Multiple Choice Questions

7.0 Introduction

1. Light energy that gives us sensation of vision, is
   (A) an electromagnetic wave.
   (B) a longitudinal wave.
   (C) a one dimensional wave.
   (D) a similar type of wave as that of sound wave beam of fast-moving particles.

2. Ray optics is valid, when characteristic dimensions are
   (A) much smaller than the wavelength of light.
   (B) much larger than the wavelength of light.
   (C) of the same order as that of the wavelength of light.
   (D) of the order of decameter.

7.1 Reflection of Light

3. While reading a newspaper, one cannot see his image in the paper because
   (A) there is diffused reflection.
   (B) there is regular reflection.
   (C) the newspaper absorbs the light incident on it.
   (D) there is no reflection at all.

4. The angle made by the incident ray with the reflecting surface or interface is called as _____.
   (A) angle of incidence
   (B) angle of reflection
   (C) emergent angle
   (D) glancing angle

5. The image formed by the mirrors used at home is
   (A) smaller in size than the object.
   (B) exactly same in size as that of the object without any change.
   (C) exactly same in size but with lateral inversion.
   (D) bigger in size than the object.

6. Select the WRONG statement in case of image formed by a plane mirror.
   (A) The image is as far behind the mirror as the object is in front of it.
   (B) The image is erect and virtual.
   (C) The size of the image is same as that of the size of the object.
   (D) Since the image formed is behind the mirror it can be taken on the screen.

7. In diffused reflection, the relation between the angle of incidence (i) and angle of reflection (r) is given by
   (A) $i < r$ (B) $i = r$
   (C) $i > r$ (D) $i = 0°$ and $r = \infty$

8. A ray of light falls on a mirror normally. The values of angle of incidence and angle of reflection respectively are
   (A) 0°, 0° (B) 0°, 90°
   (C) 90°, 0° (D) 90°, 90°

9. A plane mirror, reflecting a ray of incident light, is rotated through an angle 'θ' about an axis through the point of incidence in the plane of the mirror and perpendicular to the plane, then the reflected ray
   (A) does not rotate.
   (B) rotates through an angle $\left(\frac{\theta}{2}\right)$.
   (C) rotates through an angle θ.
   (D) rotates through an angle (2θ).

10. When a ray of light is incident at an angle of incidence (i) on a plane reflecting surface, then the angle between reflected and incident ray (i.e., angle of deviation) is
   (A) 2i (B) (90° – i)
   (C) (90° – 2i) (D) (180° – 2i)

11. The angle of incidence of a ray falling on a plane mirror is 45°. The deviation produced by the plane mirror is
   (A) 45° (B) 90°
   (C) 120° (D) 180°

12. A ray of light is reflected at an angle of 15°. If the angle of incidence is doubled, then the angle of reflection will be
   (A) 90° (B) 60°
   (C) 30° (D) 15°

13. When light rays suffer reflection at the air-glass interface, the change in phase of the reflected ray is equal to
   [C PMT 1991; J & K CET 2004]
   (A) 0 (B) $\frac{\pi}{2}$
   (C) π (D) 2π

14. When an object is placed between two plane mirrors facing each other inclined at an angle 'θ', then the number of images (n) formed is given by
   (A) $\left[\left(\frac{360°}{\theta}\right)-1\right]$ if $\left(\frac{360°}{\theta}\right)$ is even
   (B) $\left[\left(\frac{360°}{\theta}\right)-1\right]$ if $\left(\frac{360°}{\theta}\right)$ is odd and object is asymmetrical
   (C) $\left[\frac{360°}{\theta}\right]$ for all the positions of object.
   (D) $\left[\left(\frac{360°}{\theta}\right)+1\right]$ for all the positions of object.

15. Two mirrors are kept inclined to each other at an angle of 60° and an object is placed between them. The total number of images formed is _____ .
   (A) six (B) five
   (C) four (D) three

16. To get three images of a single object, one should have two plane mirrors inclined at an angle of **[AIEEE 2003]**
   (A) 30° (B) 60°
   (C) 90° (D) 150°

17. If two plane mirrors are parallel to each other, the object lying between them will have (n) number of images given by
   (A) $n = 0$ (B) $n = 1$
   (C) $n = 3$ (D) $n = \infty$

18. The line passing through pole and centre of curvature of the spherical mirror is called as
   (A) radius of curvature of the spherical mirror.
   (B) focal length of the spherical mirror.
   (C) aperture of the spherical mirror.
   (D) principal axis of the spherical mirror.

19. The focal length of spherical mirror has magnitude equal to (R is radius of curvature of the spherical mirror)
   (A) $\frac{R}{4}$ (B) $\frac{R}{2}$
   (C) R (D) 2R

20. When the wavelength of the light used is increased, the focal length of a spherical mirror _____.
   (A) remains the same
   (B) decreases to half its value
   (C) decreases slightly
   (D) increases.

21. When the object is kept between the pole and the focus of a concave mirror, in front of it, the image formed will be
(A) virtual, diminished, behind the mirror.
(B) real, diminished, infront of the mirror.
(C) virtual, enlarged, behind the mirror.
(D) real, enlarged, in front of the mirror.

22. When an object is kept between infinity and centre of curvature of a concave mirror, the image is formed _____.
(A) at the focus
(B) between focus and centre of curvature
(C) at centre of curvature
(D) at infinity

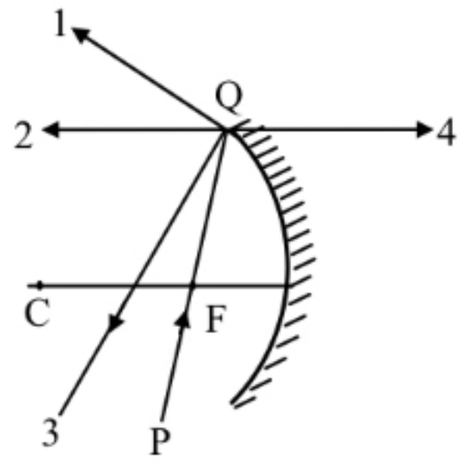
23. When an object is kept in front of a convex mirror at any distance from it, the image is
(A) always between focus and centre of curvature.
(B) at centre of curvature only.
(C) always between focus and pole.
(D) formed anywhere beyond the centre of curvature.

24. An object is placed at a distance equal to the focal length of a convex mirror. If the focal length of the mirror be f, then the distance of the image from the pole of the mirror is
(A) less than f
(B) equal to f
(C) more than f
(D) infinite

25. Which of the following statements is incorrect? **[BCECE 2015]**
(A) The magnification produced by a convex mirror is always less than one.
(B) A virtual, erect, same sized image can be obtained using a plane mirror.
(C) A virtual, erect, magnified image can be formed using a concave mirror.
(D) A real , inverted, same-sized image can be formed using a convex mirror.

26. Which of the following forms a virtual and erect image for all positions of the object? **[IIT-JEE 1996]**
(A) Convex lens
(B) Planoconvex lens
(C) Convex mirror
(D) Concave mirror

27. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked 1, 2, 3 and 4 (figure). Which of the four rays correctly shows the direction of reflected ray? **[NCERT Exemplar]**



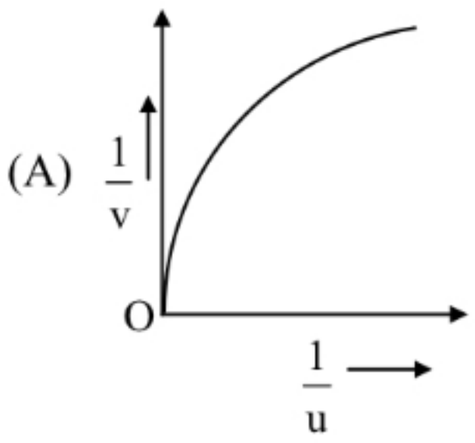
(A) 1 (B) 2 (C) 3 (D) 4

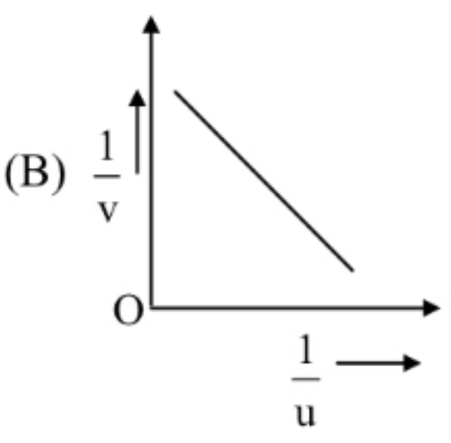
28. Given a point source of light, which of the following can produce a parallel beam of light? **[C PMT 1974; K CET 2005]**
(A) Convex mirror.
(B) Concave mirror.
(C) Concave lens.
(D) Two plane mirrors inclined at an angle of 90°.

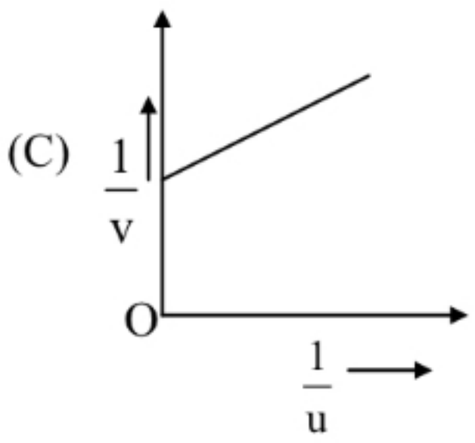
29. Under which of the following conditions will a convex mirror of focal length f produce an image that is erect, diminished and virtual? **[AMU (Engg.) 2001]**
(A) Only when $2f > u > f$
(B) Only when $u = f$
(C) Only when $u < f$
(D) Always

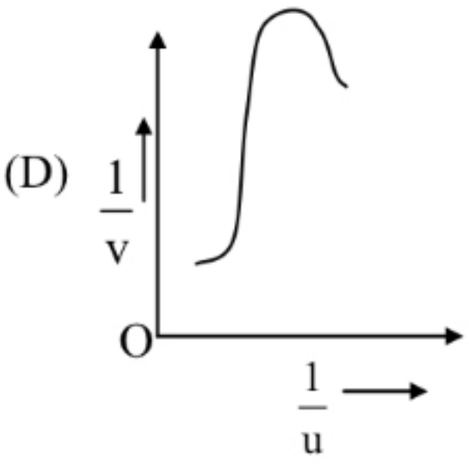
30. If half of the reflecting surface of a concave mirror is covered with black paper, then the image will
(A) remain unaffected.
(B) reduce half the size as before.
(C) shift to half the distance as before nearer to the image.
(D) have brightness half as before.

31. For a spherical mirror, the graph of $\frac{1}{v}$ versus $\frac{1}{u}$ is

(A) 

(B) 

(C) 

(D) 

32. In search lights, parabolic mirrors are used because

(A) it is easy to prepare parabolic mirror.
(B) it gives less intense light at a particular spot.
(C) it gives proper intensity by giving parallel intense beam of light.
(D) it adds to the beauty with spherical aberration.

33. A concave mirror of focal length f (in air) is immersed in water $\left(\mu = \frac{4}{3}\right)$. The focal length of mirror in water will be **[BCECE 2015]**

(A) $\frac{4}{3}f$ (B) $\frac{3}{4}f$

(C) f (D) $\frac{7}{3}f$

34. A convergent beam of light is incident on a concave mirror so as to converge to distance 20 cm from the pole of mirror. An inverted image of the same size is formed coincident with the virtual object. What is the focal length of the mirror?

(A) 40 cm (B) 20 cm
(C) 10 cm (D) 5 cm

35. An expression for linear magnification (m) produced by a spherical mirror (for Real image) is given by,

(A) $m = \frac{f - v}{f}$ (B) $m = \frac{v - f}{f}$

(C) $m = \frac{f}{f - v}$ (D) $m = \frac{f}{v - f}$

36. How does the magnification (m) of the real image formed by a lens vary with the distance (x) of the object from the focus of a concave mirror?

(A) $m \propto x$ (B) $m \propto \frac{1}{x}$

(B) $m \propto x^2$ (D) $m \propto \frac{1}{x^2}$.

37. Match the corresponding entries of column-1 with column-2 [Where m is the magnification produced by the mirror]

[NEET P-I 2016]

	Column – 1		**Column – 2**
i.	$m = -2$	a.	Convex mirror
ii.	$m = -\frac{1}{2}$	b.	Concave mirror
iii.	$m = +2$	c.	Real image
iv.	$m = +\frac{1}{2}$	d.	Virtual image

(A) i → a and d; ii → b and c; iii→ b and d; iv → b and c
(B) i → c and d; ii → b and d; iii→ b and c; iv → a and d
(C) i → b and c; ii → b and c; iii→ b and d; iv → a and d
(D) i → a and c; ii → a and d; iii→ a and b; iv → c and d

38. An object is placed at a distance of 40 cm from a concave mirror of focal length 15 cm, the image is formed at a distance of

(A) 12 cm from the object.
(B) 24 cm from the object.
(C) 24 cm from the mirror.
(D) 40 cm from the mirror.

39. A concave mirror of focal length 20 cm is placed 50 cm from a wall. How far from the wall an object be placed to form its real image on the wall?

(A) 16.7 cm (B) 30.0 cm
(C) 33.3 cm (D) 46.7 cm

40. An object is placed in front of a concave mirror of radius of curvature 40 cm at a distance of 10 cm. The position, nature and magnification of the image is

(A) At 20 cm, behind the mirror, real, inverted and m = 2
(B) At 20 cm, behind the mirror, virtual, erect and m = – 2
(C) At 20 cm, behind the mirror, virtual, erect and m = 2
(D) At 20 cm, behind the mirror, real, inverted and m = – 2

41. An object is kept in front of a concave mirror of focal length 15 cm. The image formed is three times the size of the object. The two possible distances of the object are

(A) u = – 20 cm and u = – 10 cm
(B) u = – 15 cm and u = – 10 cm
(C) u = – 20 cm and u = – 30 cm
(D) u = – 15 cm and u = – 30 cm

42. A person wants a real image of his own, 3 times enlarged. Where should he stand in front of a concave mirror of radius of curvature 30 cm? **[KCET 2015]**

(A) 90 cm (B) 10 cm
(C) 20 cm (D) 30 cm

43. The position of the object in front of a concave mirror of focal length 20 cm, producing a real image four times the size of the object is

(A) – 20 cm (B) –22.5 cm
(C) –25 cm (D) –27.5 cm

44. An object is placed at 20 cm in front of a concave mirror produces three times magnified real image. What is the focal length of the concave mirror?

[K CET 2014]

(A) 15 cm (B) 6.6 cm
(C) 10 cm (D) 7.5 cm

45. A point object is placed at a distance of 30 cm from a convex mirror of focal length 30 cm. The image will be formed at

[JIPMER 2002]

(A) infinity
(B) focus
(C) pole
(D) 15 cm behind the mirror

46. An object is placed at a distance of 16 cm from a convex mirror of focal length 20 cm, the position of image with its nature is
(A) virtual, erect behind the mirror at 8.9 cm.
(B) virtual, erect behind the mirror at 89 cm.
(C) real, erect behind the mirror at 8.9 cm.
(D) virtual, inverted behind the mirror at 89 cm.

47. An object is placed at a distance of 24 cm from a convex mirror. Its image is formed behind the mirror at a distance of 6 cm. The focal length of the convex mirror is
(A) – 8.0 cm (B) + 8.0 cm
(C) + 18.8 cm (D) + 30 cm

48. A convex mirror of radius of curvature 1.6 m has an object placed at a distance of 1 m from it. The image is formed at a distance of
(A) 8/13 m in front of the mirror.
(B) 8/13 m behind the mirror.
(C) 4/9 m in front of the mirror
(D) 4/9 m behind the mirror.

49. An object is placed in front of a convex mirror of focal length 60 cm. If image formed is half the size of the object, the position of the image is
(A) 15 cm infront of the mirror.
(B) 15 cm behind the mirror.
(C) 30 cm infront of the mirror.
(D) 30 cm behind the mirror.

50. An object is placed at a distance of 15 cm from a convex mirror of curvature 90 cm. The image position and magnification respectively are at
(A) 15 cm behind the mirror, 0.50.
(B) 11.25 cm behind the mirror, 0.60.
(C) 15 cm behind the mirror, 0.75.
(D) 11.25 cm behind the mirror, 0.75.

51. An object is at a distance of 10 cm from a spherical mirror and image of the object is at a distance of 30 cm from the mirror on the same side as that of the object. The focal length and type of the mirror is
(A) + 7.5 cm, concave.
(B) – 7.5 cm, concave.
(C) + 7.5 cm, convex.
(D) – 7.5 cm, convex.

52. The focal length of concave mirror and convex mirror, each having radius of curvature 30 cm respectively, are
(A) + 15 cm, – 15 cm
(B) + 15 cm, + 15 cm
(C) – 15 cm, + 15 cm
(D) – 15 cm, – 15 cm

53. A spherical mirror forms an erect image three times the linear size of the object. If the distance between the object and the image is 80 cm, the focal length of the mirror is
(A) + 15 cm (B) – 15 cm
(C) – 30 cm (D) + 40 cm

54. An object 1 cm tall is placed 4 cm in front of a mirror. In order to produce an upright image of 3 cm height, one needs a

[SCRA 1994]

(A) convex mirror of radius of curvature 12 cm.
(B) concave mirror of radius of curvature 12 cm.
(C) concave mirror of radius of curvature 4 cm.
(D) plane mirror of height 12 cm.

55. A convex mirror and a concave mirror having radii of curvature of 10 cm each are placed 15 cm apart facing each other. An object is placed midway between them. If the reflection first takes place in the concave mirror and then in the convex mirror, the position of the final image is
(A) on the pole of the convex mirror.
(B) on the pole of the concave mirror.
(C) at the distance of 10 cm from the convex mirror.
(D) at a distance of 5 cm from the concave mirror.

7.2 Refraction

56. When a monochromatic light passes obliquely from one transparent medium into another, its direction changes. This phenomenon is known as _____.
(A) reflection of light
(B) refraction of light
(C) polarisation of light
(D) diffraction of light

Answers to MCQ's

1.	(A)	2.	(B)	3.	(A)	4.	(D)	5.	(C)	6.	(D)	7.	(B)	8.	(A)	9.	(D)	10.	(D)
11.	(B)	12.	(C)	13.	(C)	14.	(A)	15.	(B)	16.	(C)	17.	(D)	18.	(D)	19.	(B)	20.	(A)
21.	(C)	22.	(B)	23.	(C)	24.	(A)	25.	(D)	26.	(C)	27.	(B)	28.	(B)	29.	(D)	30.	(D)
31.	(B)	32.	(C)	33.	(C)	34.	(C)	35.	(A)	36.	(B)	37.	(C)	38.	(C)	39.	(A)	40.	(C)
41.	(A)	42.	(C)	43.	(C)	44.	(A)	45.	(D)	46.	(A)	47.	(B)	48.	(D)	49.	(D)	50.	(D)
51.	(B)	52.	(C)	53.	(C)	54.	(B)	55.	(A)	56.	(B)	57.	(A)	58.	(C)	59.	(C)	60.	(B)
61.	(B)	62.	(D)	63.	(B)	64.	(D)	65.	(A)	66.	(B)	67.	(B)	68.	(D)	69.	(C)	70.	(D)
71.	(C)	72.	(B)	73.	(B)	74.	(D)	75.	(B)	76.	(D)	77.	(B)	78.	(B)	79.	(D)	80.	(B)
81.	(B)	82.	(B)	83.	(D)	84.	(A)	85.	(B)	86.	(A)	87.	(B)	88.	(D)	89.	(D)	90.	(D)
91.	(C)	92.	(A)	93.	(C)	94.	(D)	95.	(D)	96.	(D)	97.	(B)	98.	(B)	99.	(B)	100.	(D)
101.	(C)	102.	(D)	103.	(C)	104.	(C)	105.	(B)	106.	(C)	107.	(D)	108.	(D)	109.	(D)	110.	(C)
111.	(C)	112.	(C)	113.	(A)	114.	(A)	115.	(D)	116.	(D)	117.	(A)	118.	(B)	119.	(D)	120.	(D)
121.	(A)	122.	(B)	123.	(B)	124.	(D)	125.	(D)	126.	(D)	127.	(B)	128.	(C)	129.	(A)	130.	(C)
131.	(C)	132.	(D)	133.	(C)	134.	(C)	135.	(C)	136.	(C)	137.	(C)	138.	(A)	139.	(A)	140.	(A)
141.	(B)	142.	(A)	143.	(D)	144.	(A)	145.	(B)	146.	(B)	147.	(C)	148.	(B)	149.	(D)	150.	(C)
151.	(B)	152.	(A)	153.	(D)	154.	(B)	155.	(A)	156.	(A)	157.	(A)	158.	(A)	159.	(D)	160.	(D)
161.	(C)	162.	(C)	163.	(C)	164.	(B)	165.	(A)	166.	(B)	167.	(C)	168.	(A)	169.	(D)	170.	(A)
171.	(A)	172.	(B)	173.	(D)	174.	(D)	175.	(A)	176.	(D)	177.	(C)	178.	(D)	179.	(B)	180.	(B)
181.	(D)	182.	(D)	183.	(D)	184.	(D)	185.	(D)	186.	(C)	187.	(C)	188.	(D)	189.	(A)	190.	(A)
191.	(B)	192.	(D)	193.	(A)	194.	(A)	195.	(D)	196.	(D)	197.	(D)	198.	(C)	199.	(D)	200.	(C)
201.	(C)	202.	(D)	203.	(D)	204.	(C)	205.	(B)	206.	(C)	207.	(B)	208.	(D)	209.	(A)	210.	(A)
211.	(D)	212.	(D)	213.	(B)	214.	(D)	215.	(D)	216.	(B)	217.	(B)	218.	(B)	219.	(B)	220.	(C)
221.	(A)	222.	(A)	223.	(A)	224.	(D)	225.	(D)	226.	(D)	227.	(C)	228.	(A)	229.	(B)	230.	(A)
231.	(C)	232.	(A)	233.	(D)	234.	(C)	235.	(A)	236.	(C)	237.	(A)	238.	(D)	239.	(C)	240.	(A)
241.	(D)	242.	(A)	243.	(A)	244.	(C)	245.	(A)	246.	(A)	247.	(B)	248.	(B)	249.	(A)	250.	(C)
251.	(B)	252.	(A)	253.	(A)	254.	(B)	255.	(A)	256.	(A)	257.	(D)	258.	(C)	259.	(D)	260.	(D)
261.	(C)	262.	(D)	263.	(C)	264.	(A)	265.	(A)	266.	(B)	267.	(D)	268.	(D)	269.	(A)	270.	(B)
271.	(B)	272.	(C)	273.	(A)	274.	(A)	275.	(A)	276.	(C)	277.	(A)	278.	(C)	279.	(A)	280.	(C)
281.	(B)	282.	(A)	283.	(D)	284.	(D)	285.	(A)	286.	(B)	287.	(A)	288.	(A)	289.	(B)	290.	(B)
291.	(B)	292.	(C)	293.	(D)	294.	(A)	295.	(A)	296.	(C)	297.	(A)	298.	(C)	299.	(C)	300.	(C)
301.	(A)	302.	(C)	303.	(B)	304.	(D)	305.	(C)	306.	(A)	307.	(B)	308.	(A)	309.	(D)	310.	(D)
311.	(A)	312.	(A)	313.	(D)	314.	(B)	315.	(A)	316.	(A)	317.	(D)	318.	(B)	319.	(B)	320.	(A)
321.	(C)	322.	(B)	323.	(B)	324.	(D)	325.	(D)	326.	(D)	327.	(A)	328.	(C)	329.	(C)	330.	(A)
331.	(D)	332.	(A)	333.	(C)	334.	(D)	335.	(B)	336.	(B)	337.	(B)	338.	(C)	339.	(B)	340.	(C)
341.	(D)	342.	(A)	343.	(D)	344.	(D)	345.	(A)	346.	(D)	347.	(A)	348.	(A)	349.	(D)	350.	(D)
351.	(C)	352.	(C)	353.	(A)	354.	(C)	355.	(D)	356.	(A)	357.	(B)	358.	(A)	359.	(A)	360.	(C)
361.	(A)	362.	(B)	363.	(C)	364.	(D)	365.	(B)	366.	(C)	367.	(C)	368.	(D)	369.	(B)	370.	(C)

Hints to MCQ's

6. Image formed by a plane mirror is virtual. Hence it cannot be taken on the screen.

11. $\delta = 180° - 2i = 90°$.

12. $i = r$
$i' = r'$
but $i' = 2i$
$\therefore \quad 2i = r'$
$\therefore \quad r' = 2(15) = 30°$

15. $n = \dfrac{360°}{60°} - 1 = 5$

16. $n = \left(\dfrac{360°}{\theta} - 1\right) \Rightarrow 3 = \left(\dfrac{360°}{\theta} - 1\right) \Rightarrow \theta = 90°$

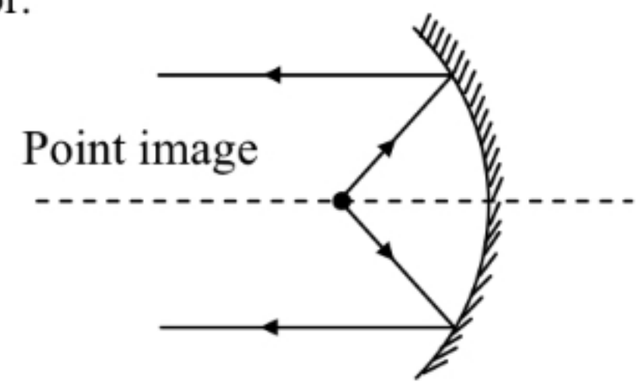
17. $\theta = 0°$ and $n = \dfrac{360°}{\theta}$
$\therefore \quad n = \dfrac{360°}{0°} = \infty$

20. Reflection takes place in the same medium.

26. Convex mirror forms virtual image for all positions of the object.

27. The ray PQ is passing through focus. In concave mirrors, if the incident ray is passing through the focus, the reflected ray passes parallel to the principal axis in front of the mirror. The only ray parallel to principal axis in front of the mirror is ray-2.

28. Object should be placed at focus of a concave mirror.



30. Since the reflection of light takes place from half of the total area of the mirror, the brightness of the image only reduces to half as before.

31. The mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ is of the form of y + x = constant.

33. As the medium has no role in focal length of mirror, it doesn't change.

34. The concave mirror forms image of the same size and at the same location. Hence, the object must be at the centre of curvature. That is R = 20 cm and f = 10 cm.

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

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

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

But $m = -\frac{v}{u} \quad \therefore \quad m = \frac{f-v}{f}$

36. $m = f/(u - f) = f/x$.

37. In case of mirrors, convex mirror always produce, diminished and virtual images.
Hence, convex mirror cannot have magnificiation, m > 1
Also, in mirrors, virtual image always forms on right hand side. Hence magnification produced is always positive. (i.e. m for virtual image, $m = +\frac{1}{2}$ or m = +2) . These conditions are satisfied by option (C).

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

$\therefore \quad \frac{1}{v} + \frac{1}{-40} = \frac{1}{-15}$

$\therefore \quad v = -24$ cm

39. $\frac{1}{u} = \frac{1}{f} - \frac{1}{v} = \frac{1}{-20} - \frac{1}{-50}$

$\therefore \quad u = -33.3$ cm
The distance of object from the wall
$= 50 - 33.3 = 16.7$ cm.

40. $f = \frac{-40}{2} = -20$ cm

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

$\therefore \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-20} - \frac{1}{-10}$

$\therefore \quad v = +20$ cm

$\Rightarrow m = -\frac{v}{u} = -\frac{20}{-10} = 2.$

41. When m = – 3 (real image)

$m = -3 = -\frac{v}{u}$

$\therefore \quad v = 3u$

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

$\therefore \quad \frac{1}{u} + \frac{1}{3u} = \frac{1}{-15}$

$\therefore \quad u = -20$ cm
When m = + 3 (virtual image)

$m = +3 = -\frac{v}{u}$

$\therefore \quad v = -3u$

$\Rightarrow \frac{1}{u} + \frac{1}{-3u} = \frac{1}{-15}$

$\therefore \quad u = -10$ cm

42. For concave mirror,

$m = -3, f = \frac{R}{2} = -\frac{30}{2} = -15$ cm

Also for spherical mirrors.

$u = \left(\frac{m-1}{m}\right) f = \left(\frac{-3-1}{-3}\right)(-15) = (+4)(-5)$

$\therefore \quad u = -20$ cm

43. $m = -4 = -\frac{v}{u}$

$\therefore \quad v = 4u$

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

$\therefore \quad \frac{1}{u} + \frac{1}{4u} = \frac{1}{-20}$

$\therefore \quad \frac{5}{4u} = -\frac{1}{20}$

$\therefore \quad u = -\frac{20 \times 5}{4} = -25$ cm.

44. $m = \frac{f}{f-u} \Rightarrow -3 = \frac{f}{f-(-20)}$

($\because$ all real images are inverted)

$-3f - 60 = f$

$f = -15$ cm

Since mirror is concave, f = 15 cm

45. u = – 30 cm, f = + 30 cm, by using mirror formula,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}\Rightarrow\frac{1}{+30}=\frac{1}{v}+\frac{1}{(-30)}$$

v = 15 cm behind the mirror

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

$\therefore \quad \frac{1}{v}+\frac{1}{-16}=\frac{1}{+20}$

$\therefore \quad v = +8.9$ cm

47. $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}=\frac{1}{-24}+\frac{1}{+6}$

$\therefore \quad f = +8.0$ cm

48. $f=\frac{1.6}{2}=0.8$ m, $\frac{1}{v}=\frac{1}{0.8}-\frac{1}{-1}$

$\therefore \quad v=\frac{4}{9}$ m

Positive sign of v indicates that the image is formed behind the convex mirror.

49. $m=\frac{f-v}{f}\Rightarrow\frac{1}{2}=\frac{60-v}{60}$

$\therefore \quad v = +30$ cm behind mirror.

50. $f=\frac{90}{2}=45$ cm

$$\Rightarrow v=\frac{uf}{u-f}=\frac{(-15)(45)}{(-15)-45}=+11.25\text{ cm}$$

$$\Rightarrow m=-\frac{v}{u}=-\frac{11.25}{-15}=0.75$$

51. $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ or $f=\frac{uv}{u+v}=\frac{(-10)(-30)}{(-10)+(-30)}$

$= -7.5$ cm

Negative sign of f is for concave mirror.

53. $\frac{v}{u}=3$ or $v=3u$,

As in case of any spherical mirror, erect image is always virtual hence, u + v = 80

$\therefore \quad 3u+u=80 \qquad \therefore \quad u=20$ cm

$\therefore \quad v = 3\times20 = 60$ cm

Virtual and erect image

$\Rightarrow \frac{1}{60}-\frac{1}{20}=\frac{1}{f} \quad \therefore \quad f=-30$ cm

54. Erect and enlarged image can be produced by a concave mirror.

$$m=\frac{I}{O}=\frac{f}{f-u}\Rightarrow\frac{+3}{+1}=\frac{f}{f-(-4)}\Rightarrow f=-6\text{ cm}$$

$$\Rightarrow R=2f=-12\text{ cm}$$

55. For concave mirror, $u=-\frac{15}{2}$ cm,

$$f=-\frac{10}{2}=-5\text{ cm}$$

$\therefore \quad \frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{-5}-\frac{1}{-\frac{15}{2}}$

$\therefore \quad v = -15$ cm

The position of the final image is on the pole of the convex mirror.

60. When light travels from rarer to denser medium, its frequency remains same hence to decrease velocity of light, wavelength decreases, as $V = \nu\lambda$.

63. Here light ray goes from optically rarer medium air to optically denser turpentine then it bends towards the normal whereas when it goes from optically denser medium turpentine to rarer medium water, it bends away from the normal

64. The emergent ray will be parallel to incident ray only if they have same refractive indices.

67. $\mu\propto\frac{1}{\lambda},\lambda_r>\lambda_v\Rightarrow\mu_v>\mu_r$

68. Because of large refractive index of diamond i.e. $\mu = 2.42$, critical angle of diamond is very less and hence a lot of total internal reflection occurs which makes diamond sparkle.

69. $\lambda\propto\frac{1}{\mu}$

$$\frac{\lambda_1}{\lambda_2}=\frac{\mu_2}{\mu_1}=\frac{\mu}{1}$$

70. $\mu=\frac{c}{v}\ \therefore\ v=\frac{c}{\mu}$

$\therefore$ Time taken by the light to travel $= \frac{t}{(c/\mu)}$

$$=\frac{\mu t}{c}$$

71. $${}_2\mu_1\times{}_3\mu_2\times{}_4\mu_3=\frac{\mu_1}{\mu_2}\times\frac{\mu_2}{\mu_3}\times\frac{\mu_3}{\mu_4}=\frac{\mu_1}{\mu_4}={}_4\mu_1$$

$$=\frac{1}{{}_1\mu_4}$$

72. Apparent depth of bottom,

$$=\frac{\frac{H}{4}}{n_1}+\frac{\frac{H}{4}}{n_2}+\frac{\frac{H}{4}}{n_3}+\frac{\frac{H}{4}}{n_4}$$

$$=\frac{H}{4}\left(\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}+\frac{1}{n_4}\right)$$

73. $h'=\frac{d}{\mu_1}+\frac{d}{\mu_2}=d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$