QB365 Question Bank Software Study Materials

Ray Optics Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

Physics

Total Marks : 40

2 Marks

20 x 2 = 40

1) Explain the reason for the glittering of diamond.

Answer : Diamond appears glittering because the total internal reflection of light.
Inside the diamond the refractive index of diamond is about 2.417 which is greater than the refractive index of glass. (μ_g =1.5).
The critical angle of diamond is 24.4^d which is much less than that of glass (g_{crown} = 40.5°, g_{flint} 31.9°).
So, when the light enters the diamond, the total internal reflection of light happens inside the diamond before getting out. This gives a sparkling effect for diamond.

2) What is Snell's window?

Answer : When light entering the water from outside is seen from inside the water, the view is restricted to a particular angle equal to the critical angle i_c. The restricted illuminated circular area is called Snell's window

3) What is angle of minimum deviation?

Answer : Angle of minimum deviation:
(i) The angle between the direction of incident ray and the emergent of a prism called the 'Angle of deviation' 'd'.
(ii) The minimum value of angle of deviation is called 'Angle of minimum deviation' 'D'.
At 'D' $i_1 = i_2$, $r_1 = r_2$

4) How are rainbows formed?

Answer : Rainbows is an example of dispersion of sunlight through droplets of water during rainy days. Rainbow is formed, where sunlight falls on the water drop of rainfall suspended in air. It splits into its constituent seven colours. Primary rainbow is formed when light entering the drop undergoes arc total internal reflection.

5) Pure water has refractive index 1.33. What is the speed of light through it?

Answer : $n = \frac{c}{v}; \quad v = \frac{c}{n}$

$$v = \frac{3 \times 10^8}{1.33} = 2.26 \times 10^8 ms^{-1}$$

Light travels with a speed of 2.26 x 10^8 m s^{-1} through pure water.

6) A optical fibre is made up of a core material with refractive index 1.68 and a cladding material of refractive index 1.44. What is the acceptance angle of the fibre if it is kept in air medium without any cladding?

Answer : Given, n_1 = 1.68, n_2 = 1.44, n_3 = 1
Acceptance angle, $i_a = sin^{-1}\left(\sqrt{n_1^2 - n_2^2}\right)$

$$i_a = sin^{-1}\left(\sqrt{(1.68)^2 - (1.44)^2}\right) = sin^{-1}(0.865)$$

$$i_a \simeq 60^o$$

If there is no cladding then, n_2 = 1
Acceptance angle, $i_a = sin^{-1}\left(\sqrt{n_1^2 - 1}\right)$

$$i_a = sin^{-1}\left(\sqrt{(1.68)^2 - 1}\right) = sin^{-1}(1.35)$$

sin^{-1}(more than 1) is not possible. But, this includes the range 0° to 90°. Hence, all the rays entering the core from flat surface will undergo total internal reflection.

Note: If there is no cladding then there is a condition on the refractive index (n_1) of the core

$$i_a = sin^{-1}\left(\sqrt{n_1^2 - 1}\right)$$

Here, as per mathematical rule

Here, as per mathematical rule,

$(n_1^2 - 1) \leq 1$ or $(n_1^2) \leq 2$ or $n_1 \leq \sqrt{2}$

Hence, in air (no cladding) the refractive index n_1 of the core should be, $n_1 \leq 1.414$

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

Answer : Since, the prism is equilateral, A = 60°;

Given, i_1 = 30°;i_2 = 75°

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

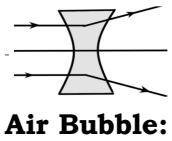
Substituting the values, d = 30°+ 75°– 60°= 45°

The angle of deviation produced d = 45°

8) What type of lens is formed by a bubble inside water?

Answer : Concave Lens:

1. It is a lens that diverges a light beam that falls on it.
2. It has at least one surface that is curved inside.

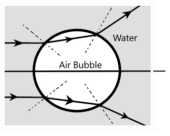


Air Bubble:

1. These are circular spheres made up of thin water films and contain air.
2. The surface of an air bubble in water bulges outwards due to the air pressure inside the bubble.

How does an air bubble act like a concave lens:

1. The refractive index of water is greater than that of air, $\eta_{water} > \eta_{air}$. This implies that, water is a denser medium than air.
2. Let us consider that a light ray passes through water and enters an air bubble. So, the light ray enters from a denser to rarer medium. So, a ray diagram can be drawn as given below.
3. The ray of light entering the air bubble will diverge, since the ray of light entering from a denser to rarer medium bends away from the normal.
4. Hence, it behaves like a concave lens.



Hence, the air bubble inside water behaves like a concave lens.

9) State Snell's law/law of refraction.

Answer : (i) The incident ray, refracted ray and normal to the refracting surface are all coplanar (ie. lie in the same plane).

(ii) The ratio of sine of angle of incident i in the first medium to the sine of angle of refraction 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.

$\frac{sin\, i}{sin\, r} = \frac{n_2}{n_1} (Snell's\ law)$

$n_1 \sin i = n_2 \sin r$

10) A point object is placed at 20 cm from a thin plano-convex lens of focal length 15 cm whose plane surface is silvered. Locate the position and nature of the final image.

Answer : u =- 20 cm, Focal length of the plano-convex lens =-15 cm

Therefore, the focal length of the bi convex lens of the same material = $\frac{15}{2} cm$

Since one surface is silvered, now we can use the mirror equation.

$ie, \frac{1}{f} = \frac{1}{v} + \frac{1}{u} (or) \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

Here, u is negative and f is also negative.

$Therefore, \frac{1}{v} = \frac{2}{-15} - \frac{1}{-20}$

$\frac{1}{20} - \frac{2}{15} = \frac{3-8}{60} = \frac{-5}{60}$

$\frac{1}{v} = \frac{1}{-12}$ (or) v = - 12 cm

11) Why does sky look blue and clouds look white?

Answer : Sky appears blue :

when white light from the sun enters the earth's atmosphere scattering takes place.

According to Ray light's scattering

Law, $S\alpha \frac{1}{\lambda_4}$

12) Is there any difference between coloured light obtained from prism and colours of soap bubble?

Answer : Yes, there is a difference between coloured light obtained from prism and soap bubble Dispenion takes place in prism. Interference takes place in soap bubbles.

13) A small disc is placed in the path-of the light from distance source. Will the center of the shadow be bright or dark?

Answer : The centre of the shadow will be bright.

14) Define radius of curvature.

Answer : The radius of the sphere of which the spherical mirror is a part is called the radius of curvature (R) of the mirror.

15) What is simultaneous reflection?

Answer : 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.

16) What is total internal reflection?

Answer : The entire light is reflected back into the denser medium itself. This phenomenon is called total internal reflection.

17) (i) Explain briefly how the focal length of a convex lens changes with increase in wavelength of incident light.
(ii) What happens to the focal length of convex lens when it is immersed in water ? Refractive index of the material of lens is greater than that of water.

Answer : (i) Focal length increases with increase of wavelength. $\frac{1}{f}\left(\frac{\mu_2}{\mu_1}-1\right)$ as wavelength increases $\frac{\mu_2}{\mu_1}$ decreases hence focal length increases.

(ii) As μ_1 increase focal length increases. $\frac{1}{f}\left(\frac{\mu_2}{\mu_1}-2\right)\frac{2}{R}$

18) How does the angular separation between fringes in single-slit diffraction experiment change when the distance of separation between the slit and screen is doubled?

Answer : Angular separation is $\theta=\frac{\beta}{D}=\frac{D\frac{\lambda}{d}}{D}=\frac{\lambda}{d}$

Since θ is independent of D, angular separation would remain same.

19) What are corpuscles?

Answer : Light is emitted as tiny, massless and perfectly elastic particles are called corpuscles.

20) What are paraxial rays and marginal rays?

Answer : (i) The paraxial rays are the rays which travel very close to the principal axis and make small angles with it.
(ii) The marginal rays are the rays which travel far away from the principal axis and make large angles with it.