Answer on Question 51837, Physics, Optics

6. Which of the following is not true of experiments involving curved mirrors?

a) image distance is negative for real image

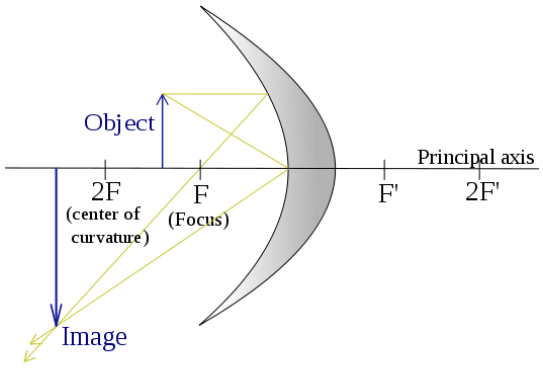
b) object distance is positive

c) image distance is negative for virtual image

d) focal length is negative for convex mirrors

Answer:

The image on the convex mirror is always virtual, thus the focal length is negative for convex mirrors. For both types of curved mirrors (convex and concave) the object distance is positive and the image distance is negative for virtual image. The concave mirrors shows different images types depending on the distance between the object and the mirror. For example, when object between focus and centre of curvature the image is real, inverted and magnified. But the image distance is positive for real image, not negative.



Thus, the answer is a) image distance is negative for real image

7. An estimate of the refractive index of glass is 1.5. If the angle of incidence is 30° the angle of refraction is:

a) 19°

b) 60°

c) 35°

d) 70°

Solution:

According to the Snell's law we have:

$$n_i sin\theta_i = n_r sin\theta_r,$$

where n_i is the refractive index of air ($n_i = 1$), n_r is the refractive index of glass ($n_r = 1.5$), θ_i is the angle of incidence, θ_r is the angle of refraction.

Then, we can find the angle of refraction:

$$sin\theta_r = \frac{n_i}{n_r} sin\theta_i = \frac{1}{1.5} \cdot sin30^{\circ} = 0.33,$$

$$\theta_r = arcsin(0.33) = 19.26^{\circ} \sim 19^{\circ}.$$

Answer: a) 19°

8. The critical angle for total internal reflection at an air-water interface is approximately 48°. In which of the following situations will total internal reflection occur?

a) light incident in water at 40°

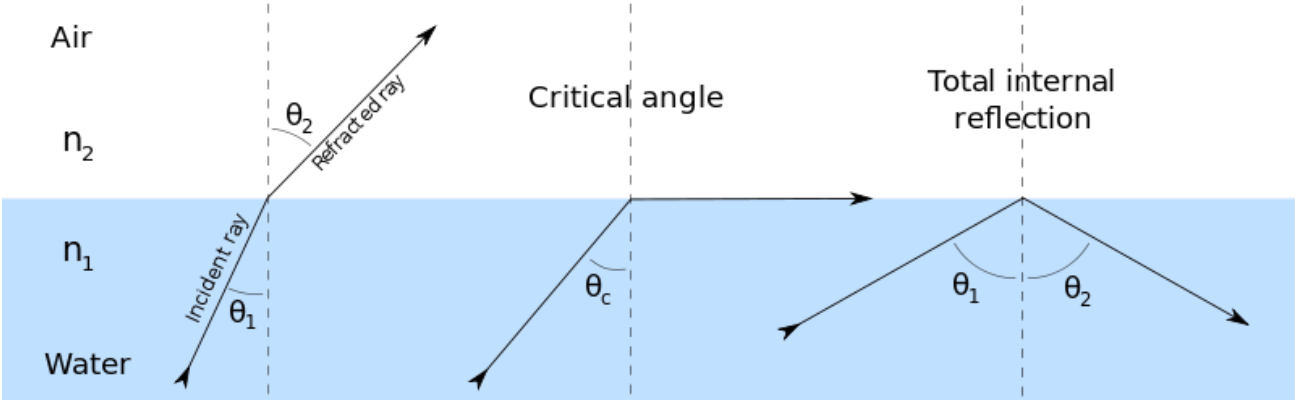
b) light incident in water at 55°

c) light incident in air at 40°

d) light incident in air at 55°

Solution:

The total internal reflection occurs when light attempts to move from a medium having a given refractive index to a medium having a lover refractive index (in our case from water with $n_1 = 1.33$ to air with $n_2 = 1.0$).



As we can see in the picture for $\theta_1 > \theta_c$ there is no reflected ray. Thus, in order to occur the total internal reflection we need b) light incident in water at 55°.

Answer: b) light incident in water at 55°.

9. When refraction occurs which of the following remains unchanged?

a) wave number

b) wavelength

c) velocity

d) frequency

Answer:

The law of refraction follows directly from the fact that the speed v with which light propagates through a medium is inversely proportional to the refractive index of the medium:

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

where, c is the speed of light in a vacuum, n is the refractive index of the medium.

Then, from the Snell's law we get:

$$\frac{sin\theta_1}{sin\theta_2} = \frac{v_1}{v_2} = \frac{n_2}{n_1}.$$

So, while the speed of the light changes when it passes into the new medium the frequency of the light f remains the same (unchanged). Because, $v = c\lambda$ for all waves, where λ is the wavelength, it follows that the wavelenght of light must also change as it crosses an interface between two different media. Therefore, the answer is d) frequency.

10. Which of these may not be a useful apparatus in an optical experiment?

a) Optical pins

b) Lenses

c) Protractor

d) Crocodile clip

Answer:

We may use optical pins in an optical experiment to illustrate the law of reflection, for example. Also, we can use lenses and protractor. With the help of protractor we can measure the angle of the reflected ray. Thus, the crocodile clip is not useful in an optical experiment and the correct answer is d) Crocodile clip.