# CHAPTER 12

# GEOMETRICAL OPTICS

## CONCEPT MAP

**LIGHT**

### Light rays and reflection

**Two laws of reflection:**
The incident ray, reflected ray and the normal at the point of incidence all lie in the same plane
(ii) $i = r$

**Characteristics of an image formed by a plane mirror:**
- Same size as object
- Inverted front-to-back
- Upright
- Virtual
- As far behind the mirror as the object is in front of the mirror

**Some applications of plane mirrors:**
- Optical testing
- Periscope
- Blind corner
- Instrument scales

### Ray diagrams

**Refractive index $n$**
is defined as
$n = \frac{\sin i}{\sin r}$ where $i$ is the angle of incidence in air

**For the special case of the refracted ray in air:**
$\sin c = \frac{1}{n}$
Where c is the critical angle

**Total internal reflection occurs when:**
- A ray of light travels from an optically denser to a less dense medium
- The angle of incidence in the optically denser medium is greater than the critical angle c

**some applications of total internal reflection:**
- Prisms in binoculars and periscopes
- optical fibres in telecommunications and the medical industry

### Light rays and refraction

**Two laws of refraction:**
The incident ray, refracted ray and the normal all lie in the same plane.
Snell's Law: $\frac{\sin i}{\sin r}$=constant

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**Real and inverted**
- Real images are formed when object distance is $p < f$
- Virtual and upright images are formed when $p \leq f$

**Some applications of thin converging lenses**
- Magnifying glass
- projector
- Camera
- Visual correction for long-sightedness

# TOPICAL MULTIPLE CHOICE QUESTIONS

## 12.1 Reflection:

(1) **Plank suggested that light consists of small packets of energy called:**
(a) Electrons (b) Neutrons (c) Photons (d) Positrons

(2) **The angle between incident ray and normal N is;**
(a) Angle of reflection (b) Angle of incidence ( c) Angle of refraction (d) Normal angle

(3) **Angle of incidence is represented by**
(a) i (b) e (c) R (d) p

(4) **The angle between the normal and the reflected ray is called angle of**
(a) Reflection (b) Refraction (c) Incidence (d) Diffraction

(5) **The incident ray, the normal, and the reflected ray at the point of incidence all lie in the**
(a) Opposite direction (b) Same plane (c) x and y axis (d) y & z - axis

(6) **According to law of reflection**
(a) $i > r$ (b) $i < r$ (c) $r > i$ (d) $i = r$

(7) **Regular reflection is reflection by the**
(a) Rough surface (b) Smooth surface
(c) Irregular surface (d) Smooth and rough surfaces

(8) **The rough surfaces of object reflect the rays of light in many directions is called**
(a) Regular reflection (b) Irregular reflection (c) Refraction (d) Interference

## 12.2 Spherical Mirrors

(9) **In concave mirror the surface is reflecting;**
(a) Outer surface (b) Outer curved (c) Inner curved surface (d) Side of the mirror

(10) **Which statement is incorrect about concave mirror?**
(a) Size of image depends upon position of the object
(b) Both virtual and real images can form
(c) Inner surface of spherical mirror is reflecting
(d) Only virtual images are formed

(11) **A spherical mirror whose outer curved surface is reflecting is called**
(a) concave mirror (b) convex mirror (c) Concave lens (d) Convex lens

(12) **Which statement is correct about convex mirror?**
(a) Size of image is smaller than object (b) Only virtual erect image is formed
(c) Outer curved surface is reflecting (d) All of the given statements are true

(13) **Vertex is the midpoint of the curved surface of spherical mirror is also called**
(a) Radius of curvature (b) Principal axis
(c) Pole (d) Principal focus

(14) **A line joining centre of curvature and pole of the spherical mirror is**
(a) Principal axis (b) principal focus (c) Centre of curvature (d) Pole

(15) **The distance from the pole to the principal focus measured along the principal axis is**
(a) Principal focus (b) Radius of curvature (c) Focal length (d) Diameter

## 12.3 Image location by spherical mirror formula
## 12.4 Refraction of light

(16) The relationship between object distance p, image distance q from the mirror and focal length of the mirror is called;
(a) Mirror focal length (b) Distance from mirror
(c) Mirror formula (d) Lens formula

(17) Mirror formula is
(a) $\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$ (b) $\frac{1}{f} = \frac{1}{p} - \frac{1}{q}$ (c) $\frac{1}{f} = \frac{1}{p} - \frac{q}{p}$ (d) $\frac{1}{f} = \frac{1}{q} + \frac{p}{q}$

(18) Focal length of spherical mirror is
(a) $\frac{R}{4}$ (b) $\frac{R}{2}$ (c) $\frac{R}{3}$ (d) $\frac{R}{9}$

(19) Convex mirror produce images
(a) Larger than object (b) Smaller than object (c) Equal to object (d) Very large in size

(20) The bending of light as it passes from one transparent medium into another is
(a) Reflection (b) Refraction (c) Reverberation (d) Incidence

(21) According to law of refraction
(a) $\frac{\sin i}{\sin r} > i$ (b) $\frac{\sin r}{\sin i} > r$ (c) $\frac{\sin i}{\sin r} = cons\tan t$ (d) $\frac{\sin r}{\sin i} > n$

(22) $\frac{\sin i}{\sin r} = n = \frac{n_2}{n_1}$ is called
(a) Boyl's-law (b) Charless's law (c) Snell's law (d) Newton's law

(23) Speed of light in air is approximately
(a) $3.0 \times 10^8$ ms$^{-1}$ (b) $4 \times 10^9$ ms$^{-1}$ (c) $4 \times 10^{14}$ ms$^{-1}$ (d) $3 \times 10^7$ ms$^{-1}$

(24) The speed of light is greater in
(a) Air (b) Water (c) Solid (d) Glass

(25) The speed of light in water is approximately
(a) $2.0 \times 10^8$ ms$^{-1}$ (b) $2.3 \times 10^8$ ms$^{-1}$ (c) $3 \times 10^8$ ms$^{-1}$ (d) $3 \times 10^7$ ms$^{-1}$

(26) ? = $\frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$
(a) Reflective index (b) Snell's law (c) Refractive index (d) Critical angle

## 12.5 Total internal reflection
## 12.6 Refraction through prism
## 12.7 Lenses

(27) When a ray of light enters from a denser medium to a rarer medium
(a) It bends toward the normal (b) It bends away from the normal
(c) It bends towards inside (d) None of these

(28) The angle of incidence that causes the refracted ray in the rarer medium to bend through 90° is called
(a) Critical angle (b) Angle of incidence (c) Angle of reflection (d) Angle of refraction

(29) No refraction occurs when the angle of incidence is
(a) Smaller than the critical angle (b) Larger than the critical angle
(c) Equal to the critical angle (d) Very small than the critical angle

(30) **The line passing through the two centres of curvatures of the lens is called**
(a) Principal focus (b) Optical centre (c) Principal axis (d) Focal length

(31) **Optical centre is represented by**
(a) A (b) f (c) F (d) C

(32) **For a concave lens, the parallel rays appear to come from a point behind the lens is called;**
(a) Principal focus (b) Principal axis (c) Focal length (d) Optical length

(33) **The distance between the optical centre and the principal focus is.**
(a) Principal focus (b) Principal axis (c) Focal length (d) Optical length

(34) **It is a transparent body (made of optical glass) with at least two polished plane faces inclined towards each other from which light is refracted;**
(a) prism (b) camera (c) lens (d) mirror

(35) **In lens number of curved surfaces at least;**
(a) two (b) three (c) one (d) four

(36) **Lenses are used in optical devices;**
(a) camera (b) eyeglasses (c) microscope (d) all given

(37) **The lens which causes incident parallel rays to converge at a point is;**
(a) convex lens (b) converging lens (c) both a & b (d) concave lens

(38) **Lens thick at the centre but thin at the edges is;**
(a) concave (b) convex (c) diverging (d) plane

(39) **SI unit of power of lens is:**
(a) meter (b) dioptre (c) centimeter (d) millimeter

(40) **1D = ?**
(a) $1m^{-1}$ (b) $m^{-2}$ (c) $m^{-3}$ (d) $cm^{-1}$

(41) **It has positive focal length;**
(a) simple lens (b) concave lens (c) convex lens (d) none of above

## 12.8 Refraction through lenses
## 12.9 Image Location by lens equation

(42) **In mirrors images are formed through reflection, but lenses form images through;**
(a) refraction (b) incidence (c) diffraction (d) reflection

(43) **In case of convex lens when object is placed beyond 2F,the image is formed;**
(a) between F and 2F (b) real, inverted (c) smaller than object (d) all of these

(44) **The image with convex lens is formed at 2F, real , inverted, the same size as the object when the object is placed at:**
(a) 2F (b) between F and 2F (c) F (d) C

(45) **When object is at F the image is;**
(a) inverted (b) real (c) small (d) not formed

(46) **Lens formula is**
(a) $\frac{1}{p}=\frac{1}{f}+\frac{1}{q}$ (b) $\frac{1}{f}=\frac{1}{p}+\frac{1}{q}$ (c) $\frac{1}{f}=\frac{q}{p}+\frac{1}{q}$ (d) $\frac{1}{f}=\frac{1}{p}-\frac{1}{q}$

(47) **For a converging lens f is;**
(a) negative (b) positive
(c) some time negative and some time positive (d) smaller

(48) **The study of behaviour of light is called;**
(a) optics (b) geometry (c) plasma (d) geometrical optics

(49) **If the object is on the right side of the lens then p is;**
(a) positive (b) negative (c) smaller (d) larger

(50) **Optical device is;**
(a) camera (b) slide projector (c) photograph enlarger (d) all of given

(51) **Which statement is correct about image formed by camera?**
(a) Real image is formed (b) Inverted image is formed
(c) Diminished image is formed (d) All options are true

(52) **In case of photograph enlarger the object is placed at distance;**
(a) more than F (b) less than 2F (c) both A and B (d) more than 3F

(53) **The working principle of photograph enlarger is the same as;**
(a) Slide projector (b) camera (c) Telescope (d) Endoscope

(54) **Which pipe is a bundle of thousand of optical fibres bounded together?**
(a) light pipe (b) Telescope (c) Microscope (d) Projector

(55) **It is used to explore the interior organs of the body?**
(a) Telescope (b) Endoscope (c) Microscope (d) Projector

(56) **Endoscope used to diagnose the stomach is;**
(a) Cystoscope (b) Gastroscope (c) Bronchoscope (d) Pancreoscope

(57) **Endoscope which is used to diagnose throat is;**
(a) Gastroscope (b) Cystoscope (c) Bronschoscope (d) None of these

## 12.11 Simple Microscope
## 12.12 Compound Microscope

(58) **A magnifying glass is a convex lens which is used to produce magnified images of small objects. It is also called;**
(a) Compound microscope (b) Simple microscope
(c) Electron microscope (d) Light microscope

(59) **For seeing tiny objects we use microscope of;**
(a) low resolving power (b) high resolving power
(c) Electron microscope (d) Light microscope

(60) **Which statement is correct about compound microscope?**
(a) Focal length of objective lens is smaller than eyepiece.
(b) Distance between objective lens and eyepiece is greater than $f_0 + f_e$.
(c) It is used to see very small object
(d) All given statements are true

(61) **The magnification of compound microscope is;**
(a) $M = \frac{L}{f_0}\left(1+\frac{d}{f_e}\right)$ (b) $M = \frac{L}{f_0}$ (c) $M = \left(1+\frac{d}{f_e}\right)$ (d) $M = \frac{L}{f_e}\left(1+\frac{d}{f_e}\right)$

## 12.13 Telescope
## 12.14 The Human Eye
## 12.15 Defects of Vision

(62) **It is an optical instrument which is used to observe distant objects using lens or mirror;**
(a) microscope (b) Kaledoscope (c) Telescope (d) Light microscope

(63) **Magnification of telescope can be determined by using formula;**
(a) $M = \frac{f_0}{f_e}$ (b) $M = \frac{f_0}{f_0}$ (c) $M = \frac{F}{L}$ (d) $M = \frac{L_0}{f_0}$

(64) **Human eye acts like;**
(a) Camera (b) Telescope (c) Kaledoscope (d) Microscope

(65) **Light enters the eye through transparent membrane called;**
(a) Retina (b) Cornea (c) Iris (d) Pupil

(66) **The coloured portion of eye controls the amount of light reaching the retina.**
(a) Iris (b) Pupil (c) Cornea (d) eye lens

(67) **The variation of focal length of eye lens is called;**
(a) Variation (b) Accommodation (c) Magnification (d) Resolution

(68) **When people cannot see distant objects clearly without the aid of spectacles the defect of vision is;**
(a) Short-sighted (b) near-sightedness (c) both A & B (d) Farsightedness

(69) **Short sighted may be due to eyeball being**
(a) too long (b) too short (c) too thick (d) too thin

(70) **Have ability to move eye lens forward or backward.**
(a) Fish (b) Human (c) Birds (d) Dog

(71) **The nearsighted eye can be corrected by using;**
(a) diverging lens (b) converging lens (c) both A & B (d) Concave mirror

(72) **The disability of the eye to form distinct images of nearby object on retina is called forsightedness or:**
(a) Short sightedness (b) isometropia (c) hypermetropia (d) Myopia

(73) **Farsightedness is corrected by using;**
(a) Converging lens (b) diverging lens (c) concave mirror (d) convex mirror

(74) **Power of concave lens is:**
(a) Greater (b) Less (c) Positive (d) Negative

(75) **Long sightedness is caused due to ---------- eye ball:**
(a) Thick (b) Thin (c) small (d) Both a & c

(76) **Near point of a normal human being is:**
(a) 25 cm (b) 50 cm (c) 100 cm (d) Infinity

(77) **Long sightedness is removed by:**
(a) Convex mirror (b) Concave mirror (c) Convex lens (d) Concave lens



## ANSWER KEY

| Q. | Ans | Q. | Ans | Q. | Ans | Q. | Ans | Q. | Ans | Q | Ans | Q | Ans | Q. | Ans |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 11 | b | 21 | c | 31 | d | 41 | c | 51 | d | 61 | a | 71 | a |
| 2 | b | 12 | d | 22 | c | 32 | a | 42 | a | 52 | c | 62 | c | 72 | c |
| 3 | a | 13 | c | 23 | a | 33 | c | 43 | d | 53 | a | 63 | a | 73 | a |
| 4 | a | 14 | a | 24 | a | 34 | a | 44 | a | 54 | a | 64 | a | 74 | d |
| 5 | b | 15 | c | 25 | b | 35 | c | 45 | d | 55 | b | 65 | b | 75 | b |
| 6 | d | 16 | c | 26 | c | 36 | d | 46 | b | 56 | b | 66 | a | 76 | a |
| 7 | b | 17 | a | 27 | b | 37 | c | 47 | b | 57 | c | 67 | b | 77 | c |
| 8 | b | 18 | b | 28 | a | 38 | b | 48 | a | 58 | b | 68 | c | | |
| 9 | c | 19 | b | 29 | b | 39 | b | 49 | b | 59 | b | 69 | a | | |
| 10 | d | 20 | b | 30 | c | 40 | a | 50 | d | 60 | d | 70 | a | | |