Chapter: 12

Geometrical Optics

Exercise MCQs

1. **Which of the following quantity is not changed during refraction of light?**
   (A) Its direction
   (B) Its speed
   (C) its frequency
   (D) its wavelength

2. **A converging mirror with radius of 20 cm creates a real image 30 cm from the mirror. What is the object distance?**
   (A) 5.0cm
   (B) -15cm
   (C) 7.5cm
   (D) 20cm

3. **An object is placed at the center of curvature of a concave mirror. The image produced by the mirror is located:**
   (A) Out beyond the center of curvature
   (B) at the center of curvature
   (C) at the focal point
   (D) Between the center of curvature and the focal point

4. **An object is 14 cm in front of a convex mirror. The image is 5.8 cm behind the mirror. What is the focal length of the mirror?**
   (A) -4.1cm
   (B) -9.9cm
   (C) -8.2cm
   (D) -20cm

5. **The index of refraction depends on:**
   (A) The focal length
   (B) The image distance
   (C) the speed of light
   (D) the object distance

6. **Which type of image is formed by a concave lens on a screen?**
   (A) Inverted and real
   (B) Upright and real
   (C) inverted and virtual
   (D) upright and virtual

7. **Which type of image is produced by the converging lens of human eye if it views, adistant object?**
   (A) Real, erect, same size
   (B) Virtual, erect, diminished
   (C) real, inverted, diminished
   (D) virtual, inverted, magnified

8. **Image formed by a camera is:**
   (A) Real, inverted, diminished
   (B) Virtual, inverted, diminished
   (C) Virtual, upright and magnified
   (D) virtual, inverted, magnified

9. **If a ray of light in glass is incident on an air surface at an angle greater than the**

critical angle, the ray will:

- (A) Refract only
- (B) Partially refract and partially reflect
- (C) reflect only
- (D) diffract only

10. The critical angle for a beam of light passing from water into air is 48.8 degrees. This means that all light rays with an angle of incidence greater than this angle will be:

- (A) absorbed
- (B) partially reflected and partially transmitted
- (C) totally reflected
- (D) totally transmitted

Answer Key:

1	(C)	6	(D)
2	(B)	7	(C)
3	(B)	8	(A)
4	(B)	9	(C)
5	(C)	10	(C)

★ Short Questions ★

Q1. What do you understand by Reflection of light?

Ans: "When light travelling in a certain medium falls on the surface of another medium, a part of it turns back in the same medium, this is called Reflection of light".

Q2. Describe the following terms used in Reflection:

(i) Normal   **(ii) Angle of Incidence**   **(iii) Angle of Reflection**

Ans:

Normal:
Normal is the perpendicular at the point of incidence.

Angle of incidence:
The angle with which a light ray strikes a reflecting surface.

Angle of reflection:
The angle between a reflected ray and the normal drawn at the point of incidence to a reflecting surface.

Q3: State Laws of Reflection?

Ans: **Laws of Reflection:**

First law of Reflection:

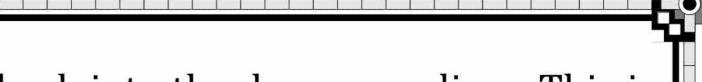The incident ray, the normal, and the reflected ray at the point of incidence all lie in the same plane.

Second law of Reflection:

The angle of incidence is equal to the angle of reflection.

Q4: **Define Refraction of Light?**

Ans: "Bending effect of light as it passes from one transparent material into another is called Refraction of light".

Q5: **Define the following terms used in refraction:**

 (i)   Angle of incidence   (ii) Angle of refraction

Ans: **Angle of incidence:**

The angle that the incident ray makes with the normal is referred as the angle of incidence.

Angle of refraction:

The angle that the refracted ray makes with the normal line is referred to as the angle of refraction.

Q6: **What is meant by Refractive index of a material?**

Ans: When a ray of light passes from one particular medium to another, the ratio of the sin of the angle of incidence to the sin of the angle of refraction is constant. This constant ratio is called the refractive index.

$$n = \frac{\sin i}{\sin r}$$

Q7: **State the Laws of Refraction of Light?**

Ans: **First law of Reflection:**

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

Second law of Reflection:

 For two particular media, the ratio of the sin of the angle of incidence to sin of the angle of refraction is a constant.

Q8: **What is meant by the term Total Internal reflection?**

Ans: The angle of incidence for which the angle of refraction becomes 90 is called critical angle. When the angle of incidence becomes larger than the critical angle, no

refraction occurs. The entire light is reflected back into the denser medium. This is knownas Total Internal reflection.

Q9: State the conditions for Total Internal reflection?

Ans: Conditions for total internal reflection:

➢ The ray of light passes from denser to a less dense medium.

➢ The angle of incidence in the denser medium is greater than the critical angle.

Q10: What is Critical Angle?

Ans: "The critical angle is defined as the angle of incidence in the optically denser medium for which the angle of refraction in the less dense medium is 90°".

Q11: What are Optical Fibres?

Ans: An optical fibre cable is a bundle of glass fibres with thickness of a human hair.

Q12: Define the following terms applied to a lens:

(i) Principal axis   **(ii) Optical centre**   **(iii) Focal length**

Ans:

(i) Principal axis:

Each of the two surfaces of a spherical lens is a section of a sphere. The line passing through the two centres of curvatures of the lens is called Principal axis.

(ii) Optical centre:

A point on the principal axis at the centre of lens is called Optical centre.

(iii) Focal length:

The focal length is the distance between the optical centre and the principal focus.

Q13: What is meant by the Principal focus of a:

(a) Convex lens   **(b) Concave lens**

Ans: Principal focus of convex lens:

The light rays travelling parallel to the principal axis of a concave lens after refraction meet at a point on the principal axis called principal focus or focal point. Hence convex lens is called converging lens.

Principal focus of Concave lens:

The parallel rays appear to come from a point behind the lens called principal focus. Hence concave lens is also called diverging lens.

Q14: Describe how light is Refracted through Convex lens?

Ans: Refraction of light through convex lens can be described with the help of three principal rays as:

➢ The ray parallel to the principal axis passes through the focal point after refraction by the lens.

➢ The ray passing through the optical center passes straight through the lens and passes deviated.

➢ The ray passing through the focal point becomes parallel to the principal axis after refraction by the lens.

Q15: **A coin is placed at a focal point of a converging lens. Is an image formed? What is its nature?**

Ans: A coin is placed at a focal point of a converging lens. No image is formed because the refracted rays are parallel and never meet.

Q16: **What are the Differences between Real and Virtual Images?**

Ans: The Differences between Real and Virtual Images are:

Real Images	Virtual Images
➢ Real image usually appear inverted.	➢ Virtual image usually appears erect.
➢ Real images can be obtained on a screen.	➢ Virtual image cannot be obtained on screen.
➢ On mirror, Real images lie in front of the reflecting surface.	➢ On mirror, Virtual image lies behind the mirror.
➢ On lens, Real images lie on the other side of the object.	➢ On lens, Virtual images lies on the same side of the object.
➢ Light rays meet at a focal point in front of the mirror.	➢ Light rays meet at a focal point behind the mirror.

Q17: **How does a converging lens form a virtual image of a Real object? How does a diverging lens can form a real image of a Real object?**

Ans: A converging lens can form a virtual image of a real object. If the object is placed between the lens and the principal focus, a virtual image can be obtained.

Image formed by diverging lens:

No, it is not possible for a diverging or a concave lens to form a real image of the real object because when you extend its light ray, they diverge and never end up intersecting.

Q18: **Define the Power of a lens and its Units.**

Ans: "The power of a lens is defined as the reciprocal of its focal length in meters"

Unit:

SI unit of power of a lens is diopter denoted by a symbol D.

Q19: What are the Differences between Resolving Power and Magnifying Power?

Ans: The differences between Resolving Power and Magnifying Power are:

Resolving Power	Magnifying Power
Resolving power of an instrument is itsability to reveal the minor details of theobject under examination.	The ratio of the angles subtended by the image as seen through the optical device to that subtended by the object at the unaided eye.

Q20: What is meant by the terms Nearsightedness and Farsightedness? How can these defects be corrected?

Ans: <u>**Nearsightedness (myopia)**</u>:

"Some people cannot see distant objects clearlywithout the aid of spectacles. This defect of vision is known as Short sight or Nearsightedness".

<u>Correction of Nearsightedness</u>:

The nearsighted eye can be corrected with glass orcontact lenses that use diverging lenses.

<u>Farsightedness (hypermetropia)</u>:

"The disability of the eye to form distinct imagesof nearby objects on its retina is known as Farsightedness".

<u>Correction of Farsightedness</u>:

Farsightedness can be corrected with the aid of asuitable converging lens.

Q21: Define Lens?

Ans: A lens is any transparent material having two surfaces, of which at least one is curved.

Q22: Why the position of fish inside the water seems to be at less depth than that of its actual position?

Ans: The position of a fish inside the water seems to be at less depth than that of itsactual positions due to refraction of light.

Q23: Define Endoscopy?

Ans: A medical procedure suing any type of endoscope is called endoscopy.

Q24: Why or why not concave mirrors are suitable for make up?

Ans: Concave mirror are used for makeup because concave mirrors are curved inwards and make the person's image larger as he\she approaches the mirror.

Q25: **Difference between telescope and microscope?**

Ans: The difference between telescope and microscope is:

Telescope	Microscope
➢ Telescope is an optical instrument which is used to observe distant objects using lenses or mirrors. ➢ In a refracting telescope, an objective forms a real image of the distant object while an eyepiece forms a virtual image that is viewed by the eye.	➢ The microscope has two converging lenses, which is used to investigate the structure of small objects. ➢ A compound microscope is used to study bacteria and other micro-objects.

Q26: **Define Light Pipe?**

Ans: Light pipe is a bundle of thousands of optical fibres bounded together.

Q27: **What is meant by principal focus or focal point?**

Ans: After reflection, ray of light parallel to the principal axis converge to a point F, this point is called "The Principal Focus"

Q28: **Under what conditions will a converging lens form a virtual image?**

Ans: The image is behind the object, virtual, erect, and larger than the object.

Q29: **Under what conditions will a converging lens form a real image that is the same size as the object?**

Ans: The image is at 2F, real, inverted, the same size as the object.

Q30: **Define Prism.**

Ans: Prism is a transparent object which has five faces. Three faces are rectangular and two faces are triangular.

Additional Short Questions

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1. **Define Accommodation.**

Ans: The variation of focal length of eye lens to form a sharp image on retina is called Accommodation.

2. **Define Mirror Formula or Lens Formula?**

Ans: Mirror Formula or Lens Formula is:

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

3. Define Spherical Mirror.

Ans: A mirror whose polished, reflecting surface is a part of a hollow sphere of glass or plastic is called a spherical mirror.

4. Difference between Regular and Irregular Reflection?

Ans: The difference between Regular and Irregular Reflection is:

Regular	Irregular Reflection
➤ The reflection by smooth surfaces iscalled regular reflection.	➤ The reflection by rough surfaces is called irregular reflection.

5. Difference between concave mirror and convex mirror?

Ans: The difference between concave mirror and convex mirror is:

Concave Mirror	Convex Mirror
➤ A spherical mirror whose inner curved surface is reflecting is called Concave mirror.	➤ A spherical mirror whose outer curved surface is reflecting is called convex mirror.
➤ The focus is in front of the mirror.	➤ The focus lies behind the mirror.

6. Define Snell's Law and write its formula?

Ans: The ratio of the sin of the angle of incidence i to the sin of the angle of refraction r is always equal to a constant. This is also called Snell's law.

$$n = \frac{\sin i}{\sin r}$$

7. Find the focal length of the convex lens if its power is 5D?

Ans: We know that:

$$f = \frac{1}{p} = \frac{1}{5} = 0.2 m$$