simple microscope</td>
</tr>
<tr>
<td>4.</td>
<td>A device used for seeing heavenly</td>
<td>(d) convex lens</td>
</tr>
</tbody>
</table>
bodies.
5. A device used for obtaining permanent image of an object.
6. A lens used as magnifying glass
7. A device in camera which controls the time of exposure.
Ans. 1. (g), 2. (a), 3. (c), 4. (e), 5. (f), 6. (d), 7.(b)

(II) Column A Column B
1. Lens used in a projector (a) at infinity
2. Lens used in Galileo’s telescope (b) at 2F
3. Position of the image by a converging lens when object is placed at 2F (c) between F and 2F
4. Position of the image formed by a converging lens when object is placed at the focus (d) concave lens
5. Position of the object when the image by a converging lens is formed beyond 2F (e) convex lens
Ans. 1. (e), 2. (d), 3. (b), 4. (a), 5. (c)

VIII. Give reasons for the following.
1. It is difficult to place a test-tube over an erect pencil looking at it through a glass slab.
Ans. When a ray of light travels from one medium to another, it changes its path. So the correct position of the pencil is not seen through a glass slab. So it is difficult to place a test tube over an erect pencil while looking at it though a glass slab.
2. Light bends towards the normal when it travels from air to water.
Ans. Since air is less dense than water, so light bends towards the normal when it travels from air to water.
3. The dispersion of light occurs when it is passed through a prism.
Ans. The dispersion of light occurs when it passes through a prism because the different colours are refracted through different angles by a prism.
4. A convex lens is used in making a magnifying glass.
   Ans. When an object is placed between principal focus and optical centre of a convex lens, a virtual, magnified and erect image is obtained on the same side of the object. So a convex lens is used in making a magnifying glass.

5. A concave lens is used in spectacles for the correction of myopia.
   Ans. A myopic person cannot see far off object clearly because its image is formed in front of retina. When a concave lens is placed in front of the eyes, the rays are diverged by the concave lens and the image is formed at the retina. So a concave lens is used in spectacles for the correction of myopia.

6. A pencil appears to be bent when placed in a glass of water.
   Ans. A ray of light deviates from its path while travelling from one optical medium to another optical medium. So a pencil appears to be bent when placed in a glass of water.

IX. Define these terms.
   1. Spectrum.
      Ans. **Spectrum**: A band of seven colours formed by the dispersion of white light by a prism is called spectrum.

   2. Dispersion of light.
      Ans. **Dispersion of light**: The phenomenon due to which white light splits into seven colours, when passed through an equilateral prism, is called dispersion of light.

   3. Optical centre.
      Ans. **Optical Centre**: A point within the lens, where a line drawn through the diameter of lens meets principal axis, is called optical centre.

   4. Principal axis.
      Ans. **Principal axis**: An imaginary line joining the centres of curvature of the two spheres, of which lens is a part is called principal axis.

   5. Focal length.
      Ans. **Focal length**: The distance between principal focus and optical centre is called focal length.
6. Principal focus of a lens.
**Ans.** **Principal focus:** When the rays parallel to the principal axis pass through a lens, they converge to or appear to diverge from a point on the principal axis. This point is called the principal focus.

7. Radius of curvature.
**Ans.** **Radius of curvature:** The centres of the spheres of which the surfaces of the lens is a part are called centres of curvatures of the lens and the radius of those spheres are called radius of curvature.

**X. Differentiate between the following.**

1. Reflection of light and refraction of light.
   **Ans.** The phenomenon due to which a ray of light, travelling from one optical medium to another optical medium, bounces off from its surface is called reflection of light. The phenomenon due to which a ray of light deviates from its path, at the surface of separation of two media, when the ray of light is travelling from one optical medium to another optical medium, is called refraction of light.

2. Light travelling in air and light travelling in water.
   **Ans.** Light travels at a lower speed in water than in air.

3. Angle of incidence and angle of refraction.
   **Ans.** The angle which an incident ray makes with the normal, at the point of incidence, is known as angle of incidence. The angle which a refracted ray makes with the normal, at the point of incidence, is known as angle of refraction.

4. Incident ray and refracted ray.
   **Ans.** A ray which strikes the surface of separation of two optical media is known as incident ray while a ray which travels in the second optical medium, is known as refracted ray.

5. Convex lens and concave lens.
   **Ans.** A piece of transparent optical material, having one or two spherical surfaces, such that it is thicker in the middle and tapering at the edges, is called convex lens while a piece of transparent optical material, having one or two spherical surfaces, such that it is thinner
in the middle and thicker at the edges is called concave lens. A convex lens converges rays of light while a concave lens diverges rays of light.

6. Focus of a convex lens and focus of a concave lens.

Ans. Focus of a convex lens is a point on the principal axis of a convex lens, where parallel beam of light rays, travelling parallel to principal axis, after passing through the lens actually meet. While focus of a concave lens is a point on the principal axis of a concave lens, from where parallel beam of light rays, travelling parallel to principal axis, after passing through the lens, appear to come.

7. Hypermetropia and myopia.

Ans.

<table>
<thead>
<tr>
<th>Hypermetropia</th>
<th>Myopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is the defect of human eye, when a person can see far off objects clearly, but not the objects nearer to him.</td>
<td>It is the defect of human eye, when a person can see nearer objects clearly but not the far off objects.</td>
</tr>
<tr>
<td>2. This defect is corrected by using convex lens of appropriate focal length.</td>
<td>This defect is corrected by using concave lens of appropriate focal length.</td>
</tr>
<tr>
<td>3. It is also known as long sightedness.</td>
<td>It is also known as short sightedness.</td>
</tr>
</tbody>
</table>

XI. Answer the following questions:

1. State the laws of refraction.

Ans. There are two laws of refraction:

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

(ii) If a circle is drawn at the point of incidence with any radius, cutting the incident ray and the refracted ray and if the perpendiculars are drawn from those points to the normal, then the ratio of perpendicular in air to the perpendicular in denser medium is a constant quantity and is commonly called refractive index of the denser medium.
2. Explain why a coin placed at the bottom of a beaker containing water appears raised?

**Ans.** A coin placed at the bottom of a beaker containing water appears raised because the rays of light from the coin ‘C’ while travelling from water to air bend away from the normal at the water air surface. These refracted rays reach the eye of the observer who sees the coin raised to C’ instead of C.

3. Draw a neat and labelled diagram for the passage of ray of light through an equilateral glass prism, showing clearly (a) angle of incidence (b) angle of emergence (c) angle of deviation (d) angle of prism.

**Ans.** Here, \( \angle EFL \) is angle of incidence
\( \angle GFO \) is angle of refraction
\( \angle MGH \) is angle of emergence
\( \angle NPH \) is angle of deviation
\( \angle A \) is the angle of prism

4. Draw a neat diagram when a ray of white light passes through an equilateral glass prism.

**Ans.**

5. By drawing a neat diagram show how a concave lens acts as a diverging lens.
6. State the characteristics of an image and draw a neat diagram when:
(a) Object is between F and 2F in case of convex lens.
(b) Object is beyond 2F in case of concave lens.

**Ans.** (a) When object is between F and 2F of a convex lens.

- **Image is**
  1. Real
  2. Magnified
  3. Inverted
  4. Formed beyond 2F on the other side of lens

(b) When object is beyond 2F of a convex lens.

- **Image is**
  1. Virtual
  2. Diminished
  3. Erect
  4. Formed between O and F on the same side of the object

7. State the functions of the following in photographic camera:
   (a) camera lens  (b) shutter  (c) diaphragm
Ans. (a) **Camera lens:** It is used to obtain a very sharp and clear image of the object.

(b) **Shutter:** A shutter of variable speed is used to control exposure time of the film.

(c) **Diaphragm:**
   (i) It controls the amount of light entering in the camera. The size of the aperture is increased in dim light and decreased in bright light.
   (ii) It controls the size of object to be photographed.

8. (a) What is the short-sighted eye?
   (b) State two causes of short-sightedness.
   (c) Name the lens used for correcting short-sightedness.

   **Ans.**
   (a) When the eye of a person can see nearby objects clearly, but cannot see far off objects clearly, it is known as short-sighted eye.
   (b) Short-sightedness is caused when
      (i) the focal length of eye lens has shortened.
      (ii) eyeball gets elongated.
   (c) Short-sightedness is corrected by using concave lens of appropriate focal length.

9. (a) What is a long-sighted eye?
   (b) State two causes of long-sightedness.
   (c) Name the lens used for correcting long-sightedness

   **Ans.**
   (a) When the eye of a person can see far off objects clearly but cannot see nearby objects clearly, it is known as long sighted eye.
   (b) Long-sightedness is caused due to
      (i) the focal length of eye lens has increased.
      (ii) the eye ball has shortened.
   (c) Long-sightedness is corrected by using convex lens of appropriate focal length.

10. What is refraction of light?
    **Ans.** The phenomenon due which a ray of light deviates from its path, at
the surface of separation of two media, when the ray of light is travelling from one optical medium to another optical medium is called refraction of light.

11. What is dispersion of light?
**Ans.** The phenomenon due to which white light splits into seven colours (VIBGYOR), when passed through an equilateral prism, is called dispersion of light.

12. Define refractive index in terms of speed of light.
**Ans.** Refractive index of a material medium is the ratio of the speed of light in vacuum to that in the medium.

\[
\text{Refractive index} = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in the medium}}
\]

13. What is spectrum? Name the various colours in the spectrum of sunlight.
**Ans.** The band of seven colours obtained on the screen when light splits into seven colours (VIBGYOR), is called spectrum. The various colours in the spectrum of sunlight are:

14. What kind of lens is used in an astronomical telescope?
**Ans.** In an astronomical telescope convex lens is used.

15. Explain the working of a microscope?
**Ans.** **Working of a microscope:** When an object AB is placed between F and 2F of objective lens of microscope, it forms a real, inverted and magnified image \( A_1B_1 \) on the other side of lens.

Now the eye lens is so adjusted that the real image \( A_1B_1 \) falls between principal focus and optical centre of the eye lens.
This gives rise to a divergent beam and virtual, highly magnified image A₂B₂.

16. Draw a ray diagram to show the position of the image formed by an object placed in front of a convex lens when the object is at infinity.

**Ans.** When object is at infinity image is
1. Real
2. Diminished to a point
3. Inverted
4. Formed at F on the other side of lens

17. Draw a ray diagram to show the position of the image formed when an object is placed between the focus and optical centre in front of a convex lens. Also give the nature and size of the image.

**Ans.** When the object is between optical centre and principal focus of a convex lens image is
1. Virtual
2. Magnified
3. Erect
4. Formed on the same side of the object

18. Mention some uses of concave lens and convex lens?

**Ans.** Uses of concave lens:
(i) It is used as an eye lens in Galilean telescope.
(ii) It is used for correcting short-sightedness.

Uses of convex lens:
(i) It is used as magnifying glass
(ii) It is used in photographic cameras, cinema projectors, microscopes, etc.

19. A beam of light travelling in a glass slab emerges into air. Draw a ray diagram showing the change of path.
17

Ans.

Ray of light bends away from the normal when it travels from glass slab (denser medium) to air (rarer medium).

20. Which factors affect the angle of deviation of light?
Ans. The factors which affect the angle of deviation of light are:
(a) Refracting angle
(b) Material of the prism

21. What happens when a ray of light passes through the optical centre of a lens?
Ans. When a ray of light passes through the optical centre of a lens, it will pass through the lens without any deviation or lateral displacement.

22. Which type of the lens is human eye made of?
Ans. Human eye is made up of convex lens.

23. What is a microscope?
Ans. A microscope is a device used to obtain a magnified image of very small objects that cannot be seen with the naked eye.

24. What is telescope?
Ans. A telescope is a device used to view distant objects.

25. Which lens is also known as converging lens?
Ans. Convex lens.

26. What is a camera?
Ans. A camera is a device that can record pictures of objects on a photographic film.

27. Define the following terms.
(a) Prism  (b) Lens
Ans. (a) A prism is a triangular block of any transparent material with three rectangular faces.
(b) A lens is a transparent medium bounded by two spherical refracting surfaces or by one spherical and one plane surface.
28. What is a real image? What are its characteristics?

**Ans.** When the rays of light diverging from a point of reflection or refraction actually converge at some other point the image so formed is called real image.

Characteristics of real image:
(a) Real image is always inverted.
(b) Real image can be taken on screen.
(c) Real image may be magnified, diminished or be of the same size as the object.

29. What is a virtual image? What are its characteristics?

**Ans.** When the rays of light diverging from a point, after reflection or refraction, appear to diverge from some other point, the image so formed is called virtual image.

Characteristics of virtual image:
(a) Virtual images are always erect.
(b) Virtual image cannot be taken on screen.
(c) Virtual image may be magnified or diminished or be of the same size as the object.

30. What is the unit of refractive index?

**Ans.** Since refractive index is the ratio of the velocity of light in two media, so it has no unit.

31. Define angle of deviation.

**Ans.** The angle of deviation is the angle between the incident ray produced forward and the emergent ray produced backward when rays of light pass through a glass prism.

32. Draw a neat and fully labelled diagram of a compound microscope.

**Ans.**

![Diagram of a compound microscope](image)
33. Draw a neat and fully labelled diagram of a telescope.

Ans.

![Telescope Diagram]