Quiz Average 6.0 **Quiz High Score** 8

PH 221 **Quiz # 09 (10 pts)** **Name** Solution

The speed of light in a vacuum is $(c = 2.998 \times 10^8\ {}^{m}/_{s})$. The speed of light for an unknown material is found to be $(v = 6.872 \times 10^7\ {}^{m}/_{s})$. What is the index of refraction for this unknown material?

A. 0.2290 **B.** 19.04 **C.** 0.4360 **D.** **4.363**

$$n = \frac{c}{v} = \frac{2.998\ x\ 10^8\ {}^{m}/_{s}}{6.872\ x\ 10^7\ {}^{m}/_{s}} = 4.363$$

So, the correct answer is D !

A child stands $7.50\ \mathrm{m}$ away from a flat mirror. Which of the following best describes what the child sees when she is looking at the mirror?

A. An Upright image located $7.50\ \mathrm{m}$ behind the mirror.

B. An Inverted image located $7.50\ \mathrm{m}$ behind the mirror.

C. An Upright image located $3.75\ \mathrm{m}$ behind the mirror.

D. An Inverted image located $3.75\ \mathrm{m}$ behind the mirror.

The image forms behind the mirror since the law of reflection holds. The image is virtual since the light rays do not really come to a focus behind the mirror but only appear to form there. If you were behind the mirror, you would not see the image. So, it is virtual. Therefore, it is Upright! Plane mirrors produce images the same size as the object was in relation to the mirror. Therefore, the image is as far behind the mirror as the object is in front of the mirror.

So, the correct answer is A !

An object is located a distance of $(12.0\ \text{cm})$ to the left of a concave mirror which has a focal length of $(30.0\ \text{cm})$. Where is the image of the object formed by the mirror?

A. 8.57 cm to the left of the mirror

C. **20.0 cm to the right of the mirror**

B. 20.0 cm to the left of the mirror

D. 8.57 cm to the right of the mirror

$$\frac{1}{i} = \frac{1}{f} - \frac{1}{o} = \frac{1}{30.0\ cm} - \frac{1}{12.0\ cm} = \frac{2-5}{60.0\ cm} = \frac{-3}{60.0\ cm} = \frac{-1}{20.0\ cm}$$

$$i = -20.0\ cm$$

Minus sign indicates virtual image so on back side of mirror or to the right of the mirror.

So, the correct answer is C !

Han Solo is encased in carbonite which has an index of refraction of $(\text{n}_{\text{Carb}} = 2.762)$. How far away does Han think Luke is from him when Luke is actually a distance $(0.698\ \text{m})$ away from the surface of the carbonite? Assume the index of refraction of air is $(\text{n}_{\text{Air}} = 1.000)$ as usual. Also assume the edge of the carbonite is a flat surface perpendicular to the line between Han and Luke.

A. 0.253 m **B.** **1.93 m** **C.** 0.698 m **D.** 3.98 m

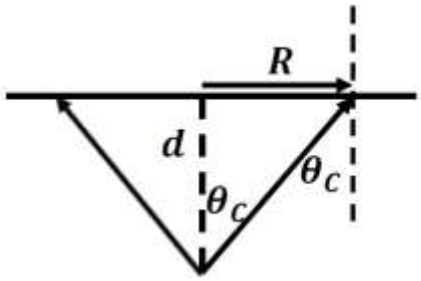
$$\frac{n_o}{o} + \frac{n_i}{i} = \frac{n_i - n_o}{R} = \frac{n_i - n_o}{\infty} = 0$$

$$i = -o\frac{n_i}{n_o} = -(0.698\ m)\left(\frac{2.762}{1.000}\right) = -(0.698\ m)(2.762) = -1.93\ m$$

So, the correct answer is B !

A water tight spotlight is located a distance $(\mathrm{d} = 3.00\ \mathrm{m})$ below the surface of a pool of water. The index of refraction for air is $(\mathrm{n_{air}} = 1.000)$ and the index of refraction for the water is $(\mathrm{n_{water}} = 1.333)$. Looking from above a bright circle of light can be seen due to the spotlight. What is the radius of this circle?

A. 1.98 m **B.** 2.25 m **C.** **3.40 m** **D.** 2.64 m



The critical angle where the refracted ray going from water to air is $90°$ can be found from Snell's law

$$n_{water}\, sin(\theta_C) = n_{air}\, sin(90°) = (1.000)(1)$$

$$\theta_C = sin^{-1}\left(\frac{1}{n_{water}}\right) = sin^{-1}\left(\frac{1}{1.333}\right) = 48.6°$$

$$tan(\theta_C) = \frac{R}{d}$$

$$R = d\, tan(\theta_C) = (3.00\ m)\, tan(48.6°) = 3.40\ m$$

So, the correct answer is C !

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