12th Science Lesson 9 Questions in English

9] Ray Optics

1. Which of the following statement is correct?

1) Light is difficult to comprehend light to a single entity
2) It has both ray and wave property
3) Ray optics deals with light that is represented as a ray travelling in straight lines

a) 1, 2
b) 2, 3
c) 1, 3
d) 2, 3
e) All the above

Explanation

Light is mystical. Yet, its behaviour is so fascinating. It is difficult to comprehend light to a single entity. In this unit, **we learn it in two different scientific aspects called ray optics and wave optics**. Ray optics deals with light that is represented as a ray travelling in straight lines. In wave optics, we study about the phenomenon associated with the propagation of light as a wave.

2. Which of the following statement is incorrect?

1) Light travels in a straight line in a medium
2) Light does not deviate from its path when it encounters another medium or an obstacle

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Light travels in a straight line in a medium. **Light may deviate in its path only when it encounters another medium or an obstacle**.

3. Which of the following statement is correct?

1) A ray of light gives information about only the direction of light.
2) It gives information about the other characteristics of light like intensity and colour

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

A ray of light gives information about only the direction of light. **It does not give information about the other characteristics of light like intensity and colour**.

4. Which of the following can be understood from ray depiction of light?

1) Reflection
2) Refraction

3) Dispersion
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

The path of the light is called a ray of light and a bundle of such rays is called a beam of light. In this chapter, we can explain the **phenomena of reflection, refraction, dispersion and scattering of light, using the ray depiction of light**.

5. The bouncing back of light into the same medium is called_____

a) Reflection
b) Refraction
c) Dispersion
d) All the above

Explanation

The bouncing back of light into the same medium when it encounters a reflecting surface is called **reflection of light**.

6. Mirrors which are silver coated at their back can reflect almost ___% of the light falling on them.

a) 70
b) 90
c) 100
d) 80

Explanation

Polished surfaces can reflect light. Mirrors which are silver coated at their back can reflect almost **90% of the light falling on them**.

7. Which of the following is correct according to law of reflection?

1) The incident ray, reflected ray and normal to the reflecting surface all are coplanar
2) The angle of incidence i is equal to the angle of reflection r
3) The angle of incidence i is not equal to the angle of reflection r.
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

According to law of reflection,

(a) The incident ray, reflected ray and normal to the reflecting surface all are coplanar (ie. lie in the same plane).

(b) The angle of incidence i is equal to the angle of reflection r

i = r

8. Which of the following statement is incorrect?

1) The law of reflection is valid at each point for any reflecting surface whether the surface is plane or curved
2) The angle between the incident and deviated light ray is called angle of deviation of the light ray.

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The law of reflection is valid at each point for any reflecting surface whether the surface is plane or curved. The angle between the incident and deviated light ray is called angle of deviation of the light ray.

9. Which of the following statement is correct?

1) If the reflecting surface is flat, then incident parallel rays after reflection come out parallel as per the law of reflection.
2) If the reflecting surface is irregular, then the incident parallel rays after reflection come out irregular rays

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

If the reflecting surface is flat, then incident parallel rays after reflection come out parallel as per the law of reflection. If the reflecting surface is irregular, then the incident parallel rays after reflection come out irregular (not parallel) rays.

10. Which of the following can be use to find angle of deviation?

a) d = 180 – 2i
b) d = 180 + 2i
c) d = 90 – 2i
d) d = 180 – i

Explanation

The angle between the incident and deviated light ray is called angle of deviation of the light ray. The incident light is AO. The reflected light is OB. The un-deviated light is OC which is the continuation of the incident light. The angle between OB and OC is the angle of deviation d. From the geometry, it is written as, d = 180 – (i+r). As, i = r in reflection, we can write angle of deviation in reflection at plane surface as,

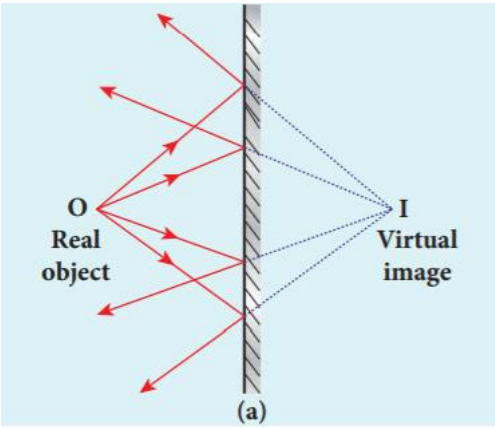
d = 180 – 2i

11. When a real object is placed at a point O in front of a plane mirror it produces divergent rays in__

a) Opposite direction
b) Same direction
c) All direction
d) None

Explanation

When a real object is placed at a point O in front of a plane mirror it produces divergent rays in all directions as shown in Figure



12. Image which cannot be formed on the screen but can only be seen with the eyes is called____

a) Real image
b) Virtual image
c) Both a and b
d) None

Explanation

After reflection from the plane mirror, they appear to come out from a point I behind the mirror. This image cannot be formed on a screen as the image is behind the mirror. **This type of image which cannot be formed on the screen but can only be seen with the eyes is called virtual image**

13. Image which can be formed on a screen and can also be seen with the eyes is called_____

a) Real image
b) Virtual image
c) Both a and b
d) Either a or b

Explanation

On the other hand, if convergent rays are incident on a plane mirror, the rays after reflection pass through a point I in front of the mirror and form an image as shown in Figure. This image can be formed on a screen as the image is in front of the mirror. This type of image which can be formed on a screen and can also be seen with the eyes is called real image.

14. It is generally known that a plane mirror can only form a_____

a) Real image
b) Virtual image

c) Both a and b
d) Either a or b

Explanation

It is generally known that a plane mirror can only form a virtual image. But now we have understood that a plane mirror can form a real image when converging rays fall on it.

15. Match the following

I.	Real Image	1. Rays appear to converge at the object
II.	Virtual Image	2. Rays actually diverge from the object
III.	Real Object	3. Rays appear to diverge from the image
IV.	Virtual Object	4. Rays actually converge at the image

a) 2, 1, 3, 4
b) 1, 3, 2, 4
c) 4, 3, 2, 1
d) 4, 2, 1, 3

Explanation

Table 6.1 Conditions for nature of objects and images

Nature of object/image	Condition
Real Image	Rays actually converge at the image
Virtual Image	Rays appear to diverge from the image
Real Object	Rays actually diverge from the object
Virtual Object	Rays appear to converge at the object

16. Which of the following statement is correct?

1) A spherical surface is a part cut from a hollow sphere.
2) Spherical mirrors are generally constructed from glass
3) Both the surface of the glass is silvered.

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

A spherical surface is a part cut from a hollow sphere. Spherical mirrors are generally constructed from glass. **One surface of the glass is silvered**. The reflection takes place at the other polished surface.

17. Which of the following statement is correct?

1) If the reflection takes place at the convex surface, it is called a convex mirror
2) If the reflection takes place at the concave surface, it is called a concave lens

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

If the reflection takes place at the convex surface, it is called a convex mirror and if the reflection takes place at the concave surface, it is called **a concave mirror**.

18. The middle point on the spherical surface of the mirror is called as____

a) Radius of curvature
b) Pole
c) Focus
d) Principal axis

Explanation

The radius of the sphere of which the spherical mirror is a part is called the radius of curvature (R) of the mirror. **The middle point on the spherical surface of the mirror (or) the geometrical centre of the mirror is called pole (P) of the mirror**.

19. The line joining the pole and the centre of curvature is called_____

a) Radius of curvature
b) Pole
c) Focus
d) Principal axis

Explanation

The line joining the pole and the centre of curvature is called the principal axis of the mirror. The light ray travelling along the principal axis towards the mirror after reflection travels back along the same principal axis. It is also called optical axis.

20. Which of the following statement is correct?

1) Light rays travelling parallel and close to the principal axis when incident on a spherical mirror, converge at a point for concave mirror or appear to diverge from a point for convex mirror on the principal axis
2) This point is called the focus or focal point (F) of the mirror.

a) 1 alone
b) 2 alone
c) 1, 2

d) None

Explanation

Light rays travelling parallel and close to the principal axis when incident on a spherical mirror, converge at a point for concave mirror or appear to diverge from a point for convex mirror on the principal axis. This point is called the focus or focal point (F) of the mirror.

21. The distance between the pole and the focus is called_____

a) Centre of curvature
b) Radius of curvature
c) Focal length
d) Pole length

Explanation

The distance between the pole and the focus is called the **focal length (f) of the mirror**. The plane through the focus and perpendicular to the principal axis is called the focal plane of the mirror.

22. Which of the following statement is correct?

1) The rays travelling very close to the principal axis and make small angles with it are called paraxial rays
2) The paraxial rays fall on the mirror very close to the pole of the mirror
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

The rays travelling very close to the principal axis and make small angles with it are called paraxial rays. The paraxial rays fall on the mirror very close to the pole of the mirror.

23. Which of the following statement is incorrect?

1) The rays travelling far away from the principal axis and fall on the mirror far away from the pole are called as marginal rays
2) Paraxial rays and marginal rays behave differently
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

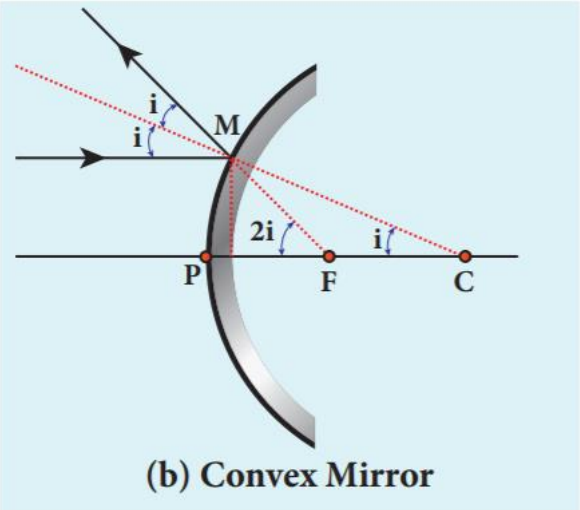
On the other hand, the rays travelling far away from the principal axis and fall on the mirror far away from the pole are called as marginal rays. Both Paraxial rays and marginal rays behave differently (get focused at different points).

24. Radius of curvature is equal to____

a) 2f
b) f

c) f/2
d) 3f

Explanation



(b) Convex Mirror

PF is focal length f and PC is the radius of curvature R.

$$2f = R \qquad \text{(or)} \qquad f = \frac{R}{2}$$

25. Which of the following statement is correct?

1) A ray parallel to the principal axis after reflection will pass through or appear to pass through the principal focus.
2) A ray passing through or appear to pass through the principal focus, after reflection will travel parallel to the principal axis.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

A ray parallel to the principal axis after reflection will pass through or appear to pass through the principal focus. A ray passing through or appear to pass through the principal focus, after reflection will travel parallel to the principal axis.

26. Which of the following statement is incorrect?

1) A ray passing through the centre of curvature retraces its path after reflection as it is a case of normal incidence
2) A ray falling on the pole will get refracted as per law of reflection keeping principal axis as the normal
    a) 1 alone
    b) 2 alone
    c) 1, 2

d) None

Explanation

A ray passing through the centre of curvature retraces its path after reflection as it is a case of normal incidence. A ray falling on the pole will get reflected as per law of reflection keeping principal axis as the normal.

27. Match the following cartesian signs

I.	u	1. Image height
II.	v	2. Object height
III.	h	3. Image distance
IV.	h'	4. Object distance

a) 1, 2, 3, 4
b) 4, 3, 2, 1
c) 4, 2, 3, 1
d) 2, 1, 3, 4

Explanation

While tracing the image, we would normally come across the **object distance u, the image distance v, the object height h, the image height (h'),** the focal length f and the radius of curvature R.

28. Which of the following cartesian sign convection is correct?

1) The Incident light is taken from left to right (i.e. object on the left of mirror)
2) All the distances are measured from the pole of the mirror (pole is taken as origin).

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Cartesian sign convention:

- The Incident light is taken from left to right (i.e. object on the left of mirror).
- All the distances are measured from the pole of the mirror (pole is taken as origin).

29. Which of the following statement about cartesian sign is correct?

1) The distances measured to the right of pole along the principal axis are taken as positive
2) The distances measured to the left of pole along the principal axis are taken as negative.
3) Heights measured in the upward perpendicular direction to the principal axis are taken as negative

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

Cartesian sign convention:

- The distances measured to the right of pole along the principal axis are taken as positive.

- The distances measured to the left of pole along the principal axis are taken as negative.
- Heights measured in the upward perpendicular direction to the principal axis are taken as positive.
- Heights measured in the downward perpendicular direction to the principal axis, are taken as negative.

30. Which of the following is mirror equation?

a) 1/u + 1/v = - 1/f
b) 1/u + 1/v = 1/f
c) 1/u - 1/v = 1/f
d) 1/u + 1/v = - 1/p

Explanation

The following equation is mirror equation:

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

31. The lateral or transverse magnification is defined as the ratio of_____

a) height of the image to the height of the object
b) height of the object to the height of the image
c) height of the virtual image to the height of the object
d) height of the real image to the height of the virtual image

Explanation

The lateral or transverse magnification is defined as the ratio of the height of the image to the height of the object. Height of the object and image are measured perpendicular to the principal axis

$$\text{magnification } (m) = \frac{\text{height of the image } (h')}{\text{height of the object } (h)}$$

32. An object is placed at a distance of 20.0 cm from a concave mirror of focal length 15.0 cm. What distance from the mirror a screen should be placed to get a sharp image?

a) 60 cm
b) – 60 cm
c) 30 cm
d) – 30 cm

Explanation

(a) Mirror equation, $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

Rewriting to find v, $\frac{1}{v}=\frac{1}{f}-\frac{1}{u}$

Substituting for f and u, $\frac{1}{v}=\frac{1}{-15}-\frac{1}{-20}$

$\frac{1}{v}=\frac{(-20)-(-15)}{300}=\frac{-5}{300}=\frac{-1}{60}$

$v=-60.0\ cm$

As the image is formed at 60.0 cm to the left of the concave mirror, the screen is to be placed at distance 60.0 cm to the left of the concave mirror.

33. An object is placed at a distance of 20.0 cm from a concave mirror of focal length 15.0 cm. What is its magnification?

a) 3
b) – 3
c) 1.5
d) – 1.5

Explanation

(b) Magnification, $m=\frac{h'}{h}=-\frac{v}{u}$

$m=\frac{h'}{h}=-\frac{(-60)}{(-20)}=-3$

As the sign of magnification is negative, the image is inverted.

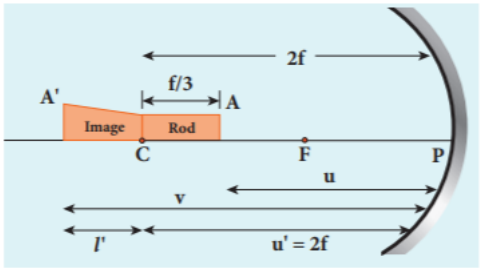
34. A thin rod of length f/3 is placed along the optical axis of a concave mirror of focal length f such that its image which is real and elongated just touches the rod. Calculate the longitudinal magnification.

a) 1
b) 1.5
c) 2
d) 3

Explanation

$$\text{longitudinal magnification } (m) = \frac{\text{length of image } (l')}{\text{length of object } (l)}$$

Given: length of object, $l = \frac{f}{3}$



Let, l be the length of the image, then,

$$m = \frac{l'}{l} = \frac{l'}{f/3} \text{ (or) } l = \frac{mf}{3}$$

Image of one end coincides with the object. Thus, the coinciding end must be at center of curvature.

Hence, $u' = R = 2f$

$$u' = u + \frac{f}{3}$$

$$u = u' - \frac{f}{3} = 2f - \frac{f}{3} = \frac{5f}{3}$$

$$v = u + \frac{f}{3} + \frac{mf}{3} = \frac{5f}{3} + \frac{f}{3} + \frac{mf}{3} = \frac{f(6+m)}{3}$$

Mirror equation, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{-\left(\frac{f(6+m)}{3}\right)} + \frac{1}{-\left(\frac{5f}{3}\right)} = \frac{1}{-f}$$

After simplifying,

$$\frac{3}{f(6+m)} + \frac{3}{5f} = \frac{1}{f}; \frac{3}{(6+m)} = \frac{2}{5}$$

$$6 + m = \frac{15}{2}; m = \frac{15}{2} - 6$$

$$m = \frac{3}{2} = 1.5$$

35. Which of the following statement is correct?

1) Light travels with the highest speed in vacuum.
2) The speed of light in vacuum is denoted as c and its value is, c = 3×10^8 ms^{-1}
3) The earliest attempt to find speed of light was made by a French scientist Hippolyte Fizeau

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

Light travels with the highest speed in vacuum. The speed of light in vacuum is denoted as c and its value is, c = 3×108 ms-1. It is a very high value. Several attempts were made by scientists to determine the speed of light. The earliest attempt was made by a French scientist Hippolyte Fizeau (1819– 1896). That paved way for the other scientists too to determine the speed of light.

36. At what angle incident light was made to hit silvered glass in Fizeau's method to determine speed of light?

a) 30^0
b) 45^0

c) 60^0
d) 90^0

Explanation

In Fizeau's method to determine speed of light, e light from the source S was first allowed to fall on a partially silvered glass plate G kept at an **angle of 45° to the incident light from the source**.

37. Which of the following statement is correct?

1) Fizeau had some difficulty to visually estimate the minimum intensity of the light when blocked by the adjacent tooth, and his value for speed of light was very close to the actual value
2) Later on, with the same idea of Fizeau and with much sophisticated instruments, the speed of light in air was determined as, $v = 2.99792\times10^8$ m s^{-1}
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Fizeau had some difficulty to visually estimate the minimum intensity of the light when blocked by the adjacent tooth, and his value for speed of light was very close to the actual value. Later on, with the same idea of Fizeau and with much sophisticated instruments, the **speed of light in air was determined as, $v = 2.99792\times10^8$ m s^{-1}**.

38. Who introduced Different transparent media like glass, water to find speed of light?

a) Fizeau
b) Einstein
c) Newton
d) Foucault and Michelson

Explanation

Different transparent media like glass, water etc. were introduced in the path of light by scientists like Foucault (1819– 1868) and Michelson (1852–1931) to find the speed of light in different media.

39. Refractive index of a transparent medium is__

a) u/v
b) c/v
c) v/c
d) v/u

Explanation

Refractive index of a transparent medium is defined as the ratio of speed of light in vacuum (or air) to the speed of light in that medium.

$$n = \frac{c}{v}$$

40. One type of transparent glass has refractive index 1.5. What is the speed of light through this glass?

a) $2\times10^8\,ms^{-1}$
b) $2\times10^8\,ms^{-2}$
c) $3\times10^8\,ms^{-1}$
d) $2\times10^8\,ms^3$

Explanation

Solution

$$n=\frac{c}{v};\qquad v=\frac{c}{n}$$

$$v=\frac{3\times10^8}{1.5}=2\times10^8\ m\ s^{-1}$$

Light travels with a speed of $2\times10^8 m\,s^{-1}$ through this glass.

41. The smallest value of refractive index is for vacuum and is_____

a) 0.1
b) 1
c) 0
d) 0.5

Explanation

Refractive index does not have unit. The **smallest value of refractive index is for vacuum, which is 1.** For any other medium refractive index is greater than 1.

42. _____ is also called as optical density of the medium.

a) Refractive index
b) Pole length
c) Centre of curvature
d) Reflective index

Explanation

Refractive index is also called as optical density of the medium. Higher the refractive index of a medium, greater is its optical density and speed of light through the medium is lesser and vice versa.

43. Match the media with the respective refractive index:

I.	Air	1. 1.46
II.	Pure water	2. 1.0003
III.	Ice	3. 1.31
IV.	Quartz	4. 1.33

a) 2, 1, 3, 4
b) 2, 4, 3, 1
c) 3, 2, 1, 4

d) 4, 2, 1, 3

Explanation

Media	Refractive index
Vacuum	1.00
Air	1.0003
Carbon dioxide gas	1.0005
Ice	1.31
Pure water	1.33
Ethyl alcohol	1.36
Quartz	1.46
Vegetable oil	1.47
Olive oil	1.48

44. Match the media with the respective refractive index:

I.	Gallium phosphide	1. 3.50
II.	Diamond	2. 2.16
III.	Qubic zirconia	3. 2.42
IV.	Sapphire	4. 1.77

a) 3, 1, 2, 4
b) 1, 3, 2, 4
c) 1, 2, 4, 3
d) 3, 1, 2, 4

Explanation

Acrylic	1.49
Table salt	1.51
Glass	1.52
Sapphire	1.77
Zircon	1.92
Qubic zirconia	2.16
Diamond	2.42
Gallium phosphide	3.50

45. Light travels from air in to glass slab of thickness 50 cm and refractive index 1.5. What is the speed of light in glass?

a) 2×10^8 m s^{-1}
b) 3×10^8 m s^{-1}
c) 2.5×10^8 m s^{-1}

d) 12 x 10^8 m s^{-1}

Explanation

Given, thickness of glass slab, $d = 50$ cm = 0.5 m, refractive index, $n = 1.5$

refractive index, $n = \frac{c}{v}$

speed of light in glass is,

$$v = \frac{c}{n} = \frac{3\times10^8}{1.5} = 2\times10^8 m\ s^{-1}$$

46. Light travels from air in to glass slab of thickness 50 cm and refractive index 1.5. What is the time taken by the light to travel through the glass slab?

a) 2.5 x 10^{-9} s
b) 3.5 x 10^{-9} s
c) 1.5 x 10^{-9} s
d) 0.5 x 10^{-9} s

Explanation

speed of light in glass is,

$$v = \frac{c}{n} = \frac{3\times10^8}{1.5} = 2\times10^8 m\ s^{-1}$$

Time taken by light to travel through glass slab is,

$$t = \frac{d}{v} = \frac{0.5}{2\times10^8} = 2.5\times10^{-9} s$$

47. Light travels from air in to glass slab of thickness 50 cm and refractive index 1.5. What is the optical path of the glass slab?

a) 45 cm
b) 75 cm
c) 125 cm
d) 25 cm

Explanation

Optical path,

$$d' = nd = 1.5\times0.5 = 0.75\,m = 75\,cm$$

Light would have travelled 25 cm more (75 cm – 50 cm) in vacuum by the same time had there not been a glass slab.

48. Which of the following statement is correct?

1) Refraction is passing through of light from one optical medium to another optical medium through a boundary
2) Law of refraction is called Snell's law
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

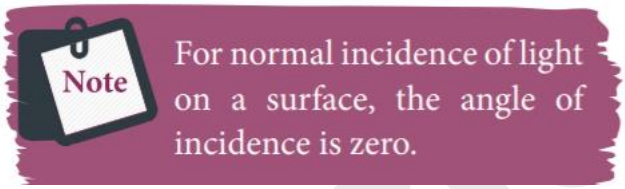
Explanation

Refraction is passing through of light from one optical medium to another optical medium through a boundary. In refraction, the angle of incidence i in one medium and the angle of reflection r in the other medium are measured with respect to the normal drawn to the surface at the point of incidence of light. Law of refraction is called Snell's law

49. For normal incidence of light on a surface, the angle of incidence is_____

a) 45^0
b) 0^0
c) 30^0
d) 60^0

Explanation



50. Which of the following is correct regarding Snell's law?

a) Sin i / Sin r = n2/ n1
b) Sin i / Sin r = n1/ n2
c) Sin r / Sin i = n2/ n1
d) Sin r / Sin r_1 = n2/ n1

Explanation

The ratio of angle of incident i in the first medium to the angle of reflection r in the second medium is equal to the ratio of refractive index of the second medium n_2 to that of the refractive index of the first medium n_1.

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

51. The angle of deviation is equal to__, When light travels from rarer to denser medium

a) i – r
b) i + r
c) r – i

d) – i

Explanation

We know that the angle between the incident and deviated light is called angle of deviation. When light travels from rarer to denser medium it deviates towards normal as shown in Figure 6.16. The angle of deviation in this case is,

d = i – r

52. Which of the following statement about Characteristics of refraction is correct?

1) When light passes from rarer medium to denser medium it deviates towards normal in the denser medium.
2) When light passes from denser medium to rarer medium it deviates away from normal in the rarer medium
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Characteristics of refraction:

- When light passes from rarer medium to denser medium it deviates towards normal in the denser medium.
- When light passes from denser medium to rarer medium it deviates away from normal in the rarer medium.

53. The phenomenon in which a part of light from a source undergoing reflection and the other part of light from the same source undergoing refraction at the same surface is called____

a) Simultaneous refraction
b) Simultaneous refraction
c) Simultaneous dispersion
d) Either a or b

Explanation

The phenomenon in which a part of light from a source undergoing reflection and the other part of light from the same source undergoing refraction at the same surface is **called simultaneous reflection or simultaneous refraction**. Such surfaces are available as partially silvered glasses.\

54. Assertion(A): Production of optical surfaces capable of refracting as well as reflecting is possible

Reason(R): Glass can be made partially see through and partially reflecting by varying the amount of coating on its surface

a) Both (A) and (R) are correct, but (R) does not explain (A)
b) Both (A) and (R) are wrong
c) Both (A) and (R) are correct and (R) explains (A)
d) (A) is Correct and (R) is wrong

Explanation

Production of optical surfaces capable of refracting as well as reflecting is possible by properly coating the surfaces with suitable materials. Thus, a glass can be made partially see through and partially reflecting by varying the amount of coating on its surface.

55. Which of the following are the name of partially reflecting mirror?

1) Two-way mirror
2) Half-silvered mirror
3) Semi-silvered mirror
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

Partially reflecting mirror is commercially called as **two-way mirror, half-silvered or semi-silvered mirror etc.**

56. Which of the following statement is correct?

1) In semi-silvered mirror, hidden cameras can be kept behind
2) We need to be cautious when we stand in front of mirrors kept in unknown places.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Partially reflecting mirror is commercially called as two-way mirror, half- silvered or semi-silvered mirror etc. This gives a perception of regular mirror if the other side is made dark. But still hidden cameras can be kept behind such mirrors. We need to be cautious when we stand in front of mirrors kept in unknown places.

57. Which of the following statement about partially reflecting mirror is correct?

1) There is a method to test the two-way mirror
2) Place the finger nail against the mirror surface, if there is a gap between nail and its image, then it is a regular mirror.
3) If the fingernail directly touches its image, then it is a two-way mirror.
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

We need to be cautious when we stand in front of mirrors kept in unknown places. There is a method to test the two-way mirror. Place the finger nail against the mirror surface. If there is a gap between nail and its image, then it is a regular mirror. If the fingernail directly touches its image, then it is a two-way mirror.

58. Light travelling through transparent oil enters in to glass of refractive index 1.5. If the refractive index of glass with respect to the oil is 1.25, what is the refractive index of the oil?

a) 1.2
b) 2.5
c) 2.6
d) 1.7

Explanation

Given, n_{go} =1.25 and n_g =1.5

Refractive index of glass with respect to oil,

$$n_{go} = \frac{n_g}{n_o}$$

Rewriting for refractive index of oil,

$$n_o = \frac{n_g}{n_{go}} = \frac{1.5}{1.25} = 1.2$$

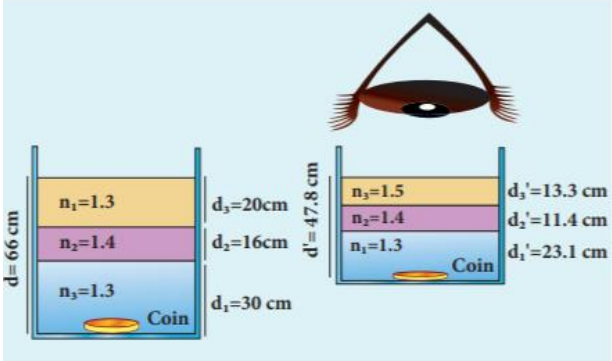
The refractive index of oil is, n_o = 1.2

59. A coin is at the bottom of a trough containing three immiscible liquids of refractive indices 1.3, 1.4 and 1.5 poured one above the other of heights 30 cm, 16 cm, and 20 cm respectively. What is the apparent depth at which the coin appears to be when seen from air medium outside?

a) 47.8 cm
b) 33.8 cm
c) 27.8 cm
d) 77.8 cm

Explanation

When seen from top, the coin will still appear to be at the bottom with each medium appearing to have shrunk with respect to the air medium outside. This situation is illustrated below.



The equations for apparent depth for each medium is,

$$d_1' = \frac{d_1}{n_1}; \quad d_2' = \frac{d_2}{n_2}; \quad d_3' = \frac{d_3}{n_3}$$

$$d' = d_1' + d_2' + d_3' = \frac{d_1}{n_1} + \frac{d_2}{n_2} + \frac{d_3}{n_3}$$

$$d' = \frac{30}{1.3} + \frac{16}{1.4} + \frac{30}{1.5} = 23.1 + 11.4 + 13.3$$

$$d' = 47.8 \ cm$$

60. When a ray passes from an optically denser medium to an optically rarer medium, it bends__ from Normal

a) Towards
b) Away
c) Into
d) None

Explanation

When a ray passes from an optically denser medium to an optically rarer medium, **it bends away from normal**. Because of this, the angle of refraction r on the rarer medium is greater than the corresponding angle of incidence i in the denser medium. As angle of incidence i is gradually increased, r rapidly increases and at a certain stage it becomes 90° or gracing the boundary.

61. Which of the following statement is correct?

1) Due to refraction of light through different layers of atmosphere which vary in refractive index, the path of light deviates continuously when it passes through atmosphere
2) Sun is visible a little before the actual sunrise and also until a little after the actual sunset due to refraction of light through the atmosphere
    a) 1 alone
    b) 2 alone

c) 1, 2
d) None

Explanation

Due to refraction of light through different layers of atmosphere which vary in refractive index, the path of light deviates continuously when it passes through atmosphere. For example, the Sun is visible a little before the actual sunrise and also until a little after the actual sunset due to refraction of light through the atmosphere. **By actual sunrise what we mean is the actual crossing of the sun at the horizon**

62. The apparent shift in the direction of the sun is around half a degree and the corresponding time difference between actual and apparent positions is about___

a) 4 minutes
b) 2 minutes
c) 3 minutes
d) 10 minutes

Explanation

The apparent shift in the direction of the sun is around half a degree and the corresponding time **difference between actual and apparent positions is about 2 minutes**. Sun appears flattened (oval shaped) during sun rise and sunset due to the same phenomenon.

63. Which of the following statement is correct?

1) If the angle of incidence in the denser medium is increased beyond the critical angle, there is no refraction possible in to the rarer medium
2) The entire light is reflected back into the denser medium itself. This phenomenon is called total internal reflection

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

If the angle of incidence in the denser medium is increased beyond the critical angle, there is no refraction possible in to the rarer medium. The entire light is reflected back into the denser medium itself. This phenomenon is called total internal reflection.

64. Which of the following are the conditions for total internal reflection?

1) Light must travel from denser to rarer medium
2) Angle of incidence in the denser medium must be greater than critical angle

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The two conditions for total internal reflection are,

(a) light must travel from denser to rarer medium,

(b) angle of incidence in the denser medium must be greater than critical angle ($i > i_c$).

65. The critical angle for water-air interface is____°

a) 45
b) 48.6
c) 34.5
d) 12.5

Explanation

Refractive index of glass is about 1.5. The critical angle for glass-air interface is $i_c = \sin^{-1}\left(\frac{1}{1.5}\right) = 41.8^{\circ}.$

The critical angle for water-air interface is,

$$i_c = \sin^{-1}\left(\frac{1}{1.3}\right) = 48.6^{\circ}.$$

66. Match the refractive index with the respective material:

I.	Ice	1. 1.541
II.	Water	2. 1.333
III.	Crown glass	3. 1.310
IV.	Diamond	4. 2.417

a) 2, 1, 3, 4
b) 3, 2, 1, 4
c) 2, 3, 1, 4
d) 4, 1, 2, 3

Explanation

Material	Refractive index	Critical Angle
Ice	1.310	49.8°
Water	1.333	48.6°
Fused Quartz (SiO_2)	1.458	43.3°
Crown Glass	1.541	40.5°
Flint Glass	1.890	31.9°
Calcite ($CaCO_2$)	1.658	37.0°
Diamond	2.417	24.4°
Strontium Titanate ($SrTiO_3$)	2.417	24.4°
Rutile	2.621	22.4°

67. Which of the followign statement is correct?

1) Diamond appears dazzling because the total internal reflection of light happens inside the diamond
2) The refractive index of only diamond is about 1.417.

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Diamond appears dazzling because the total internal reflection of light happens inside the diamond. The **refractive index of only diamond is about 2.417**.

68. The critical angle of diamond is about____ °

a) 34.4
b) 24.4
c) 14.4
d) 49.9

Explanation

Diamond is much larger than that for ordinary glass which is about only 1.5. **The critical angle of diamond is about 24.4°**. It is much less than that of glass. A skilled diamond cutter makes use of this larger range of angle of incidence (24.4° to 90° inside the diamond), to ensure that light entering the diamond is total internally reflected from the many cut faces before getting out.

69. Which of the following statement is correct?

1) The refractive index of air increases with its density
2) Hot air is more dense

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The refractive index of air increases with its density. In hot places, air near the ground is hotter than air at a height. Hot air is less dense.

70 . Assertion(A): In the cold places the refractive index increases towards the ground

Reason(R): The temperature of air close to the ground is lesser than the temperature above the surface of earth

a) Both (A) and (R) are correct, but (R) does not explain (A)
b) Both (A) and (R) are wrong
c) Both (A) and (R) are correct and (R) explains (A)
d) (A) is Correct and (R) is wrong

Explanation

In the cold places the refractive index increases towards the ground because the temperature of air close to the ground is lesser than the temperature above the surface of earth. Thus, the density and refractive index of air near the ground is greater than at a height.

71. Where does reverse effect of mirage will take place?

1) Desert
2) Glacier
3) Sea
4) Frozen lake

a) 1, 2, 4
b) 1, 3, 4
c) 2, 3, 4
d) All the above

Explanation

In the cold regions like glaciers and frozen lakes and seas, the reverse effect of mirage will happen. Hence, an inverted image is formed little above the surface.

72. Which of the following statement is correct?

1) When a light source like electric bulb is kept inside a water tank, the light from the source travels in all direction inside the water
2) The light that is incident on the water surface at an angle less than the critical angle will undergo refraction and emerge out from the water.

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

When a light source like electric bulb is kept inside a water tank, the light from the source travels in all direction inside the water. The light that is incident on the water surface at an angle less than the critical angle will undergo refraction and emerge out from the water. The light incident at an angle greater than critical angle will undergo total internal reflection.The light falling particularly at critical angle graces the surface.

73. What is the radius of the illumination when seen above from inside a swimming pool from a depth of 10 m on a sunny day? What is the total angle of view? [Given, refractive index of water is 4/3]

a) 48.6^{o}
b) 97.2^{o}
c) 112.9^{o}
d) 99.2^{o}

Explanation

Solution

Given, $n = 4/3$, $d = 10$ m.

Radius of illumination, $R = \frac{d}{\sqrt{n^2 - 1}}$

$$R = \frac{10}{\sqrt{(4/3)^2 - 1}} = \frac{10 \times 3}{\sqrt{16 - 9}}$$

$$R = \frac{30}{\sqrt{7}} = 11.32m$$

To find the angle of the view of the cone,

$$i_c = \sin^{-1}\left(\frac{1}{n}\right)$$

$$i_c = \sin^{-1}\left(\frac{1}{4/3}\right) = \sin^{-1}\left(\frac{3}{4}\right) = 48.6^\circ$$

The total angle of view is,

$$2i_c = 2 \times 48.6^\circ = 97.2^\circ$$

74. Which of the following statement is correct?

1) Transmitting signals through optical fibres is possible due to the phenomenon of total internal reflection.
2) Optical fibres consists of inner part called core and outer part called cladding (or) sleeving.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Transmitting signals through optical fibres is possible due to the phenomenon of total internal reflection. Optical fibres consists of inner part called core and outer part called **cladding (or) sleeving**

75. The refractive index of the material of the core must be___ than that of the cladding for total internal reflection to happen

a) Lower
b) Higher
c) Equal to
d) None

Explanation

The refractive index of the material of the core must be higher than that of the cladding for total internal reflection to happen. Signal in the form of light is made to incident inside the core-cladding boundary at an angle greater than the critical angle. Hence, it undergoes repeated total internal reflections along the length of the fibre without undergoing any refraction.

76. Which of the following statement is incorrect?

1) To ensure the critical angle incidence in the core-cladding boundary inside the optical fibre, the light should be incident at a certain angle at the end of the optical fiber while entering in to it
2) This angle is called acceptance angle.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

To ensure the critical angle incidence in the core-cladding boundary inside the optical fibre, the light should be incident at a certain angle at the end of the optical fiber while entering in to it. This angle is called **acceptance angle**

77. Which of the following statement is correct?

1) An endoscope is an instrument used by doctors which has a bundle of optical fibres that are used to see inside a patient's body.
2) Endoscopes work on the phenomenon of total internal refraction
3) Even operations could be carried out with the endoscope cable which has the necessary instruments attached at their ends.
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

An endoscope is an instrument used by doctors which has a bundle of optical fibres that are used to see inside a patient's body. **Endoscopes work on the phenomenon of total internal reflection**. The optical fibres are inserted in to the body through mouth, nose or a special hole made in the body. Even operations could be carried out with the endoscope cable which has the necessary instruments attached at their ends.

78. The thickness of a glass slab is 0.25 m. it has a refractive index of 1.5. A ray of light is incident on the surface of the slab at an angle of 60^{o}. Find the lateral displacement of the light when it emerges from the other side of the mirror(in cm).

a) 12.81
b) 14.21
c) 16.21
d) 32.81

Explanation

Solution

Given, thickness of the slab, t = 0.25 m, refractive index, $n = 1.5$, angle of incidence, $i = 60^{o}$.

Using Snell's law, $1 \times \sin i = n \sin r$

$$\sin r = \frac{\sin i}{n} = \frac{\sin 60}{1.5} = 0.58$$

$$r = \sin^{-1} 0.58 = 35.25^{\circ}$$

Lateral displacement is, $L = t\left(\frac{\sin(i-r)}{\cos(r)}\right)$

$$L = (0.25) \times \left(\frac{\sin(60-35.25)}{\cos(35.25)}\right) = 0.1281\, m$$

The lateral displacement is, $L = 12.81\, cm$

79. Which of the following statement is correct?

1) The refractions also do take place at spherical surface between two transparent media
2) The laws of refraction hold good at every point on the spherical surface.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

The refractions also do take place at spherical surface between two transparent media. The laws of refraction hold good at every point on the spherical surface. The normal at the point of incidence is perpendicular to the tangent plane to the spherical surface at that point.

80. Which of the following assumptions are made while considering refraction at spherical surfaces?

1) The incident light is assumed to be dichromatic
2) The incident light is assumed to be monochromatic
3) The incident ray of light is very close to the principal axis
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

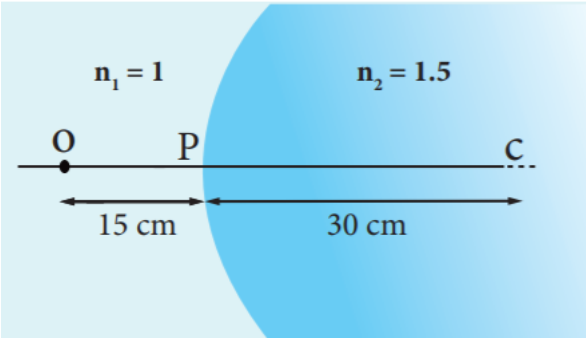
Explanation

The following assumptions are made while considering refraction at spherical surfaces.

(a) The incident light is assumed to be **monochromatic (single colour)**

(b) The incident ray of light is very close to the principal axis (paraxial rays).

81. Locate the image of the point object O in the situation shown. The point C denotes the centre of curvature of the separating surface.



a) **Virutal image**
b) Real image
c) Either a or b
d) Both a and b

Explanation

Solution

Given, $u = -15$ cm, $R = 30$ cm, $n_1 = 1$ and $n_2 = 1.5$

Equation for single spherical surface is,

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$$

Substituting the values,

$$\frac{1.5}{v} - \frac{1}{-15} = \frac{(1.5-1)}{30}; \qquad \frac{1.5}{v} + \frac{1}{15} = \frac{(0.5)}{30}$$

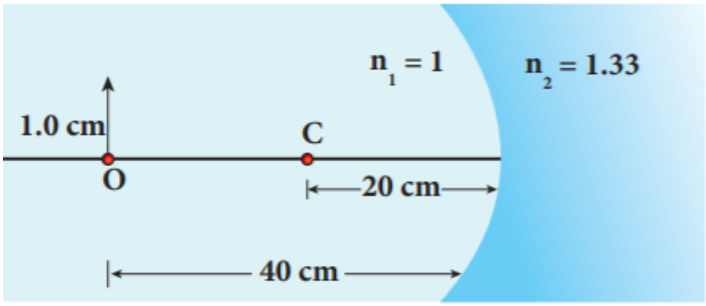
$$\frac{1.5}{v} + \frac{1}{15} = \frac{1}{60}; \qquad \frac{1.5}{v} = \frac{1}{60} - \frac{1}{15};$$

$$\frac{1.5}{v} = \frac{1-4}{60} = \frac{-3}{60}; = -\frac{1}{20}$$

$v = -30$ cm

The image is a virtual image formed 30 cm to the left of the spherical surface.

82. Find the size of the image formed in the given figure.



a) 6 cm
b) 0.6 cm
c) 0.8 cm
d) 2.1 cm

Explanation

Given, $u = -40$ cm, $R = -20$ cm, $n_1 = 1$ and $n_2 = 1.33$

Equation for single spherical surface is,

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$$

Substituting the values,

$$\frac{1.33}{v} - \frac{1}{-40} = \frac{(1.33-1)}{-20}; \quad \frac{1.33}{v} + \frac{1}{40} = \frac{(0.33)}{-20}$$

$$\frac{1.33}{v} = -\frac{(0.33)}{20} - \frac{1}{40};$$

$$\frac{1.33}{v} = \frac{-0.66-1}{40} = -\frac{1.66}{40}$$

$$v = -40 \times \frac{1.33}{1.66} = -32.0\ cm$$

Equation for magnification is, $m = \frac{h_2}{h_1} = \frac{n_1 v}{n_2 u}$

$$\frac{h_2}{1.0} = \frac{(1.0)\times(-32)}{(1.33)\times(-40)} = 0.6cm \quad \text{(or)} \quad h_2 = 0.6cm$$

The erect virtual image of height 0.6 cm is formed at 32.0 cm to the left of the single spherical surface.

83. Which of the following statement is correct?

1) A lens is formed by a transparent material bounded between two spherical surfaces or one plane and another spherical surface
2) In a thin lens, the distance between the surfaces is very small.
    a) 1 alone
    b) 2 alone

c) 1, 2
d) None

Explanation

A lens is formed by a transparent material bounded between two spherical surfaces or one plane and another spherical surface. In a thin lens, the distance between the surfaces is very small. If there are two spherical surfaces, then there will be two centres of curvature C_1 and C_2 and correspondingly two radii of curvature R_1 and R_2.

84. Which of the following statement is correct?

1) The primary focus F1 is defined as a point where an object should be placed to give parallel emergent rays to the principal axis
2) The secondary focus F2 is defined as a point where all the parallel rays travelling close to the principal axis converge to form an image on the principal axis
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

The primary focus F1 is defined as a point where an object should be placed to give parallel emergent rays to the principal axis. For a convergent lens, such an object is a real object and for a divergent lens, it is a virtual object. The distance PF1 is the primary focal length f1 . The secondary focus F2 is defined as a point where all the parallel rays travelling close to the principal axis converge to form an image on the principal axis. For a convergent lens, such an image is a real image and for a divergent lens, it is a virtual image. The distance PF2 is the secondary focal length f 2.

85. The focal length of the thin lens is taken as___ for a converging lens and___ for a diverging lens.

a) +, -
b) -, -
c) +, +
d) -, +

Explanation

The sign of focal length is not decided on the direction of measurement of the focal length from the pole of the lens as they have two focal lengths, one to the left and another to the right (primary and secondary focal lengths on either side of the lens). **The focal length of the thin lens is taken as positive for a converging lens and negative for a diverging lens**.

86. Which of the following is lens equation?

a) 1/f = 1/u -1/v
b) 1/f = 1/v – 1/u
c) 1/f = 1/u + 1/v
d) 1/f = -1/u + 1/v

Explanation

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

This equation is known as lens equation which relates the object distance u and image distance v with the focal length f of the lens. This formula holds good for a any type of lens

87. A biconvex lens has radii of curvature 20 cm and 15 cm each. The refractive index of the material of the lens is 1.5. What is its focal length?(cm)

a) 17.14
b) 14.17
c) 23.18
d) 12.12

Explanation

Given, $n = 1.5$, R_1=20 cm and R_2= −15 cm

Lens maker's formula, $\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

Substituting the values,

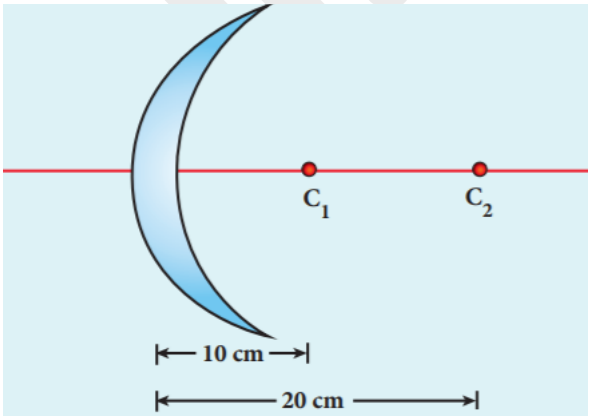
$$\frac{1}{f}=(1.5-1)\left(\frac{1}{20}-\frac{1}{-15}\right)$$

$$\frac{1}{f}=(0.5)\left(\frac{1}{20}+\frac{1}{15}\right)=(0.5)\left(\frac{3+4}{60}\right)=\left(\frac{1}{2}\times\frac{7}{60}\right)=\frac{7}{120}$$

$$f=\frac{120}{7}=17.14cm$$

As the focal length is positive the lens is a converging lens.

88. Determine the focal length of the lens made up of a material of refractive index 1.52 as shown in the diagram. (Points C1 and C2 are the centers of curvature of the first and second surface.)



a) 38. 46 cm
b) 39.46 cm

c) 42.12 cm
d) 19.18 cm

Explanation

Solution

This lens is called convexo-concave lens

Given, $n = 1.52$, $R_1 = 10$ cm and $R_2 = 20$ cm

Lens makers formula, $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Substituting the values,

$$\frac{1}{f} = (1.52-1)\left(\frac{1}{10} - \frac{1}{20}\right)$$

$$\frac{1}{f} = (0.52)\left(\frac{2-1}{20}\right) = (0.52)\left(\frac{1}{20}\right) = \frac{0.52}{20}$$

$$f = \frac{20}{0.52} = 38.46\,\text{cm}$$

As the focal length is positive, the lens is a converging lens.

89. Which of the following statement is correct?

1) Power of lens is the measurement of deviating strength of a lens
2) Power of the lens is directly proportional to focal length

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Power of lens is the measurement of deviating strength of a lens i.e. when a ray is incident on a lens then the degree with which the lens deviates the ray is determined by the power of the lens. **Power of the lens is inversely proportional to focal length** i.e. greater the power of lens, greater will be the deviation of ray and smaller will be the focal length.

90. If the focal length is 150 cm for a glass lens, what is the power of the lens?(in D)

a) 0.67
b) 0.91
c) 0.33
d) 0.71

Explanation

Given, focal length, $f = 150$ cm (or) $f = 1.5\ m$

Equation for power of lens is, $P = \frac{1}{f}$

Substituting the values,

$P = \frac{1}{1.5} = 0.67 \text{diopter}$

As the power is positive, it is a converging lens.

---

91. What is the focal length of the combination if a lens of focal length −70 cm is brought in contact with a lens of focal length 150 cm?

a) 131.25 cm
b) -131.25 cm
c) 121.25 cm
d) -121.25 cm

Explanation

Given, focal length of first lens, f_1 = −70 cm, focal length of second lens, f_2 = 150 cm.

Equation for focal length of lenses in contact, $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

Substituting the values,

$$\frac{1}{F} = \frac{1}{-70} + \frac{1}{150} = -\frac{1}{70} + \frac{1}{150}$$

$$\frac{1}{F} = \frac{-150+70}{70\times150} = \frac{-80}{70\times150} = -\frac{80}{10500}$$

$$F = \frac{-1050}{8} = -131.25 cm$$

92. What is the focal length of the combination if a lens of focal length −70 cm is brought in contact with a lens of focal length 150 cm? What is the power of the combination?

a) − 0.67 D
b) − 0.76 D
c) 0.67 D
d) 0.76 D

Explanation

Given, focal length of first lens, f_1 = −70 cm, focal length of second lens, f_2 = 150 cm.

Equation for focal length of lenses in contact, $\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}$

Substituting the values,

$$\frac{1}{F}=\frac{1}{-70}+\frac{1}{150}=-\frac{1}{70}+\frac{1}{150}$$

$$\frac{1}{F}=\frac{-150+70}{70\times150}=\frac{-80}{70\times150}=-\frac{80}{10500}$$

$$F=\frac{-1050}{8}=-131.25cm$$

As the focal length is negative, the combination of two lenses is a diverging system of lenses.

The power of combination is,

$$P=\frac{1}{F}=\frac{1}{-1.3125m}=-0.76\,\text{diopter}$$

93. System of combination of lenses is commonly used in designing lenses for____

1) Camera
2) Microscope
3) Telescopes
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

System of combination of lenses is commonly used in designing lenses for cameras, microscopes, telescopes and other optical instruments. They produce better magnification as well as sharpness of the images.

94. Which of the following statement is correct?

1) A prism is a triangular block of glass or plastic
2) It is bounded by the three plane faces not parallel to each other.
3) Its one face is grounded which is called base of the prism.
4) The other two faces are polished which are called refracting faces of the prism
    a) 1, 2, 3
    b) 2, 3, 4
    c) 1, 3, 4
    d) All the above

Explanation

A prism is a triangular block of glass or plastic. It is bounded by the three plane faces not parallel to each other. Its one face is grounded which is called base of the prism. The other two faces are polished which are called refracting faces of the prism. The angle between the two refracting faces is called angle of prism (or) refracting angle (or) apex angle of the prism.

95. Angle of deviation depends on Which of the following factors?

1) Angle of incidence
2) Angle of the prism
3) Material of the prism
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

The angle of deviation depends on these following factors:

(i) the angle of incidence

(ii) the angle of the prism

(iii) the material of the prism

(iv) the wave length of the light

96. A monochromatic light is incident on an equilateral prism at an angle 30° and emerges at an angle of 75° . What is the angle of deviation produced by the prism?

a) 30°
b) 45°
c) 90°
d) 60°

Explanation

Solution

Given, as the prism is equilateral,

$A = 60°;\ i_1 = 30°;\ i_2 = 75°$

Equation for angle of deviation, $d = i_1 + i_2 - A$

Substituting the values, $d = 30°+75°-60°=45°$

The angle of deviation produced is, $d = 45°$

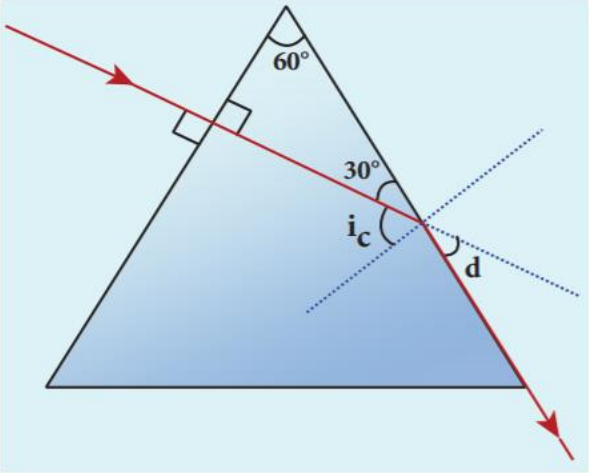
97. Light ray falls at normal incidence on the first face of an equilateral prism and emerges gracing the second face. What is the angle of deviation?

a) 45°
b) 30°
c) 60°

d) 90°

Explanation

Solution



The given situation is shown in the figure.

Here, $A = 60°$; $i_1 = 0°$; $i_2 = 90°$

Equation for angle of deviation,

$d = i_1 + i_2 - A$

Substituting the values,

$d = 0° + 90° - 60° = 30°$

The angle of deviation produced is, $d = 30°$

98. Light ray falls at normal incidence on the first face of an equilateral prism and emerges gracing the second face. What is the refractive index of the material of the prism?

a) 4
b) 3
c) 2
d) 7

Explanation

The given situation is shown in the figure.

Here, $A = 60°$; $i_1 = 0°$; $i_2 = 90°$

Equation for angle of deviation,

$d = i_1 + i_2 - A$

Substituting the values,

$d = 0° + 90° - 60° = 30°$

The angle of deviation produced is, $d = 30°$

The light inside the prism must be falling on the second face at critical angle as it graces the boundary.

Equation for critical angle is, $\sin i_c = \frac{1}{n}$

$n = \frac{1}{\sin i_c}$; $n = \frac{1}{\sin 30^\circ} = \frac{1}{1/2} = 2$

The refractive index of the material of the prism is, $n = 2$

99. The angle of minimum deviation for a prism is 37o . If the angle of prism is 60o , find the refractive index of the material of the prism.

a) 2
b) 3.5
c) 1.5
d) 4.5

Explanation

Solution

Given, A=60°; D=37°

Equation for refractive index is,

$$n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Substituting the values,

$$n = \frac{\sin\left(\frac{60^0 + 37^0}{2}\right)}{\sin\left(\frac{60^0}{2}\right)} = \frac{\sin\left(48.5^0\right)}{\sin\left(30^0\right)} = \frac{0.75}{0.5} = 1.5$$

The refractive index of the material of the prism is, $n = 1.5$

100. Which of the following statement is correct?

1) When white light enter in to a prism, the effect called dispersion takes place.
2) Dispersion is splitting of white light into its constituent colours.
3) This band of colours of light is called its spectrum.

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

So far the angle of deviation produced by a prism is discussed for monochromatic light (i.e. light of single colour). When white light enter in to a prism, the effect called dispersion takes place. Dispersion is splitting of white light into its constituent colours. This band of colours of light is called its spectrum.

101. Which of the following colour is most deviated?

a) Red
b) Orange
c) Violet
d) Green

Explanation

When a narrow beam of parallel rays of white light is incident on the face of a prism and the refracted beam is received on a white screen, a band of colours is obtained in the order, recollected by the word: VIBGYOR i.e., Violet, Indigo, Blue, Green, Yellow, Orange and Red. **Violet is the most deviated** and red is the least deviated colour.

102. Which of the following statement is correct?

1) The colours obtained in a spectrum depend on the nature of the source of the light used
2) Each colour of light is associated with a definite wavelength

a) 1 alone
b) 2 alone

c) 1, 2
d) None

Explanation

The colours obtained in a spectrum depend on the nature of the source of the light used. Each colour of light is associated with a definite wavelength.

103. What is the wavelength of violet light?

a) 400 nm
b) 700 nm
c) 200 nm
d) 1300 nm

Explanation

Red light is at the longer wavelength end (700 nm) while the **violet light is at the shorter wavelength end (400 nm)**. Therefore the violet ray travels with a smaller velocity in glass prism than red ray.

104. _____ has demonstrated through a classic experiment to produce white light when all the colours of VIBGYOR are recombined

a) Einstein
b) Newton
c) Galileo
d) Edison

Explanation

Sir Isaac Newton has demonstrated through a classic experiment to produce white light when all the colours of VIBGYOR are recombined. He used a prism to produce dispersion and made all the colours to incident on another inverted prism to combine all the colours to get white light.

105. Which of the following statement is correct?

1) Dispersion takes place because light of different wave lengths travel with different speeds inside the prism
2) In Vacuum, all the colours travel with the same speed

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Dispersion takes place because light of different wave lengths travel with different speeds inside the prism. . In Vacuum, all the colours travel with the same speed. The refractive index of two different glasses for different colours.

106. Which light has high refractive index?

a) Red
b) Violet
c) Blue

d) Orange

Explanation

In other words, the refractive index of the material of the prism is different for different colours. For **violet, the refractive index is high** and for red the refractive index is the low.

107. Which of the following statement is correct?

1) The speed of light is independent of wavelength in vacuum
2) vacuum is a non-dispersive medium in which all colours travel with the same speed

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The speed of light is independent of wavelength in vacuum. Therefore, **vacuum is a non-dispersive medium** in which all colours travel with the same speed.

108. Match the following colour of light with their wavelength(nm)

I.	Violet	1. 656.3
II.	Blue	2. 589.3
III.	Yellow	3. 486.1
IV.	Red	4. 396.6

a) 1, 3, 2, 4
b) 4, 2, 3, 1
c) 4, 3, 2, 1
d) 1, 4, 2, 3

Explanation

Table 6.4 Refractive indices for different wavelengths

Colour	Wavelength (nm)	Crown glass	Flint glass
Violet	396.9	1.533	1.663
Blue	486.1	1.523	1.639
Yellow	589.3	1.517	1.627
Red	656.3	1.515	1.622

109. Find the dispersive power of flint glass if the refractive indices of flint glass for red, green and violet light are 1.613, 1.620 and 1.632 respectively.

a) 0.0306
b) 0.0405
c) 0.0333
d) 0.0230

Explanation

Solution

Given, n_V=1.632; n_R=1.613; n_G=1.620

Equation for dispersive power is,

$$\omega = \frac{(n_V - n_R)}{(n_G - 1)}$$

Substituting the values,

$$\omega = \frac{1.632 - 1.613}{1.620 - 1} = \frac{0.019}{0.620} = 0.0306$$

The dispersive power of flint glass is,
$\omega = 0.0306$

110. Which of the following statement is correct?

1) When sunlight enters the atmosphere of the earth, the atmospheric particles present in the atmosphere change the direction of the light
2) This process is known as dispersion of light.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

When sunlight enters the atmosphere of the earth, the atmospheric particles present in the atmosphere change the direction of the light. This process is known as scattering of light.

111. The intensity of Rayleigh's scattering is inversely proportional to_____ power of wavelength

a) 3^{rd}
b) 4^{th}
c) 5^{th}
d) 6^{th}

Explanation

If the scattering of light is by atoms and molecules which have size a very less than that of the wave length λ of light a<< λ, scattering is called Rayleigh's scattering. The **intensity of Rayleigh's scattering is inversely proportional to fourth power of wavelength**.

112. Which of the following statement is correct?

1) Violet colour which has the shortest wavelength gets much scattered during day time
2) Blue light which has shorter wavelength is scattered away and the less-scattered red light of longer wavelength
    a) 1 alone
    b) 2 alone
    c) 1, 2

d) None

Explanation

According to equation, violet colour which has the shortest wavelength gets much scattered during day time. The next scattered colour is blue. As our eyes are more sensitive to blue colour than violet colour the sky appears blue during day time. But, during sunrise and sunset, the light from sun travels a greater distance through the atmosphere. Hence, **the blue light which has shorter wavelength is scattered away and the less-scattered red light of longer wavelength manages to reach our eye**.

$$I \propto \frac{1}{\lambda^4}$$

113. The angle of view for violet to red in primary rainbow is___° to____ °

a) 52, 54
b) 40, 42
c) 54, 65
d) 32, 56

Explanation

Primary rainbow is formed when light entering the drop undergoes one total internal reflection inside the drop before coming out from the drop as shown in figure. The **angle of view for violet to red in primary rainbow is 40° to 42°**.

114. The angle of view for red to violet in a secondary rainbow is,____° to___ °

a) 52, 54
b) 40, 42
c) 54, 65
d) 32, 56

Explanation

A secondary rainbow appears outside of a primary rainbow and develops when light entering a raindrop undergoes two internal reflections. The **angle of view for red to violet in a secondary rainbow is, 52° to 54°**.

115. Which of the following statement is correct?

1) Rainbow is an example of dispersion of sunlight through droplets of water during rainy days.
2) When sunlight falls on the water drop suspended in air, it splits (or dispersed) into its constituent six colours

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Rainbow is an example of dispersion of sunlight through droplets of water during rainy days. Rainbow is observed during a rainfall or after the rainfall or when we look at a water fountain provided the sun is at the back of the observer. **When sunlight falls on the water drop suspended in air, it splits (or dispersed) into its constituent seven colours**.

116. Assertion(A): If earth has no atmosphere the sky would be dark

Reason(R): If earth has no atmosphere there would not have been any scattering

a) Both (A) and (R) are correct, but (R) does not explain (A)
b) Both (A) and (R) are wrong
c) Both (A) and (R) are correct and (R) explains (A)
d) (A) is Correct and (R) is wrong

Explanation

If earth has no atmosphere there would not have been any scattering and the sky would appear dark. That is why sky appears dark for the astronauts who could see the sky from above the atmosphere.

117. Which of the following statement is correct?

1) In clouds all the colours get equally scattered irrespective of wavelength
2) Rain clouds appear dark because of the condensation of water droplets on dust particles that makes the cloud become opaque
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

In clouds all the colours get equally scattered irrespective of wavelength. This is the reason for the whitish appearance of cloud as shown. But, the rain clouds appear dark because of the condensation of water droplets on dust particles that makes the cloud become opaque.

118. Which of the following statement is correct?

1) Light is a form of energy that is transferred from one place to another
2) A glance at the evolution of various theories of light put forward by scientists will give not only an over view of the nature of light but also its propagation and some phenomenon demonstrated by it
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Light is a form of energy that is transferred from one place to another. A glance at the evolution of various theories of light put forward by scientists will give not only an over view of the nature of light but also its propagation and some phenomenon demonstrated by it.

119. Who among the following gave Corpuscular theory?

a) Newton
b) Einstein
c) Edison
d) Galileo

Explanation

Sir Isaac Newton (1672) gave the corpuscular theory of light which was also suggested earlier by Descartes (1637) to explain the laws of reflection and refraction.

120. Which of the following statement is correct?

1) According Corpusculartheory, light is emitted as tiny, massless (negligibly small mass) and perfectly elastic particles called corpuscles
2) As the corpuscles are very small, the source of light does not suffer appreciable loss of mass even if it emits light for a long time
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

According this theory, light is emitted as tiny, massless (negligibly small mass) and perfectly elastic particles called corpuscles. As the corpuscles are very small, the source of light does not suffer appreciable loss of mass even if it emits light for a long time. On account of high speed, they are unaffected by the force of gravity and their path is a straight line in a medium of uniform refractive index.

121. The energy of light is the____ energy of corpuscles

a) Potential
b) Kinetic
c) Either a or b
d) Both a and b

Explanation

On account of high speed, they are unaffected by the force of gravity and their path is a straight line in a medium of uniform refractive index. **The energy of light is the kinetic energy of these corpuscles**. When these corpuscles impinge on the retina of the eye, the vision is produced.

122. Which of the following phenomena cannot be explained by corpuscular theory?

a) Polarisation
b) Interference
c) Diffraction
d) All the above

Explanation

Corpuscular theory could not explain the reason why the speed of light is lesser in denser medium than in rarer medium and also the phenomena like **interference, diffraction and polarisation.**