CHAPTER 9

LIGHT: REFLECTION AND REFRACTION

MULTIPLE CHOICE QUESTIONS

1. What type of mirror is used in torches and headlights of vehicles?
A) Plane mirror
B) Concave mirror
C) Convex mirror
D) None of these
Answer: B) Concave mirror
Explanation: Concave mirrors focus light into a parallel beam, making them ideal for torches and headlights.

2. A ray parallel to the principal axis of a concave mirror passes through which point after reflection?
A) Pole
B) Centre of curvature
C) Focus
D) Aperture
Answer: C) Focus
Explanation: According to ray diagram rules, such rays pass through the focus after reflection.

3. If the radius of curvature of a spherical mirror is 30 cm, its focal length is:
A) 15 cm
B) 30 cm
C) 45 cm
D) 60 cm
Answer: A) 15 cm
Explanation: Focal length = Radius of curvature / 2, so f = 30/2 = 15 cm.

4. A convex mirror forms an image that is always:
A) Real and inverted
B) Virtual and erect
C) Real and erect
D) Virtual and inverted
Answer: B) Virtual and erect
Explanation: Convex mirrors always produce diminished, erect and virtual images.

5. Which mirror can form a magnified virtual image?
A) Convex mirror
B) Plane mirror
C) Concave mirror
D) All of these
Answer: C) Concave mirror
Explanation: Concave mirrors form magnified virtual images when the object is between the pole and focus.

6. In spherical mirrors, the pole is:
A) The center of the mirror
B) A point on the principal axis
C) A point on the surface of the mirror
D) None of these
Answer: C) A point on the surface of the mirror
Explanation: The pole lies at the center of the mirror's reflecting surface.

7. The unit of power of a lens is:
A) Metre
B) Dioptre
C) Centimetre
D) Watt
Answer: B) Dioptre
Explanation: Power of a lens (P) is the reciprocal of focal length in metres, measured in dioptres.

8. The power of a lens with focal length 50 cm is:
A) +2 D
B) +1 D
C) +0.5 D
D) +3 D
Answer: B) +2 D
Explanation: P = 100/f (in cm), so P = 100/50 = 2 D.

9. If a ray passes through the centre of curvature of a concave mirror, it is:
A) Reflected through focus
B) Reflected back on the same path
C) Reflected through pole
D) Not reflected
Answer: B) Reflected back on the same path
Explanation: Rays through the center of curvature strike normal to the mirror and retrace the same path.

10. Refraction occurs due to:
A) Change in frequency of light
B) Change in direction of light
C) Change in speed of light
D) Both B and C
Answer: D) Both B and C
Explanation: Light bends due to a change in its speed when it passes from one medium to another.

11. The magnification produced by a mirror is -2. This implies the image is:
A) Virtual and erect
B) Virtual and diminished
C) Real and inverted
D) Real and erect
Answer: C) Real and inverted

Explanation: Negative magnification implies real and inverted image. Magnification > 1 indicates enlargement.

12. The principal focus of a convex mirror is:
A) In front of the mirror
B) Behind the mirror
C) On the mirror surface
D) At the center of curvature
Answer: B) Behind the mirror
Explanation: Reflected rays appear to diverge from a point behind the mirror.

13. A light ray passing through the principal focus of a concave mirror will reflect and travel:
A) Parallel to the principal axis
B) Through the pole
C) To the center of curvature
D) Along the same path
Answer: A) Parallel to the principal axis
Explanation: A ray through focus reflects parallel to the axis in concave mirrors.

14. Which of the following always forms a virtual and erect image?
A) Concave mirror
B) Convex mirror
C) Convex lens
D) Concave lens
Answer: B) Convex mirror
Explanation: Convex mirrors always produce virtual and erect images.

15. An object is placed 10 cm from a convex mirror of focal length 15 cm. The image will be:
A) Real, inverted
B) Virtual, erect, diminished
C) Virtual, erect, enlarged

D) Real, erect
Answer: B) Virtual, erect, diminished
Explanation: Convex mirrors always produce diminished, erect and virtual images.

16. A concave mirror is used in solar cookers because:
A) It produces a virtual image
B) It focuses sunlight to a point
C) It does not reflect light
D) It is flat and easy to clean
Answer: B) It focuses sunlight to a point
Explanation: Concave mirrors converge sunlight at focus to produce heat.

17. A ray incident obliquely at the pole of a mirror follows which law?
A) Newton's Law
B) Ohm's Law
C) Snell's Law
D) Law of reflection
Answer: D) Law of reflection
Explanation: All reflections obey the law of reflection at the point of incidence.

18. Which surface causes maximum reflection of light?
A) White paper
B) Wooden surface
C) Highly polished metal
D) Rough wall
Answer: C) Highly polished metal
Explanation: Smooth, shiny surfaces reflect the most light.

19. A concave mirror is used by dentists because it forms:
A) Diminished image
B) Virtual, enlarged image
C) Real, enlarged image
D) Real, diminished image

Answer: B) Virtual, enlarged image
Explanation: At short distances, concave mirrors produce magnified virtual images.

20. The image formed by a plane mirror is:
A) Real, erect and same size
B) Virtual, erect and same size
C) Real, inverted and diminished
D) Virtual, inverted and enlarged
Answer: B) Virtual, erect and same size
Explanation: Plane mirrors produce virtual, laterally inverted, erect images of same size.

21. A person sees a virtual, inverted and diminished image. Which mirror is being used?
A) Plane mirror
B) Convex mirror
C) Concave mirror
D) Cylindrical mirror
Answer: C) Concave mirror
Explanation: Only concave mirror can produce such images when object is beyond C.

22. For a mirror, if image distance is positive, the image is formed:
A) In front of mirror
B) Behind the mirror
C) Cannot say
D) On the surface
Answer: A) In front of mirror
Explanation: In mirror sign convention, image in front = positive v.

23. The radius of curvature of a spherical mirror is 24 cm. Its focal length is:
A) 12 cm
B) 24 cm

C) 48 cm
D) 6 cm
Answer: A) 12 cm
Explanation: f = R/2 = 24/2 = 12 cm.

24. The image formed by a concave mirror is virtual and larger than the object. The object is located:
A) Between P and F
B) Beyond C
C) At F
D) At C
Answer: A) Between P and F
Explanation: Only in this case does a concave mirror form virtual, enlarged images.

25. In rear-view mirrors, convex mirrors are used because they provide:
A) Enlarged view
B) Narrow view
C) Wide field of view
D) Real image
Answer: C) Wide field of view
Explanation: Convex mirrors diverge light, offering a larger field of view.

26. The power of a concave lens is –2 D. Its focal length is:
A) +0.5 m
B) –0.5 m
C) +2 m
D) –2 m
Answer: B) –0.5 m
Explanation: P = 1/f → f = 1/P = 1/–2 = –0.5 m.

27. If the image formed by a mirror is real, inverted and of the same size as the object, the object is placed:
A) At focus
B) At infinity

C) At centre of curvature
D) Between focus and pole
Answer: C) At centre of curvature
Explanation: At C, image is real, inverted and same size.

28. A concave mirror of focal length 10 cm will form an image at infinity if the object is placed at:
A) 5 cm
B) 10 cm
C) 20 cm
D) Focus
Answer: D) Focus
Explanation: Object at F results in image at infinity for concave mirrors.

29. When an object is placed at infinity, a concave mirror forms an image at:
A) Infinity
B) Centre of curvature
C) Focus
D) Pole
Answer: C) Focus
Explanation: Distant object produces real, diminished image at focus.

30. A virtual image larger than the object is always formed by a:
A) Plane mirror
B) Concave mirror
C) Convex mirror
D) Concave lens
Answer: B) Concave mirror
Explanation: When object is between P and F, concave mirror gives virtual, magnified image.

31. If a ray passes through the centre of curvature of a spherical mirror, it:
A) Reflects back along the same path
B) Passes through the focus

C) Becomes parallel to principal axis
D) Passes through the pole
Answer: A) Reflects back along the same path
Explanation: Ray along the normal (C) reflects on the same path.

32. What is the magnification of an image formed by a convex mirror if image distance is +6 cm and object distance is –12 cm?
A) +2
B) –2
C) +0.5
D) –0.5
Answer: C) +0.5
Explanation: m = –v/u = –(+6)/(–12) = +0.5.

33. A convex mirror has a focal length of 20 cm. Where is the image formed when an object is 20 cm from the mirror?
A) 20 cm in front
B) 10 cm behind
C) 40 cm behind
D) 20 cm behind
Answer: B) 10 cm behind
Explanation: Use mirror formula: 1/f = 1/v + 1/u → v = +10 cm.

34. An object is placed 10 cm from a convex lens with focal length 15 cm. The image formed will be:
A) Virtual and diminished
B) Real and inverted
C) Real and magnified
D) Virtual and magnified
Answer: D) Virtual and magnified
Explanation: Object between O and F in convex lens gives virtual, magnified image.

35. A ray of light entering obliquely from air to glass bends:
A) Towards the normal
B) Away from the normal
C) Undeviated
D) Along the surface
Answer: A) Towards the normal
Explanation: Light slows down in denser medium and bends towards normal.

36. Which device uses concave mirrors to concentrate sunlight?
A) Periscope
B) Solar furnace
C) Microscope
D) Telescope
Answer: B) Solar furnace
Explanation: Concave mirrors focus sunlight at one point to produce heat.

37. A lens forms a virtual image which is always diminished. The lens is:
A) Convex
B) Concave
C) Cylindrical
D) Plano-convex
Answer: B) Concave
Explanation: Concave lenses always form diminished, virtual, erect images.

38. Which of the following is true for image formed by a plane mirror?
A) Virtual and magnified
B) Real and inverted
C) Virtual and same size
D) Diminished and real
Answer: C) Virtual and same size
Explanation: Plane mirrors produce virtual images of the same size and lateral inversion.

39. An erect image three times the size of the object is obtained using a mirror. The object is placed:
A) Between pole and focus of concave mirror
B) At centre of curvature
C) In front of convex mirror
D) At focus
Answer: A) Between pole and focus of concave mirror
Explanation: Virtual, enlarged image formed in this position.

40. Which lens is used in magnifying glasses?
A) Concave
B) Convex
C) Plane
D) Plano-concave
Answer: B) Convex
Explanation: Convex lenses magnify objects when held close.

41. What is the refractive index of a medium in which light travels at 2×10^8 m/s?
A) 1.5
B) 1.33
C) 1.0
D) 2.0
Answer: A) 1.5
Explanation: $n = c/v = 3\times10^8 / 2\times10^8 = 1.5$.

42. The refractive index of diamond is 2.42. This means:
A) Light slows down 2.42 times in diamond
B) Diamond is transparent
C) Light speeds up in diamond
D) Light bends less in diamond
Answer: A) Light slows down 2.42 times in diamond
Explanation: Higher refractive index means more optical density and lower speed.

43. A concave mirror forms a real image of double the size of the object. If object is at 10 cm, image distance is:
A) –10 cm
B) –20 cm
C) –5 cm
D) +20 cm
Answer: B) –20 cm
Explanation: m = –v/u → –2 = –v/10 → v = –20 cm.

44. The bending of light at the interface of two media is due to:
A) Change in direction
B) Change in speed
C) Change in frequency
D) Change in amplitude
Answer: B) Change in speed
Explanation: Refraction occurs because of speed change in different media.

45. A lens has a power of +4 D. Its focal length is:
A) 0.25 m
B) 25 cm
C) Both A and B
D) 4 m
Answer: C) Both A and B
Explanation: f = 1/P = 1/4 = 0.25 m = 25 cm.

46. What is the magnification of a plane mirror?
A) 0
B) +1
C) –1
D) Infinite
Answer: B) +1
Explanation: Plane mirror forms virtual, same-sized image → m = +1.

47. The focal length of a convex lens is 10 cm. If an object is placed at 5 cm, the image is:
A) Real and inverted
B) Virtual and erect
C) Real and erect
D) At infinity
Answer: B) Virtual and erect
Explanation: Object within F gives virtual, magnified image on same side.

48. A lens produces a magnification of –1. What type of lens and position of object?
A) Convex, at 2F
B) Concave, at 2F
C) Convex, at F
D) Concave, at infinity
Answer: A) Convex, at 2F
Explanation: Convex lens forms real, inverted, same-sized image at 2F.

49. A concave lens has focal length –20 cm. What is its power?
A) +5 D
B) –5 D
C) +2 D
D) –2 D
Answer: B) –5 D
Explanation: P = 100/f = 100/–20 = –5 D.

50. The image formed by a convex mirror of an object placed at infinity is:
A) Real and diminished
B) Virtual and erect
C) Virtual, erect, point-sized
D) Real and erect
Answer: C) Virtual, erect, point-sized
Explanation: Image formed at focus, highly diminished and virtual.

51. An object is placed 30 cm in front of a concave mirror with focal length 15 cm. What will be the image distance and its nature?
A) –30 cm, real and inverted
B) –15 cm, virtual and erect
C) –30 cm, virtual and erect
D) –30 cm, real and erect
Answer: A) –30 cm, real and inverted
Explanation: Using mirror formula: $1/v + 1/u = 1/f \rightarrow v = -30$ cm; real and inverted image.

52. A convex lens forms an image twice the size of the object, on the opposite side of the lens. The object distance must be:
A) Less than F
B) Between F and 2F
C) At 2F
D) Beyond 2F
Answer: B) Between F and 2F
Explanation: Convex lens magnifies and inverts image beyond 2F when object is between F and 2F.

53. A concave mirror gives an erect and magnified image. The object must be located:
A) Beyond C
B) At F
C) Between P and F
D) At C
Answer: C) Between P and F
Explanation: Only when object is between pole and focus, concave mirror gives virtual, erect and enlarged image.

54. An object 2 cm high is placed at 10 cm in front of a convex mirror of focal length 15 cm. What is the height of the image?

A) 0.6 cm

B) 1 cm

C) 1.5 cm

D) 2.5 cm

Answer: A) 0.6 cm

Explanation: Use mirror formula to find v = +6 cm. m = −v/u = −6/−10 = +0.6 → h′ = 2 × 0.6 = 1.2 cm.

55. The speed of light in a medium is 2×10^8 m/s. What is its refractive index relative to air?

A) 1.33

B) 1.5

C) 1.25

D) 1.42

Answer: B) 1.5

Explanation: n = c/v = 3×10^8 / 2×10^8 = 1.5.

56. An object 5 cm high is placed at 15 cm in front of a convex lens of focal length 10 cm. Calculate the position and nature of image.

A) +30 cm, real and inverted

B) +60 cm, real and erect

C) +30 cm, virtual and erect

D) +60 cm, real and inverted

Answer: A) +30 cm, real and inverted

Explanation: Using lens formula, v = +30 cm; image is real and inverted.

57. A lens forms a virtual image at 25 cm from the lens on the same side as the object. If the object is at 10 cm, find the type and focal length.

A) Convex, +16.7 cm

B) Concave, −16.7 cm

C) Convex, −16.7 cm

D) Concave, +16.7 cm

Answer: B) Concave, –16.7 cm
Explanation: v = –25 cm, u = –10 cm → 1/f = 1/v – 1/u = –0.04 – (–0.1) = –0.06 → f = –16.7 cm.

58. If a concave mirror produces an image at 40 cm from it, when the object is placed 20 cm in front, find the focal length.
A) 13.3 cm
B) 15 cm
C) 20 cm
D) 26.6 cm
Answer: A) 13.3 cm
Explanation: Using mirror formula, 1/f = 1/v + 1/u = –1/40 – 1/20 = –3/40 → f = –13.3 cm.

59. A ray passes from air into water. It bends:
A) Away from the normal
B) Toward the normal
C) Reflects back
D) Passes undeviated
Answer: B) Toward the normal
Explanation: Light slows down in water, bending towards the normal.

60. The image formed by a lens is inverted and of same size. Object is at 2F. The lens is:
A) Convex
B) Concave
C) Plano-concave
D) Cylindrical
Answer: A) Convex
Explanation: Convex lens gives real, inverted, same-sized image when object is at 2F.

61. A ray enters a rectangular glass slab and emerges parallel to incident ray. This happens due to:
A) Law of reflection
B) Equal and opposite refraction
C) Total internal reflection
D) Snell's law
Answer: B) Equal and opposite refraction
Explanation: Bending at air-glass and glass-air is equal and opposite.

62. Which has highest optical density?
A) Water
B) Kerosene
C) Diamond
D) Alcohol
Answer: C) Diamond
Explanation: Diamond has the highest refractive index (2.42), indicating highest optical density.

63. What kind of lens is used to correct hypermetropia?
A) Concave lens
B) Convex lens
C) Cylindrical lens
D) Plane lens
Answer: B) Convex lens
Explanation: Convex lens converges light for distant objects in hypermetropia.

64. The focal length of a lens is 40 cm. Its power is:
A) 0.25 D
B) 2.5 D
C) 1.5 D
D) 0.4 D
Answer: B) 2.5 D
Explanation: P = 100/f = 100/40 = 2.5 D.

65. A concave mirror gives a real image 20 cm high of an object 5 cm high. The magnification is:

A) +4

B) −4

C) +0.25

D) −0.25

Answer: B) −4

Explanation: m = h′/h = −20/5 = −4; real and inverted.

66. A concave lens with focal length 20 cm is placed 60 cm away from the object. The image distance is:

A) −15 cm

B) −20 cm

C) −30 cm

D) −12 cm

Answer: A) −15 cm

Explanation: Use lens formula: 1/f = 1/v − 1/u → v = −15 cm.

67. A convex mirror has focal length of 20 cm. What is the power?

A) −5 D

B) +5 D

C) −2.5 D

D) +2.5 D

Answer: D) +2.5 D

Explanation: P = 100/f = 100/40 = +2.5 D (f = R/2).

68. In which position will a convex lens form a virtual, erect and magnified image?

A) At 2F

B) Beyond 2F

C) Between F and 2F

D) Between F and optical centre

Answer: D) Between F and optical centre

Explanation: Only when object is inside F, convex lens gives virtual, magnified image.

69. A student obtains a real image on a screen using a convex lens. What happens to image if the object is moved closer to the lens?
A) Image size decreases
B) Image size increases
C) Image becomes virtual
D) Image disappears
Answer: B) Image size increases
Explanation: Closer the object to lens (but still beyond F), larger the real image.

70. A glass slab is placed over printed text. Letters appear raised due to:
A) Reflection
B) Diffraction
C) Refraction
D) Scattering
Answer: C) Refraction
Explanation: Apparent shift due to refraction of light in denser medium.

71. A concave mirror produces a virtual image 30 cm behind the mirror. If the object is 10 cm in front, the focal length is:
A) –15 cm
B) –20 cm
C) –30 cm
D) –10 cm
Answer: B) –20 cm
Explanation: Use mirror formula: $1/f = 1/v + 1/u \rightarrow v = +30, u = -10 \rightarrow f = -20$ cm.

72. What happens to the image formed by a convex mirror as the object is moved farther away?
A) Image becomes real
B) Image size increases

C) Image size decreases
D) Image disappears
Answer: C) Image size decreases
Explanation: In convex mirrors, distant objects form smaller, virtual images closer to focus.

73. A convex lens is used as a magnifier. What should be the distance of object from lens?
A) At focus
B) Beyond 2F
C) Between optical centre and F
D) At 2F
Answer: C) Between optical centre and F
Explanation: Convex lens acts as magnifier when object is within focal length.

74. A person uses a concave mirror and sees an enlarged, upright image. The object is placed:
A) Beyond C
B) At F
C) At C
D) Between P and F
Answer: D) Between P and F
Explanation: Concave mirrors give virtual, erect, enlarged images only in this position.

75. A lens forms a real, inverted image three times the object size. What is the nature of lens and image distance if object is at 10 cm?
A) Convex, –30 cm
B) Concave, +30 cm
C) Convex, +30 cm
D) Concave, –30 cm
Answer: C) Convex, +30 cm
Explanation: v = +30 cm; convex lens; m = –3.

76. The lens formula is given by:
A) 1/f = 1/v + 1/u
B) 1/f = 1/v – 1/u
C) f = v + u
D) f = v – u
Answer: B) 1/f = 1/v – 1/u
Explanation: Lens formula relates image, object distance and focal length.

77. Which mirror can produce both real and virtual images?
A) Plane mirror
B) Convex mirror
C) Concave mirror
D) None of these
Answer: C) Concave mirror
Explanation: Depending on object position, concave mirrors produce both types.

78. A ray of light falls normally on a surface separating two media. It:
A) Reflects
B) Bends toward normal
C) Bends away from normal
D) Passes undeviated
Answer: D) Passes undeviated
Explanation: Normal incidence causes no deviation.

79. Which of these lenses has maximum power?
A) f = +100 cm
B) f = +25 cm
C) f = +10 cm
D) f = –50 cm
Answer: C) f = +10 cm
Explanation: P = 100/f → Shorter focal length → greater power.

80. A convex lens with power +5 D is placed in contact with a lens of power –2 D. The equivalent focal length is:
A) 33.3 cm
B) 20 cm
C) 50 cm
D) 100 cm
Answer: A) 33.3 cm
Explanation: P = 5 – 2 = 3 D → f = 100/3 = 33.3 cm.

81. Which mirror is used as a rear-view mirror in vehicles and why?
A) Concave mirror, because it gives a magnified image
B) Plane mirror, because it gives real image
C) Convex mirror, because it provides a wider field of view
D) Convex mirror, because it gives real images
Answer: C) Convex mirror, because it provides a wider field of view
Explanation: Convex mirrors show more area, essential for rear-view applications.

82. A dentist uses a mirror to examine a patient's teeth. The mirror used is:
A) Convex, to reduce the image size
B) Concave, to magnify the image
C) Plane, to give a laterally inverted image
D) Convex, to form a virtual image
Answer: B) Concave, to magnify the image
Explanation: Dentists need enlarged, erect images; concave mirrors fulfill this.

83. A shaving mirror should form a virtual, erect and enlarged image. Which mirror should be used?
A) Plane mirror
B) Convex mirror
C) Concave mirror
D) Cylindrical mirror

Answer: C) Concave mirror
Explanation: A concave mirror used at short distances produces such an image.

84. Solar cookers use concave mirrors primarily to:
A) Form multiple images
B) Spread the sunlight evenly
C) Convert light into electricity
D) Focus sunlight at one point
Answer: D) Focus sunlight at one point
Explanation: The concave mirror concentrates sunlight to a focus, increasing heat.

85. A magnifying glass uses a convex lens because it:
A) Makes objects look smaller
B) Produces a virtual and diminished image
C) Produces a virtual and enlarged image
D) Inverts the image
Answer: C) Produces a virtual and enlarged image
Explanation: When held close, convex lens forms virtual, magnified images.

86. Which lens is used in a simple microscope?
A) Convex lens
B) Concave lens
C) Cylindrical lens
D) Plane lens
Answer: A) Convex lens
Explanation: Convex lens magnifies nearby objects, hence used in microscopes.

87. A person finds difficulty reading small print. The lens required for correction is:
A) Concave lens
B) Convex lens

C) Plane mirror
D) Cylindrical lens
Answer: B) Convex lens
Explanation: Convex lens corrects hypermetropia, common in reading difficulty.

88. A diverging lens is used in correcting:
A) Hypermetropia
B) Astigmatism
C) Myopia
D) Presbyopia
Answer: C) Myopia
Explanation: Concave lenses are diverging and used to correct short-sightedness.

89. Which mirror is preferred in street lamps to spread light over a large area?
A) Plane mirror
B) Concave mirror
C) Convex mirror
D) Parabolic mirror
Answer: C) Convex mirror
Explanation: Convex mirrors diverge light rays widely, illuminating large areas.

90. Which mirror is best suited for make-up application at home?
A) Plane mirror
B) Concave mirror
C) Convex mirror
D) Rear-view mirror
Answer: B) Concave mirror
Explanation: Concave mirrors give enlarged images for close inspection.

91. A convex mirror shows the image of a car 6 m behind it. The image is 2 m away from the mirror. What is the focal length of the mirror?
A) 2 cm
B) 3 m
C) 4 m
D) 5 m
Answer: B) 3 m
Explanation: Use mirror formula and solve using u = −6, v = +2 → f = +3 m.

92. Which of the following setups will give a real image?
A) Plane mirror with object at 5 cm
B) Convex mirror with object at 20 cm
C) Convex lens with object at 2F
D) Concave mirror with object between P and F
Answer: C) Convex lens with object at 2F
Explanation: A convex lens at 2F forms a real, same-size, inverted image at 2F.

93. Why do we see our face smaller in a convex mirror?
A) It forms a virtual and magnified image
B) It forms a virtual and diminished image
C) It forms a real and inverted image
D) It forms a real and magnified image
Answer: B) It forms a virtual and diminished image
Explanation: Convex mirrors reduce the size while keeping images erect and virtual.

94. A convex lens is used as a projector lens. The reason is:
A) It forms inverted and virtual images
B) It forms erect and magnified images
C) It forms real, enlarged images on screen
D) It forms multiple images
Answer: C) It forms real, enlarged images on screen

Explanation: Convex lenses produce real, inverted, magnified images useful for projection.

95. In which case does a convex lens form a virtual image?
A) Object at F
B) Object between F and lens
C) Object at 2F
D) Object beyond 2F
Answer: B) Object between F and lens
Explanation: Only in this position does a convex lens form a virtual, erect, enlarged image.

96. Rear-view mirrors of vehicles must be convex because:
A) They reflect less light
B) They give magnified images
C) They form real images
D) They give erect, diminished and wide-view images
Answer: D) They give erect, diminished and wide-view images
Explanation: Convex mirrors provide a wider field of view which is safe for drivers.

97. Why does a fish in water appear to be at a different position when seen from air?
A) Diffraction
B) Refraction
C) Total internal reflection
D) Dispersion
Answer: B) Refraction
Explanation: The bending of light at water-air interface shifts apparent position.

98. A student places a coin in a glass of water and it appears raised. The reason is:
A) Scattering
B) Reflection

C) Refraction
D) Interference
Answer: C) Refraction
Explanation: Light bends at air-water boundary, making coin appear higher.

99. A real image formed by a concave mirror can be captured on:
A) Retina
B) Lens
C) Screen
D) Water surface
Answer: C) Screen
Explanation: Real images can be formed on screens because they involve actual convergence.

100. A torch reflector uses concave mirror because:
A) It forms virtual images
B) It gives sharp and parallel light beam
C) It is flat
D) It is cheap
Answer: B) It gives sharp and parallel light beam
Explanation: Concave mirrors reflect light into parallel rays when placed at focus.

101. A convex lens has focal length 10 cm. Where should an object be placed to obtain a virtual image?
A) At 10 cm
B) At 20 cm
C) Between lens and 10 cm
D) Beyond 20 cm
Answer: C) Between lens and 10 cm
Explanation: Object between focus and lens gives virtual, erect image.

102. A coin appears lifted inside a tumbler of water. This effect is used in:
A) Optical fibers
B) Contact lenses
C) Prism design
D) Swimming pool tiles
Answer: B) Contact lenses
Explanation: Refraction is the principle behind curved surfaces of lenses.

103. A child places a ruler inside a glass of water and observes it bent. What concept is illustrated?
A) Scattering
B) Reflection
C) Diffraction
D) Refraction
Answer: D) Refraction
Explanation: The bending of ruler is due to change in speed of light in water.

104. A glass slab placed on a paper shifts the print slightly. This is due to:
A) Partial reflection
B) Absorption
C) Refraction
D) Polarisation
Answer: C) Refraction
Explanation: Light bends through glass, causing apparent shift in printed lines.

105. A camera lens system uses convex lenses to:
A) Spread light
B) Collect light and focus it
C) Invert the image
D) Produce virtual image
Answer: B) Collect light and focus it
Explanation: Convex lenses gather and concentrate light on the sensor.

106. A ray passing through optical centre of a lens:
A) Bends away
B) Bends towards
C) Gets absorbed
D) Passes undeviated
Answer: D) Passes undeviated
Explanation: Light through optical centre of lens goes straight without bending.

107. Why does a convex lens burn paper when sunlight is focused?
A) It absorbs heat
B) It reflects sunlight
C) It converges sunlight to a point
D) It diffuses the light
Answer: C) It converges sunlight to a point
Explanation: Converging rays increase intensity at focal point causing ignition.

108. Spectacles for correcting farsightedness use:
A) Concave lens
B) Convex lens
C) Plane glass
D) Cylindrical lens
Answer: B) Convex lens
Explanation: Convex lens converges light rays onto retina for distant vision.

109. A rearview mirror must not produce real images because:
A) Real images are inverted
B) Real images are magnified
C) Real images are formed far
D) Real images cannot be captured
Answer: A) Real images are inverted
Explanation: Erect images are essential for safe driving.

110. A 5 cm tall object is placed at 10 cm in front of a concave mirror. If focal length is 15 cm, the image formed is:
A) Real and inverted
B) Virtual and erect
C) Virtual and inverted
D) Real and erect
Answer: B) Virtual and erect
Explanation: Object between pole and focus gives virtual, magnified, erect image.

111. Why are security mirrors in shops made convex?
A) To enlarge the image
B) To create real images
C) To provide a wide field of view
D) To make images look inverted
Answer: C) To provide a wide field of view
Explanation: Convex mirrors show more area, ideal for surveillance.

112. A student wants to focus sunlight onto a single point to heat a small object. Which mirror should they use?
A) Plane mirror
B) Convex mirror
C) Concave mirror
D) Cylindrical mirror
Answer: C) Concave mirror
Explanation: Concave mirrors converge sunlight at a focus, concentrating energy.

113. Which device uses refraction to split light into its constituent colors?
A) Lens
B) Prism
C) Mirror
D) Plane glass

Answer: B) Prism
Explanation: A prism refracts and disperses light into a spectrum.

114. In designing a magnifying glass, what must be the focal length of the lens used?
A) Long focal length
B) Short focal length
C) Infinite focal length
D) Variable focal length
Answer: B) Short focal length
Explanation: Short focal lengths produce greater magnification.

115. Which of these can be used to produce an inverted image on a screen?
A) Concave mirror
B) Convex mirror
C) Plane mirror
D) Concave lens
Answer: A) Concave mirror
Explanation: When object is beyond F, concave mirrors produce real, inverted images.

116. A camera uses a convex lens to:
A) Magnify virtual images
B) Form real images on film or sensor
C) Produce upright images
D) Widen the field of view
Answer: B) Form real images on film or sensor
Explanation: Convex lens forms real, inverted images directly onto the sensor.

117. A microscope uses a convex lens because it:
A) Forms multiple images
B) Forms virtual and diminished images
C) Forms virtual and enlarged images

D) Forms only real images
Answer: C) Forms virtual and enlarged images
Explanation: Microscopes magnify small objects for observation using convex lenses.

118. Which property of light is used in optical fibers?
A) Reflection
B) Dispersion
C) Refraction
D) Total internal reflection
Answer: D) Total internal reflection
Explanation: Light is guided through fibers using repeated total internal reflections.

119. When an object is placed at the focus of a convex lens, the image is:
A) At infinity, real and inverted
B) At focus, virtual and erect
C) At 2F, real and erect
D) Between F and O, virtual
Answer: A) At infinity, real and inverted
Explanation: Object at focus results in rays becoming parallel and image at infinity.

120. Why does a pencil in a glass of water appear bent?
A) Light slows down and bends
B) Light reflects completely
C) Light spreads into colors
D) The glass acts as a lens
Answer: A) Light slows down and bends
Explanation: Refraction at water surface shifts the apparent position.

121. A concave mirror can form both real and virtual images. Justify.
A) It always forms virtual images
B) It depends on the position of the object
C) It forms only real images

D) Virtual images are not possible in mirrors
Answer: B) It depends on the position of the object
Explanation: When object is between pole and focus → virtual image; beyond focus → real image.

122. Convex mirrors are used in vehicles' side mirrors. Justify this choice.
A) They form magnified images
B) They form real and inverted images
C) They give a wider field of view
D) They reduce headlight glare
Answer: C) They give a wider field of view
Explanation: Convex mirrors diverge rays, showing a larger area behind the vehicle.

123. Convex lenses can form real or virtual images. Explain why.
A) They have flat surfaces
B) They always form real images
C) Depends on the object distance from lens
D) They always magnify images
Answer: C) Depends on the object distance from lens
Explanation: Closer than F → virtual; beyond F → real and inverted.

124. A concave lens cannot form real images. Justify.
A) It converges light rays
B) It diverges light rays
C) It has a large aperture
D) It reflects light
Answer: B) It diverges light rays
Explanation: Diverging rays do not actually meet, forming virtual, erect, diminished images.

125. When a ray passes through the centre of curvature of a mirror, it reflects along the same path. Why?
A) It strikes at an angle
B) It strikes perpendicular to the surface

C) It bends due to refraction
D) It gets absorbed
Answer: B) It strikes perpendicular to the surface
Explanation: At the centre, the incident angle is 0°, so the ray retraces its path.

126. A convex lens forms a real, inverted image when object is beyond F. Justify.
A) It diverges rays
B) It reflects rays
C) It converges rays at a point
D) It refracts rays away
Answer: C) It converges rays at a point
Explanation: Rays converge after refraction, forming real images on the other side.

127. Refraction of light causes a pencil in water to appear bent. Justify this observation.
A) Reflection from the surface
B) Change in light direction due to speed change
C) Prism effect
D) Lateral inversion
Answer: B) Change in light direction due to speed change
Explanation: Light bends at the water-air boundary, altering apparent position.

128. A concave mirror is used in solar cookers. Justify.
A) It magnifies the sun
B) It disperses sunlight
C) It focuses sunlight at one point
D) It reflects sunlight randomly
Answer: C) It focuses sunlight at one point
Explanation: Parallel sunlight rays converge at the mirror's focus, generating heat.

129. The image formed by a plane mirror is laterally inverted. Why?
A) Mirror reverses the size
B) Mirror bends the light
C) Mirror reverses left and right
D) Mirror creates a virtual image
Answer: C) Mirror reverses left and right
Explanation: Lateral inversion flips the horizontal orientation.

130. Convex lenses are used in projectors. Justify.
A) They form erect images
B) They create virtual images
C) They diverge rays
D) They form real, magnified images
Answer: D) They form real, magnified images
Explanation: Projectors require real, enlarged images on screen; convex lenses provide this.

131. Total internal reflection occurs only when light moves from denser to rarer medium. Justify.
A) Only rarer media bend rays
B) Light always reflects
C) Refracted ray bends away and may reflect fully
D) Light slows down
Answer: C) Refracted ray bends away and may reflect fully
Explanation: Above critical angle, all light reflects back in denser medium.

132. Magnifying glasses use convex lenses. Justify.
A) They create multiple images
B) They reduce image size
C) They form virtual, enlarged images
D) They reflect light
Answer: C) They form virtual, enlarged images
Explanation: Used close to objects, convex lenses magnify images seen by eye.

133. Concave lenses are used in peepholes. Justify.
A) They form large images
B) They reflect light
C) They focus rays
D) They form diminished, erect images
Answer: D) They form diminished, erect images
Explanation: Concave lenses give a wide, small view ideal for security use.

134. Refractive index determines how much light bends. Justify.
A) It depends on color
B) It depends on thickness
C) It relates to light's speed in medium
D) It is a fixed number
Answer: C) It relates to light's speed in medium
Explanation: n = c/v; higher index = greater bending due to lower speed.

135. An object appears raised in water due to refraction. Explain.
A) Water reflects images
B) Water scatters rays
C) Light bends away from the normal
D) Light bends towards the normal
Answer: C) Light bends away from the normal
Explanation: From water to air, light bends away, raising the object's apparent depth.

136. Virtual images cannot be obtained on a screen. Justify.
A) They are too small
B) They don't really exist at a location
C) They move fast
D) They are behind the object
Answer: B) They don't really exist at a location
Explanation: Virtual images only appear to come from a position; light doesn't actually meet there.

137. A convex mirror never forms a real image. Justify.
A) It absorbs light
B) It doesn't reflect light
C) Reflected rays always diverge
D) Light passes through it
Answer: C) Reflected rays always diverge
Explanation: Diverging rays never actually meet to form real images.

138. Refractive index of water is 1.33. What does this indicate?
A) Light slows down 1.33 times in air
B) Light slows down in water compared to vacuum
C) Water bends light by 1.33 degrees
D) Light speed is same in water and air
Answer: B) Light slows down in water compared to vacuum
Explanation: Refractive index indicates how much speed is reduced in a medium.

139. A convex lens converges light. Justify with application.
A) Used in peepholes
B) Used in headlamps
C) Used in magnifiers and cameras
D) Used in wall mirrors
Answer: C) Used in magnifiers and cameras
Explanation: Its converging property is essential for focusing and magnification.

140. Concave mirrors are used by ENT doctors. Justify.
A) They create a wide field of view
B) They form diminished images
C) They magnify close images
D) They produce real images
Answer: C) They magnify close images
Explanation: Concave mirrors form enlarged, virtual images of close objects.

141. A prism splits white light into colors. Justify.
A) Because of total internal reflection
B) Because light slows down
C) Because of dispersion
D) Because of reflection
Answer: C) Because of dispersion
Explanation: Different wavelengths bend differently in a prism, separating into colors.

142. Light bends more in glass than in water. Justify.
A) Glass has more thickness
B) Water is denser
C) Glass has higher refractive index
D) Light travels faster in glass
Answer: C) Glass has higher refractive index
Explanation: Greater optical density causes greater bending.

143. The image in a plane mirror is laterally inverted. Justify with example.
A) The letters look reversed in a mirror
B) Mirror reduces size
C) Mirror forms real image
D) Mirror does not reflect
Answer: A) The letters look reversed in a mirror
Explanation: Plane mirrors reverse left and right, causing lateral inversion.

144. Light bends when it enters a different medium. Justify.
A) Its frequency changes
B) Its color changes
C) Its speed changes
D) Its direction is fixed
Answer: C) Its speed changes
Explanation: Speed change at boundary causes bending, called refraction.

145. The human eye uses a convex lens. Justify.
A) It needs diverging rays
B) It reflects light
C) It focuses light on retina
D) It forms virtual images
Answer: C) It focuses light on retina
Explanation: The eye lens converges rays to form images on retina.

146. Myopia is corrected using concave lenses. Justify.
A) They converge light rays
B) They bend rays away to focus on retina
C) They create virtual images
D) They block excess light
Answer: B) They bend rays away to focus on retina
Explanation: Concave lenses spread rays so they focus properly on the retina.

147. The focal length of a concave lens is always negative. Why?
A) It converges light
B) It bends light to the axis
C) It diverges light and focus is virtual
D) It forms real images
Answer: C) It diverges light and focus is virtual
Explanation: The rays appear to diverge from a virtual focus on the same side.

148. Concave mirrors are used in torch reflectors. Justify.
A) They magnify objects
B) They scatter light
C) They form parallel beams when bulb is at focus
D) They invert the image
Answer: C) They form parallel beams when bulb is at focus
Explanation: Light rays reflect parallel when source is at the mirror's focus.

149. In water, a straight object appears bent at the surface. Justify.
A) Water surface is curved
B) Water reflects the object
C) Due to refraction of light
D) The object moves in water
Answer: C) Due to refraction of light
Explanation: Refraction alters light's direction, changing the object's apparent path.

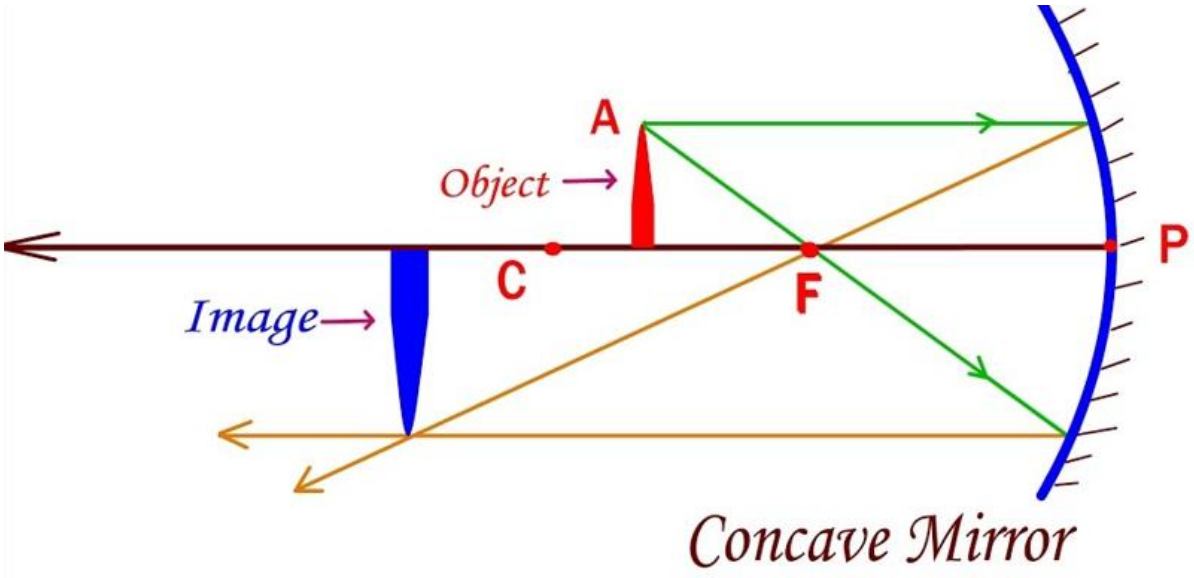
150. A convex lens forms a virtual image only when the object is closer than focal length. Justify.
A) Rays cross after lens
B) Rays diverge before focus
C) Rays appear to diverge from a point
D) Lens is thick
Answer: C) Rays appear to diverge from a point
Explanation: In this case, light rays don't actually meet, forming a virtual, magnified image.

ANSWER THE FOLLOWING QUESTIONS WITH TWO OR THREE SENTENCES

151. Explain with a ray diagram how a concave mirror forms a real, inverted and magnified image when the object is placed between F and C.
Answer:
When an object is placed between the focus (F) and the centre of curvature (C) of a concave mirror, a real, inverted and enlarged image is formed beyond C. A ray parallel to the principal axis reflects through the focus, and a ray passing through the centre of curvature reflects back on itself. These rays intersect beyond C, forming the required image. The image is real because the rays actually meet, it is inverted, and it is larger

than the object because it lies farther from the mirror than the object. This principle is used in devices like solar concentrators and makeup mirrors.

Diagram
Image formation by concave mirror when object is between focus and centre of curvature



Keywords: Concave mirror, Real image, Inverted, Enlarged, Focus, Centre of curvature

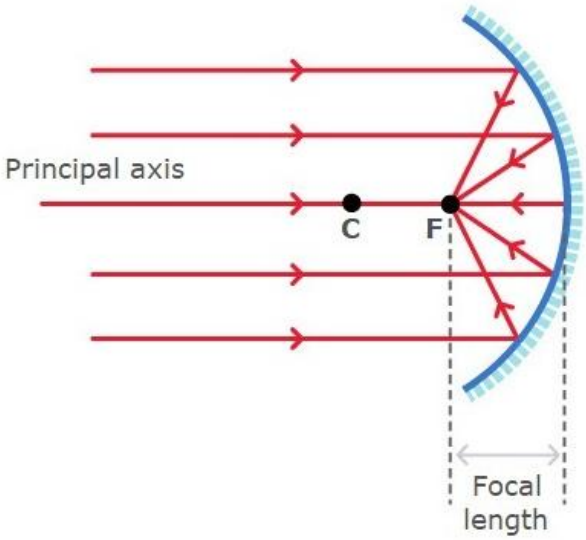
152. Define the principal focus of a concave mirror. Draw a ray diagram to show how light rays converge at the focus.

Answer:

The principal focus of a concave mirror is the point on the principal axis where light rays parallel to the axis converge after reflection from the mirror surface. For a concave mirror, this point lies in front of the mirror. To show this, several rays parallel to the principal axis are drawn incident on the mirror; after reflection, all pass through the focus. The diagram clearly illustrates convergence due to the curved surface. This principle is important in designing satellite dishes and telescopes.

Diagram
Parallel rays converging at the focus of a concave mirror

Reflection of light on a concave mirror



Keywords: Principal focus, Concave mirror, Parallel rays, Converge, Reflection, Focal point

153. An object 2 cm high is placed at 12 cm in front of a concave mirror of focal length 8 cm. Use mirror formula to find the position, nature and size of the image.

Answer:

Using the mirror formula:

$1/f = 1/v + 1/u$

Given: $f = -8$ cm, $u = -12$ cm

$1/v = 1/-8 - 1/-12 = (-3 + 2)/24 = -1/24 \rightarrow v = -24$ cm

The negative sign means the image is formed on the same side as the object, which means it is real.

Magnification $m = -v/u = -(-24)/(-12) = -2 \rightarrow$ image height = m × object height = $-2 \times 2 = -4$ cm

So, the image is real, inverted and magnified 2 times.

Keywords: Mirror formula, Concave mirror, Image distance, Magnification, Real image, Inverted

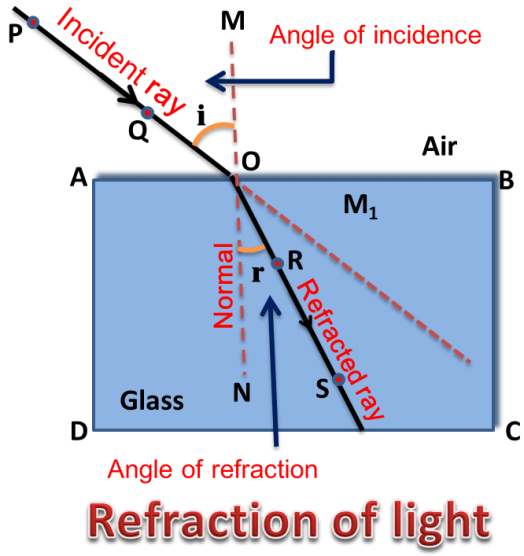
154. Explain how refraction occurs at the boundary between two media with a labelled diagram.

Answer:

Refraction is the bending of light as it travels from one medium to another with different optical densities. It occurs because light travels at different speeds in different media. When light enters a denser medium (like air to glass), it bends towards the normal; when it enters a rarer medium (glass to air), it bends away from the normal. The degree of bending depends on the refractive index. This phenomenon is demonstrated with a diagram showing incident, refracted and emergent rays at the interface of two media.

Diagram

Refraction of light at the interface of two transparent media



Keywords: Refraction, Optical density, Normal, Refracted ray, Medium, Refractive index

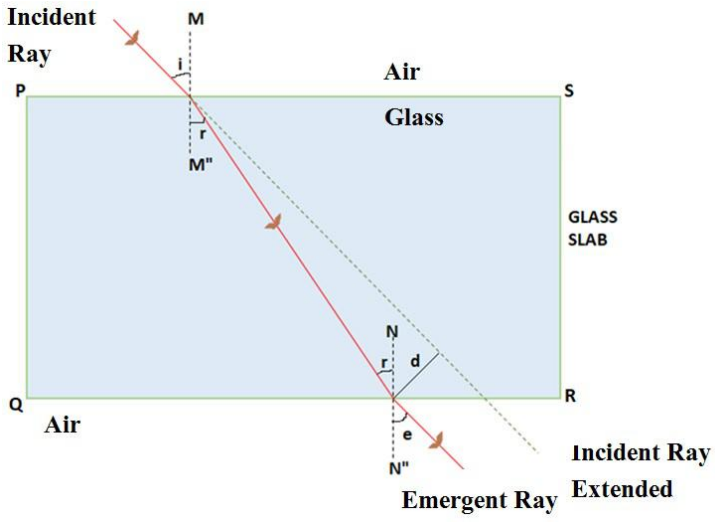
155. A ray of light passes through a rectangular glass slab. Explain with diagram why the emergent ray is parallel to the incident ray.

Answer:

When a light ray passes through a rectangular glass slab, it is refracted at both air-glass and glass-air interfaces. At the first surface, it bends towards the normal (as it enters denser medium), and at the second surface, it bends away (as it exits to rarer medium). The overall effect is lateral displacement, but the emergent ray is parallel to the incident ray. This is because the two refractions are equal and opposite. A diagram of the slab shows the bending and parallel emergent ray.

Diagram

Emergent ray parallel to incident ray in glass slab refraction



Keywords: Rectangular slab, Refraction, Parallel ray, Lateral shift, Denser medium, Emergent ray

156. A convex lens of focal length 20 cm forms an image of an object placed 30 cm from the lens. Find the image position and nature of image.

Answer:

Using the lens formula: $1/f = 1/v - 1/u$

Given: $f = +20$ cm, $u = -30$ cm

$1/v = 1/20 + 1/30 = (3 + 2)/60 = 5/60 \rightarrow v = 12$ cm

The positive value of v means the image is formed on the opposite side of the lens.
Magnification m = v/u = 12/(−30) = −0.4
Thus, the image is real, inverted and diminished in size.
Keywords: Convex lens, Lens formula, Real image, Inverted, Image distance, Magnification

157. Assertion (A): A convex mirror is preferred for use in vehicles. Reason (R): Convex mirrors form real images.
A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true but R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true
Answer:

C) A is true but R is false
Explanation: Convex mirrors are used in vehicles because they provide a wide field of view. However, they do not form real images; they form virtual, erect and diminished images. Hence, the reason is incorrect though the assertion is true.
Keywords: Convex mirror, Virtual image, Wide view, Vehicles, Assertion, Reasoning

158. Assertion (A): Light bends when it enters a different medium. Reason (R): The speed of light changes in different media.
A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true but R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true
Answer:

A) Both A and R are true and R is the correct explanation of A
Explanation: Refraction occurs because the speed of light is different in different media. When light enters a new medium at an angle, the change in speed causes the light to change direction (bend).

Keywords: Refraction, Speed of light, Medium, Bending, Assertion, Reasoning

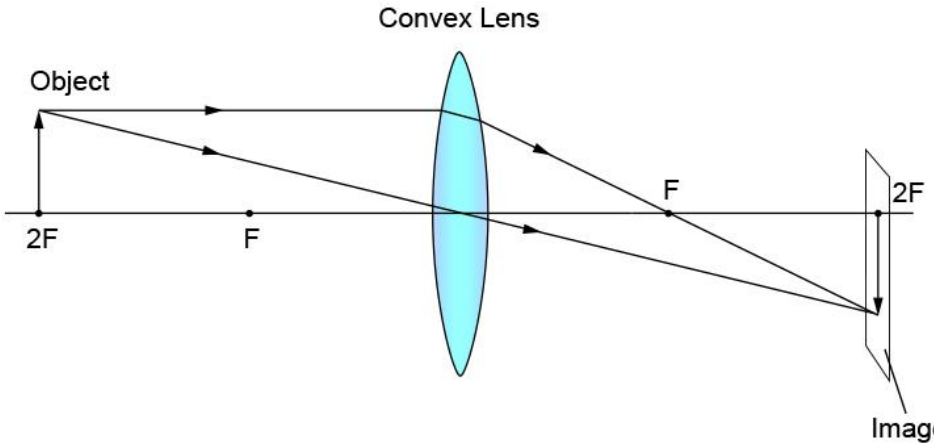
159. Draw a ray diagram to show the image formation by a convex lens when the object is at 2F. Describe the nature, size and position of the image.

Answer:

When the object is placed at 2F (twice the focal length) in front of a convex lens, the image is formed at 2F on the opposite side. The image is real, inverted, and same size as the object. The diagram includes a ray parallel to the principal axis (passing through F after refraction) and a ray through the optical centre (which passes undeviated). These rays meet at 2F forming the image.

Diagram

Ray diagram for object at 2F in convex lens



Keywords: Convex lens, Real image, Same size, Ray diagram, Object at 2F, Image formation

160. Assertion (A): A concave mirror can form a magnified, virtual image.
Reason (R): Concave mirrors only form real images.
A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true but R is not the correct explanation of A
C) A is true but R is false

D) A is false but R is true
Answer:

C) A is true but R is false
Explanation: Concave mirrors can form both real and virtual images depending on object position. A magnified, virtual image is formed when the object is placed between the pole and the focus. Hence, the reason is incorrect.
Keywords: Concave mirror, Virtual image, Magnified, Image position, Assertion, Real image

161. A convex mirror is used for security in shops. Explain how its image characteristics make it suitable for this use.
Answer:
A convex mirror always forms a virtual, erect, and diminished image of objects, regardless of their position. Its most important feature is that it provides a wider field of view than any other type of mirror, which is essential for surveillance. The curvature causes rays from different angles to be reflected toward the observer. This allows shopkeepers to monitor large areas through a single mirror mounted at an elevated point. Though the image is small, it is sufficient for detection of movement or presence.
Keywords: Convex mirror, Security, Wide field of view, Diminished image, Virtual, Surveillance

162. An object is placed at a distance of 10 cm from a concave mirror with focal length 15 cm. Find the position and nature of the image.
Answer:
Using the mirror formula:
$1/f = 1/v + 1/u \rightarrow f = -15$ cm, $u = -10$ cm
$1/v = 1/-15 - 1/-10 = (-2 + 3)/30 = 1/30 \rightarrow v = +30$ cm
Since the image distance (v) is positive, it indicates that the image is formed behind the mirror, and is therefore virtual. Also, magnification $m = -v/u = -30/(-10) = +3$, so the image is magnified and erect.

Keywords: Concave mirror, Virtual image, Mirror formula, Magnification, Image distance, Focal length

163. How can you use a convex lens to burn a paper? Explain with reason and conditions required.

Answer:

A convex lens can focus sunlight to a single point known as the principal focus. To burn paper, the lens must be held so that the paper lies exactly at the focus of the lens. This is where parallel rays of sunlight converge after passing through the lens. At this point, the light's energy is concentrated, increasing the temperature. If the lens has a short focal length, the heat is more intense. The process demonstrates the converging property of convex lenses.

Keywords: Convex lens, Burning, Focus, Convergence, Sunlight, Energy concentration

164. A student wants to use a concave mirror as a shaving mirror. At what position should he keep his face and why?

Answer:

To use a concave mirror for shaving, the object (face) must be placed between the pole (P) and focus (F) of the mirror. In this position, the mirror forms an image that is virtual, erect, and magnified. This is suitable for grooming purposes because it allows clear and enlarged view of facial features. If the object were beyond focus, the image would be real and inverted, which is not useful.

Keywords: Concave mirror, Shaving mirror, Virtual image, Magnified, Image position, Grooming

165. Design a method to determine the focal length of a convex lens using sunlight.

Answer:

To determine the focal length of a convex lens, place the lens in direct sunlight and hold a white paper behind it. Adjust the distance between the paper and the lens until a sharp, bright spot (image of the Sun) appears on

the paper. Measure the distance from the lens to the paper; this is the focal length of the lens. This works because sunlight consists of parallel rays which converge at the focal point after passing through the convex lens.
Keywords: Convex lens, Focal length, Sunlight, Parallel rays, Sharp image, Convergence

166. A 5 cm high object is placed at 25 cm from a convex lens of focal length 10 cm. Calculate image distance, magnification and describe the image.
Answer:
Given: u = −25 cm, f = +10 cm
Using lens formula: 1/v = 1/f + 1/u = 1/10 − 1/25 = (5 − 2)/50 = 3/50 → v = 16.7 cm
Magnification m = v/u = 16.7/−25 = −0.67
Image height = m × object height = −0.67 × 5 = −3.35 cm
Hence, the image is real, inverted and smaller in size than the object.
Keywords: Convex lens, Real image, Inverted, Magnification, Image height, Lens formula

167. Explain why a coin in water appears to be raised. Support your answer with refraction concepts.
Answer:
A coin placed at the bottom of a glass filled with water appears raised due to the refraction of light. As light rays pass from water (denser medium) to air (rarer medium), they bend away from the normal. Our brain assumes light travels in a straight line, so it traces the rays back in a straight path, making the object appear at a higher position than it really is. This is a common example of optical illusion caused by refraction.
Keywords: Refraction, Apparent depth, Coin in water, Optical illusion, Light bending, Medium change

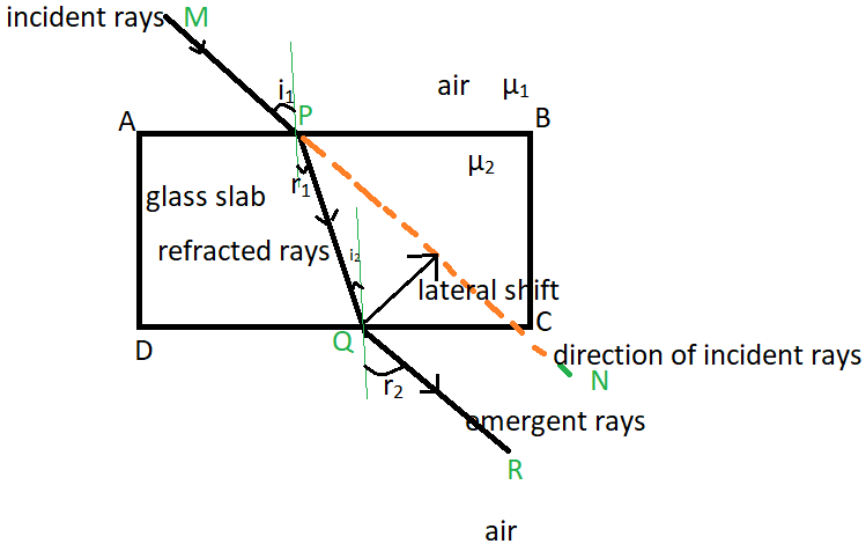
168. How does lateral shift occur in a glass slab? Explain with a diagram-based explanation.

Answer:

Lateral shift is the sideways displacement of a light ray as it passes through a rectangular glass slab. When a ray enters the glass from air, it bends towards the normal due to refraction. When it exits the slab, it bends away from the normal. The emergent ray is parallel to the incident ray but displaced laterally. The amount of shift depends on the thickness of the slab and angle of incidence.

Diagram

Lateral displacement of a light ray in a glass slab



Keywords: Lateral shift, Refraction, Glass slab, Parallel ray, Optical path, Emergent ray

169. A ray of light enters from air into glass and then into water. Describe the path of light with justification.

Answer:

When a ray of light enters from air into glass, it bends towards the normal because glass is denser. As it passes from glass to water, it bends away from the normal, since water is optically less dense than glass. The overall

bending depends on the refractive indices of the materials. Each change in medium causes the ray to change direction due to variation in light speed. The final emergent ray depends on the relative optical densities.
Keywords: Refraction, Air to glass, Glass to water, Optical density, Refractive index, Light path

170. A convex mirror gives a virtual image at a distance of 10 cm behind the mirror. The object is placed 30 cm in front. Calculate the focal length.
Answer:
Using mirror formula: $1/f = 1/v + 1/u$
Given: $v = +10$ cm (virtual image), $u = -30$ cm
$1/f = 1/10 - 1/30 = (3 - 1)/30 = 2/30 = 1/15 \rightarrow f = 15$ cm
Since it is a convex mirror, focal length = +15 cm
Hence, the mirror has a focal length of +15 cm and forms a virtual, erect, diminished image.
Keywords: Convex mirror, Virtual image, Mirror formula, Focal length, Object distance, Image distance

171. Justify why convex lenses are used in spectacles for hypermetropia.
Answer:
Hypermetropia or farsightedness occurs when the image of a nearby object forms behind the retina. This happens when the eye lens is too flat or the eyeball is too short. A convex lens converges light rays before they enter the eye, so they are focused correctly on the retina. The converging nature of the convex lens compensates for the eye's weak focusing power.
Keywords: Hypermetropia, Convex lens, Farsightedness, Spectacles, Image correction, Retina

172. Explain how a convex lens acts as a magnifying glass. Under what conditions does this occur?
Answer:
A convex lens acts as a magnifying glass when the object is placed between the lens and its focus. In this position, the lens forms a virtual, erect and magnified image on the same side of the lens. The lens must be

held close to the object and the viewer's eye. This is used in magnifiers, watches, and reading glasses to observe small details.

Keywords: Convex lens, Magnification, Virtual image, Erect, Close object, Magnifying glass

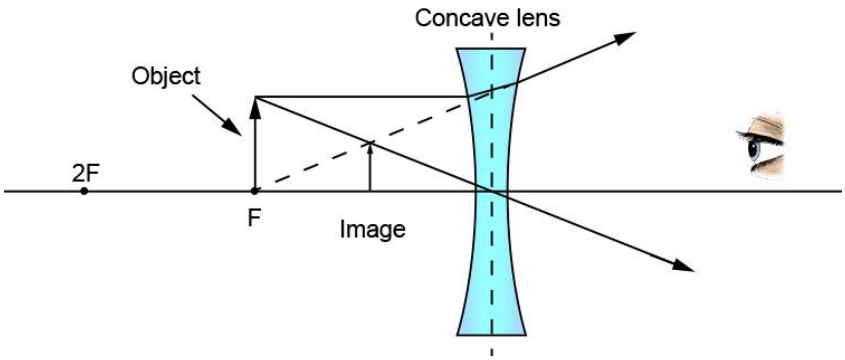
173. Describe the image formation by a concave lens using ray diagrams for any object distance.

Answer:

A concave lens always forms a virtual, erect and diminished image irrespective of the object's distance. One ray parallel to the principal axis diverges after refraction and appears to come from the focus. Another ray passes undeviated through the optical centre. These rays diverge, but when extended backward, they appear to meet at a point on the same side as the object.

Diagram

Image formation by a concave lens



Keywords: Concave lens, Virtual image, Ray diagram, Erect image, Diverging lens, Image position

174. Why does light bend at the interface of two different media? Explain using the wave speed concept.

Answer:

Light bends at the interface of two media due to a change in its speed. When light enters a medium with different optical density, its velocity changes, causing the direction to change. If it enters a denser medium, it slows down and bends toward the normal. If it enters a rarer medium, it speeds up and bends away from the normal. This bending is called refraction and is explained by Snell's law.

Keywords: Refraction, Wave speed, Bending, Optical density, Snell's law, Medium interface

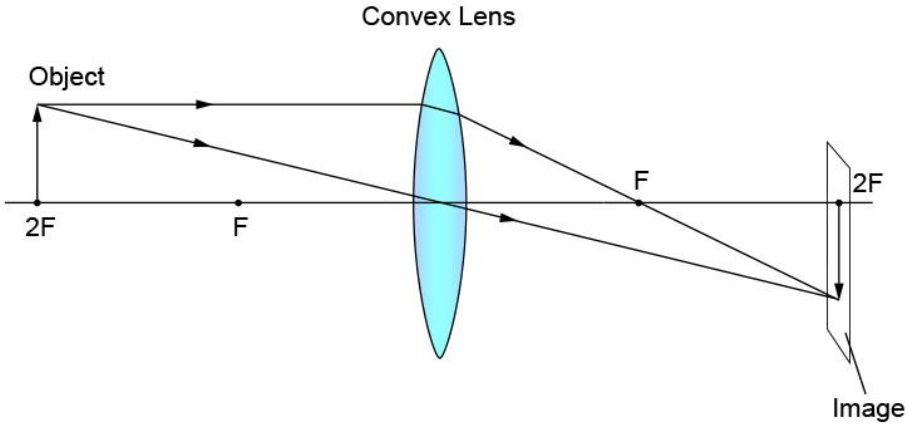
175. A convex lens forms an image of the same size as the object. Find the object position and explain with a diagram.

Answer:

A convex lens forms an image of the same size when the object is placed at 2F. The image is formed on the opposite side at 2F. It is real, inverted and of equal size. The ray diagram shows one ray parallel to the axis passing through focus and one passing through the optical centre, intersecting at 2F.

Diagram

Image formation by convex lens when object is at 2F



Keywords: Convex lens, Object at 2F, Real image, Same size, Ray diagram, Image position

176. A driver uses a convex mirror as a side mirror. Justify why this is better than using a plane or concave mirror.

Answer:

Convex mirrors are preferred for side mirrors in vehicles because they provide a wider field of view. This allows the driver to see more of the road and surrounding area, improving safety. Unlike concave mirrors, convex mirrors do not invert the image and always provide an upright, virtual and diminished image. This makes them useful for detecting nearby vehicles without confusion. Plane mirrors, in contrast, offer a limited field of view and cannot cover blind spots.

Keywords: Convex mirror, Side mirror, Wide view, Diminished image, Safety, Vehicle

177. A spoon appears distorted when placed in a glass of water. Justify your observation using refraction.

Answer:

When a spoon is partially submerged in water, the part inside appears bent or displaced. This is due to the refraction of light as it moves from water to air. The light rays coming from the submerged portion bend away from the normal, causing the apparent position to shift. Our eyes trace back the refracted rays in a straight line, resulting in a visually distorted image. The effect is more noticeable at oblique viewing angles.

Keywords: Spoon in water, Refraction, Apparent shift, Light bending, Optical illusion, Distortion

178. While looking into a concave mirror, your face appears magnified and upright. Justify how this happens.

Answer:

When your face is close to a concave mirror, specifically between the pole

and the focus, the reflected rays diverge but appear to originate from a point behind the mirror. This forms a virtual, erect and magnified image. The mirror's inward curvature causes rays to reflect in a way that produces this enlargement. This property is used in shaving and makeup mirrors, where a detailed view of the face is needed.

Keywords: Concave mirror, Magnified image, Upright image, Virtual, Close object, Facial view

179. Why is a convex lens used in reading glasses for old-age hypermetropic people? Justify your answer.

Answer:

With age, the eye lens loses flexibility and cannot converge light rays from nearby objects effectively. This condition is called hypermetropia. A convex lens helps by converging the incoming light rays before they enter the eye, so they focus on the retina instead of behind it. The lens compensates for the weak accommodation power of the eye. This allows the person to see nearby objects clearly.

Keywords: Convex lens, Hypermetropia, Old age, Focusing, Reading glasses, Retina

180. A glass slab does not deviate the emergent ray from the original path. Justify how this happens.

Answer:

When light passes through a rectangular glass slab, it refracts twice: once when entering and once when leaving. The first refraction bends the ray toward the normal, and the second bends it away from the normal. The two deviations cancel each other out, and the emergent ray becomes parallel to the incident ray, though it undergoes lateral shift. This behavior is unique to rectangular slabs due to their parallel sides.

Keywords: Glass slab, Emergent ray, Refraction, Parallel ray, Lateral shift, Light path

181. Why does a convex lens form a virtual and enlarged image only when the object is closer than the focal length?

Answer:

A convex lens can only form a virtual and enlarged image when the object is placed between the optical centre and the focal point. In this case, the rays diverge after refraction and do not meet on the other side of the lens. However, if extended backward, they appear to come from a point behind the lens. This makes the image virtual and larger. Beyond the focal length, the lens forms real and inverted images.

Keywords: Convex lens, Virtual image, Focal length, Enlarged, Diverging rays, Image formation

182. While looking at a fish in a pond, it appears at a different location than it actually is. Justify.

Answer:

This is due to the refraction of light at the water-air interface. The light rays coming from the fish bend away from the normal as they pass into air. Our brain traces the rays in a straight line, placing the image of the fish at a higher, incorrect position. As a result, the fish appears closer to the surface than it actually is. This is a classic example of apparent depth caused by refraction.

Keywords: Refraction, Apparent depth, Fish in water, Light bending, Optical illusion, Water interface

183. A magnifying glass must be held close to an object to work. Justify the reason based on lens behavior.

Answer:

A magnifying glass is a convex lens used to produce a virtual and enlarged image of a small object. For this to happen, the object must be placed between the lens and its focal point. At this distance, the rays diverge after refraction and appear to come from a larger image on the same side as the object. Holding the lens close ensures a bigger virtual image, which is essential for reading or examining fine details.

Keywords: Magnifying glass, Convex lens, Virtual image, Enlarged, Close object, Focal point

184. Explain why a concave mirror is used in solar concentrators. Justify your answer with light behavior.

Answer:

Concave mirrors can focus parallel rays of sunlight to a single point known as the focus. In solar concentrators, this property is used to collect and concentrate solar energy at a point to produce high temperatures. The mirror's parabolic shape ensures that all incoming sunlight is reflected and converged efficiently. This concentrated energy can be used for heating, cooking or generating steam.

Keywords: Concave mirror, Solar concentrator, Focus, Convergence, Sunlight, Heat generation

185. A real image can be captured on a screen, but a virtual one cannot. Justify with reference to ray behavior.

Answer:

A real image is formed when light rays actually converge at a point after reflection or refraction. Since the rays meet at a physical location, the image can be projected onto a screen. A virtual image, on the other hand, is formed when the rays only appear to meet but don't actually intersect. Therefore, virtual images cannot be projected or captured on a screen; they can only be seen by looking into the optical device.

Keywords: Real image, Virtual image, Screen, Light rays, Converge, Diverge

ANSWER THE FOLLOWING QUESTIONS BRIEFLY

186. With the help of ray diagrams, explain the image formation by a concave mirror for various positions of the object.

Answer:

Concave mirrors form images based on the object's position relative to its focus (F) and center of curvature (C).

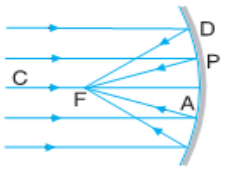
1. Object at infinity: Image is formed at F, point-sized, real, and inverted.
2. Object beyond C: Image between F and C, smaller, real, and inverted.
3. Object at C: Image at C, same size, real, and inverted.
4. Object between F and C: Image beyond C, larger, real, and inverted.
5. Object at F: Image at infinity, highly enlarged, real, and inverted.
6. Object between P and F: Image behind the mirror, larger, virtual, and erect.
   Ray diagrams involve:

- Ray parallel to the principal axis reflects through F.
- Ray through C reflects back on itself.
- Ray through F reflects parallel.
- Ray incident at pole follows angle of incidence = angle of reflection.

This topic is essential for understanding the functioning of concave reflectors in torches, headlights, and shaving mirrors.

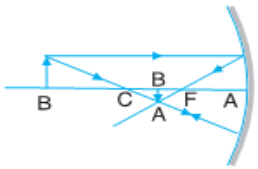
Diagram

Ray diagrams showing different image formations by concave mirror



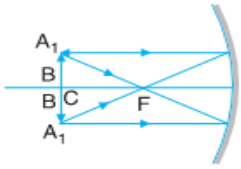
Real, inverted, highly diminished image at focus

(a) When the object is situated at ∞



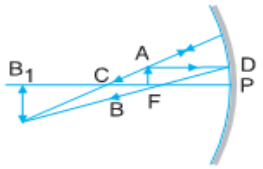
Real, inverted, diminished between C and F

(b) Object beyond C



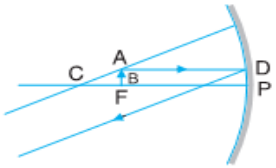
Real, inverted image of the same size as object at C

(c) Object at C



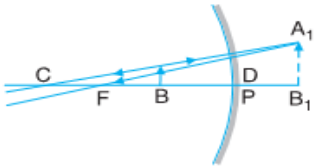
Real, inverted, enlarged image beyond C

(d) Object between C and F



Real, inverted, highly enlarged image at infinity

(e) Object at F



Virtual, erect, enlarged mage behind the mirror

(f) Object between F and P

Keywords: Concave mirror, Real image, Virtual image, Inverted, Enlarged, Ray diagram, Focus, Pole, Centre of curvature, Mirror

187. Draw and explain the image formation in a convex lens for all object positions. Write characteristics of each image.

Answer:

A convex lens forms different types of images depending on object placement:

1. Object at infinity: Image at focus (F_2), point-sized, real, and inverted.
2. Object beyond $2F_1$: Image between F_2 and $2F_2$, diminished, real, and inverted.
3. Object at $2F_1$: Image at $2F_2$, same size, real, and inverted.

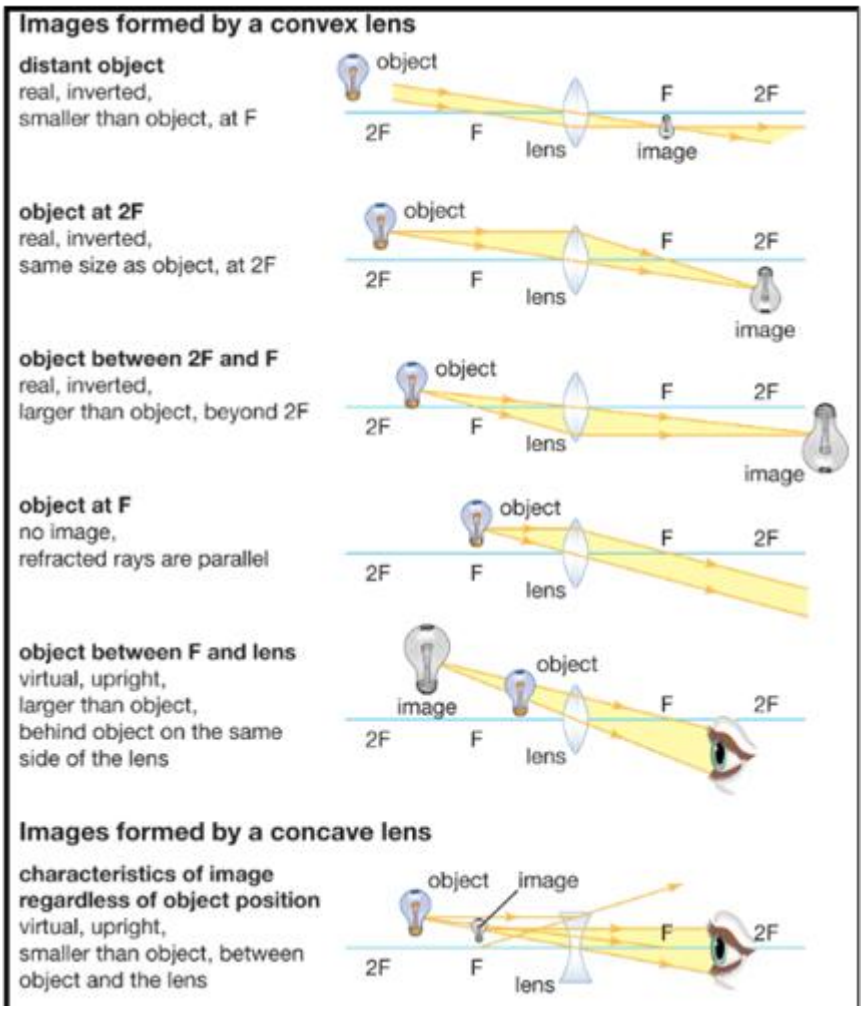
4. Object between F_1 and $2F_1$: Image beyond $2F_2$, magnified, real, and inverted.
5. Object at F_1: Image at infinity, highly magnified, real, and inverted.
6. Object between optical centre and F_1: Image behind lens, magnified, virtual, and erect.
   Each ray diagram includes:

- A ray parallel to principal axis refracts through F_2.
- A ray through optical centre passes undeviated.
- A ray through F_1 emerges parallel.

These principles are used in magnifiers, cameras, projectors, and human eyes.

Diagram

Ray diagrams for image formation by a convex lens



Keywords: Convex lens, Real image, Virtual image, Inverted, Magnified, Focus, Principal axis, Optical centre, Refraction, Ray diagram

188. A concave lens always forms a virtual, erect and diminished image. Explain with reasons and a diagram. Mention its applications.

Answer:

A concave lens is a diverging lens and forms images that are always virtual, erect, and diminished, regardless of object distance.

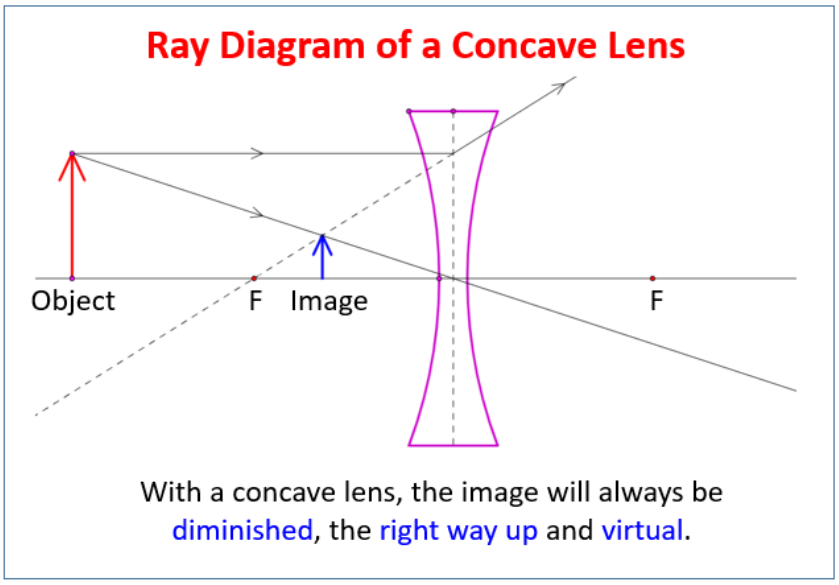
Ray behavior:

- A ray parallel to the principal axis appears to diverge from focus after refraction.

- A ray passing through the optical centre goes undeviated.
  Since refracted rays diverge, they do not meet; they only appear to diverge from a point. Thus, the image formed is always virtual (cannot be captured on screen), upright, and smaller.
  This type of lens is used in:
- Correcting myopia (short-sightedness)
- Peepholes in doors
- Combination with convex lenses in optical devices

Diagram

Image formation by concave lens using ray diagram



Keywords: Concave lens, Diverging, Virtual image, Diminished, Refraction, Optical centre, Ray diagram, Myopia, Upright image, Application

189. Assertion (A): A concave mirror is used in solar cookers.
Reason (R): Concave mirrors can diverge light rays falling on them.
Choose the correct option and justify your answer.
A) Both A and R are true, and R is the correct explanation of A

B) Both A and R are true, but R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true
Answer:
Correct option: C) A is true but R is false
Concave mirrors are used in solar cookers because they converge parallel rays of sunlight to a single point – the focus. This concentration of light increases the temperature, allowing cooking of food. The reason is incorrect because concave mirrors do not diverge light; convex mirrors do. The ability of a concave mirror to focus energy at one point makes it suitable for solar applications.
Keywords: Concave mirror, Solar cooker, Assertion-Reason, Converging mirror, Sunlight, Focus, Heat, Reflection, Real image, Energy concentration

190. Assertion (A): A virtual image can never be obtained on a screen.
Reason (R): A virtual image is formed by converging light rays at a point.
Choose the correct option and justify your answer.
A) Both A and R are true, and R is the correct explanation of A
B) Both A and R are true, but R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true
Answer:
Correct option: C) A is true but R is false
Virtual images cannot be captured on screens because they are not formed by actual convergence of rays. Instead, they are formed by the apparent divergence of rays. The rays do not meet; they only appear to do so when extended backward. Thus, the image appears behind the mirror or lens and cannot be projected. The assertion is correct, but the reason is wrong.
Keywords: Virtual image, Real image, Assertion-Reason, Converging rays, Diverging rays, Mirror, Lens, Screen, Reflection, Refraction

191. A torch uses a concave mirror, while a car's rearview mirror is convex. Justify the use of each mirror with image properties.
Answer:
A torch uses a concave mirror to produce a strong, parallel beam of light. The bulb is placed at the focus, and the concave surface reflects the diverging light rays into parallel rays. This creates a concentrated beam for long-distance visibility.
In contrast, a rearview mirror in vehicles is convex. It always forms virtual, erect, and diminished images. Its wider field of view allows the driver to see more of the road and reduces blind spots. Though the image is smaller, it is more informative. Convex mirrors do not form real images and cannot focus light.
Thus, concave mirrors are used for focused light projection, and convex mirrors for broad field visibility.
Keywords: Concave mirror, Convex mirror, Torch, Rearview mirror, Field of view, Parallel rays, Virtual image, Real image, Diminished, Application

192. Explain how the lens formula is derived and how it helps in understanding image position in lenses. Give an example.
Answer:
The lens formula is:
$1/f = 1/v - 1/u$, where:

- f = focal length of the lens
- v = image distance from optical centre
- u = object distance from optical centre
  The sign convention used is similar to mirrors:
- All distances are measured from the optical centre.
- Distances toward the left are negative, to the right are positive.
  The formula is derived using geometry and the laws of refraction. It helps calculate the unknown image or object distance, given two of the three quantities.

Example: A convex lens of focal length 15 cm forms an image at 30 cm. Find the object position.
$1/f = 1/v - 1/u \rightarrow 1/15 = 1/30 - 1/u \rightarrow 1/u = 1/30 - 1/15 = -1/30 \rightarrow u = -30$ cm
So, object is 30 cm left of the lens.

Keywords: 1/f = 1/v – 1/u, Refraction, Focal length, Image distance, Object distance, Convex lens, Sign convention, Real image, Optics, 30 cm

193. A convex lens of focal length 20 cm forms an image at 30 cm from the lens. Find the object distance, image type, and magnification. Explain your answer with reasoning.

Answer:

Given: $f = +20$ cm, $v = +30$ cm
Using lens formula: $1/f = 1/v - 1/u$
$1/20 = 1/30 - 1/u \rightarrow 1/u = 1/30 - 1/20 = (2 - 3)/60 = -1/60 \rightarrow u = -60$ cm
Object is 60 cm left of the lens.
Magnification (m) = $v/u = 30/(-60) = -0.5$
The negative magnification indicates that the image is real and inverted. The magnitude (0.5) shows that it is diminished. The convex lens, when the object is beyond 2F, produces a real, inverted and smaller image between F and 2F.

Keywords: 60 cm left of the lens, Focal length, 1/f = 1/v – 1/u, Real image, Inverted, Diminished, F and 2F, Object distance, –0.5, smaller image

194. Why does a pencil appear broken when immersed in water at an angle? Justify the observation using ray diagrams and concept of refraction.

Answer:

The broken appearance of a pencil in water is due to refraction. Light rays coming from the submerged part of the pencil pass from water to air. Since water is optically denser, the rays bend away from the normal as they enter air. The brain traces the rays back in a straight line, making the pencil appear at a higher position. This apparent shift creates the illusion of

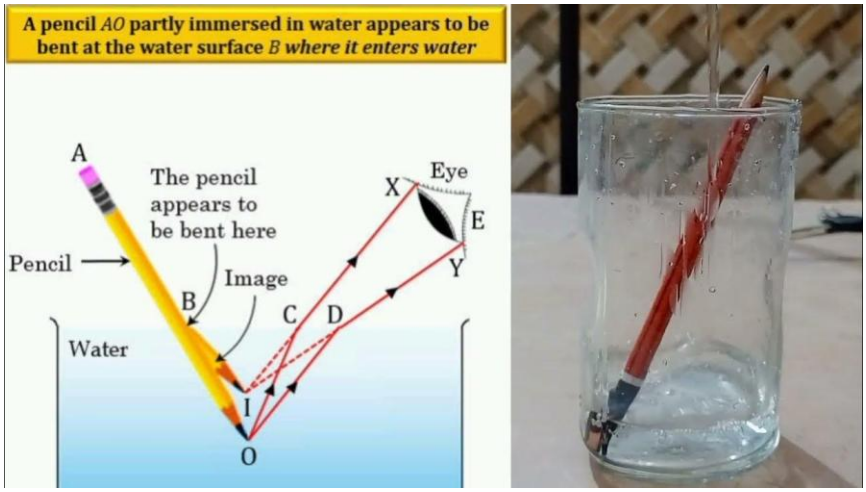
a broken or bent pencil.
A ray diagram shows:

- Incident ray from the pencil under water
- Refracted ray bending away
- Apparent position above real position

This is a common everyday example of refraction at work.

Diagram

Apparent bending of pencil due to refraction



Keywords: Refraction, Apparent depth, Bending light, Pencil in water, Water-air interface, Normal, Ray diagram, Optical illusion, Medium change, Light path

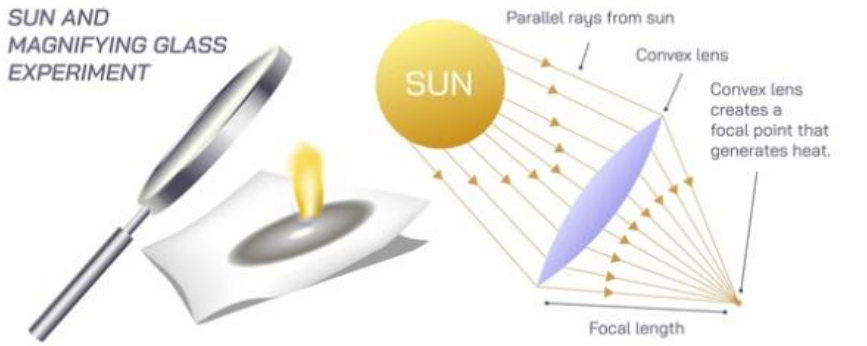
195. A student observes the Sun's image on a paper through a convex lens and burns the paper. Explain the scientific principle, safety precautions and energy conversion involved.
Answer:
When parallel rays from the Sun fall on a convex lens, they converge at the focus. If a sheet of paper is placed at this point, the light energy is concentrated and can generate enough heat to ignite the paper. This demonstrates the converging property of convex lenses. The energy

conversion involved is from solar (light) energy to heat energy.
Safety precautions:

- Do not look at the Sun directly through the lens.
- Avoid prolonged exposure of skin to focused light.
- Conduct the experiment outdoors in daylight.
  This principle is used in solar cookers and concentrators for eco-friendly heating.

Diagram

Sunlight focused by convex lens to burn paper



Keywords: Convex lens, Sunlight, Convergence, Focal point, Light to heat, Solar energy, Safety, Real image, Experiment, Ignition

196. Justify why concave mirrors are used by ENT doctors during ear and nose examinations. Explain the physics behind this application.
Answer:
ENT specialists use concave mirrors because of their ability to form virtual, erect, and magnified images when the object is placed between the mirror's pole and focus. The mirror reflects the light from a head-mounted source onto the specific part of the patient's body being examined — usually the ear, nose, or throat.
The concave mirror not only concentrates the light onto a small area (focusing property) but also allows the doctor to see an enlarged, upright image of the affected region.
Because the mirror is mounted with a central hole (for the doctor's eye), it

combines illumination and magnification. The image appears behind the mirror, making internal structures more visible without distortion.
This setup improves precision in diagnosis and treatment. Unlike convex mirrors, concave mirrors can form real or virtual images, making them versatile for medical use.
Keywords: Concave mirror, ENT doctor, Virtual image, Magnification, Focus, Pole, Medical application, Reflection, Light convergence, Erect image

197. Justify why an object submerged in water appears to be raised. Derive the relation between real and apparent depth.
Answer:
An object under water appears raised because of refraction at the water–air interface. Light rays coming from the object bend away from the normal as they move from water (denser) to air (rarer).
Due to this, the brain traces the refracted rays in a straight line backward, perceiving the object at a shallower depth — this is called apparent depth.
The relationship is:
Apparent depth / Real depth = 1 / Refractive index
So, if the refractive index of water is 4/3 and real depth is 12 cm, the object appears at 9 cm.
This phenomenon has practical implications in activities like spearfishing, where one has to aim below the apparent position of the fish to hit the real target.
It also explains why swimming pool bottoms look closer than they are.
Keywords: Refraction, Apparent depth, Real depth, Water-air interface, Refractive index, Light bending, Optical illusion, Medium change, Raised image, Derivation

198. Justify the use of a convex mirror in ATMs and elevators. How does its geometry help in practical situations?
Answer:
Convex mirrors are used in ATMs, elevators, and hallways because they provide a wide field of view. Their outward-curved surface reflects light

rays in such a way that they appear to diverge from a point behind the mirror.
This results in the formation of virtual, erect, and diminished images — though smaller, they cover a larger area.
This allows users and security personnel to monitor surroundings and check for safety, especially in blind corners.
Due to the mirror's geometry, even a small convex mirror can display wide-angle views, making it ideal for areas with limited space.
The image is not distorted and allows real-time monitoring of people approaching or standing nearby.
In elevators, these mirrors help passengers see who is behind them, reducing risks and improving security.
Keywords: Convex mirror, Wide view, Virtual image, Security, Diminished image, ATM, Elevator, Safety, Surveillance, Reflection

199. Justify the role of refraction in designing lenses for optical instruments like telescopes and microscopes.
Answer:
Refraction is the key principle in the functioning of optical instruments such as microscopes, telescopes, cameras, and magnifiers. When light passes from one medium to another (e.g., air to glass), it changes direction — this is refraction.
In a convex lens, parallel rays converge at the focus, forming real, inverted images which can be projected or magnified.
In microscopes, two or more convex lenses are used: the objective lens forms a real image which is magnified again by the eyepiece.
In telescopes, lenses or mirrors gather distant light and refract it to form a real image, which is magnified.
This is possible only because the materials (glass/plastic) are optically denser, allowing light to slow down and bend inside them.
Careful design using the lens maker's formula and understanding of refraction allows accurate image formation and magnification.

Keywords: Refraction, Lens, Microscope, Telescope, Optical instruments, Convex lens, Real image, Converging rays, Eyepiece, Objective lens

200. Justify why the image of the sun formed by a convex lens on a paper is real and inverted. How does the lens behave in this context?

Answer:

The Sun's rays are effectively parallel when they reach the Earth due to its large distance. When these rays pass through a convex lens, they converge at the principal focus, forming a real image on the paper.

This real image is inverted (though the Sun appears circular) and can even burn the paper due to energy concentration.

The lens in this scenario is acting as a converging lens, converting parallel rays into focused rays meeting at a point.

The image is visible because the light rays actually meet at the focal point.

This principle is also applied in solar concentrators, which use convex lenses to convert solar energy into heat energy.

Such real images can only be captured on a screen, proving their physical existence.

Keywords: Convex lens, Sun image, Real image, Inverted, Focus, Convergence, Solar energy, Burning, Paper, Parallel rays