PS #10 = KEY =

Welcome to the homework page test1. If this isn't you then please go back to the homework login page.

You may log out and return later if you wish without losing any saved data. You will have **TEN** attempts for each assigned problem. Every unsuccessful attempt will lower that part of the problem's value by 5%.

*For example*, if you get it right on the first try, then you will receive 100% for that problem. If you are twice incorrect and submit the correct on the third try, then you will receive a 90% for that part of the problem. You will not recieve any points for that part of the problem after 10 attempts.

You do not have to answer all the problems during a single session or in any particular order. To answer a problem simply type the numerical value in the box provided, check the box to the right of the part(s) you want to answer, and then click the submit button. You can freely log in and out of the homework page without losing any submitted information so feel free to take breaks if necessary.

LET'S BEGIN!

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## Problem #1

$\lambda = 632.8 \times 10^{-9}$

$\lambda f = c \qquad f = c/\lambda$

The wavelength of a red helium-neon laser beam in air is 632.8nm. (a) What is the frequency? (b) What is its wavelength in glass that has an index of refraction of 1.50?

$f = 3\times10^8 / 632.8\times10^{-9} = 4.74\times10^{14}$ Hz

$1\ \text{THz} = 10^{12}$ Hz

(a) 474 THz ☑ Answer part (a)

(b) 421.9 nm ☑ Answer part (b)

$\lambda_m = \frac{\lambda_0}{n} = \frac{632.8\text{ nm}}{1.5} = 421.9\text{ nm}$

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

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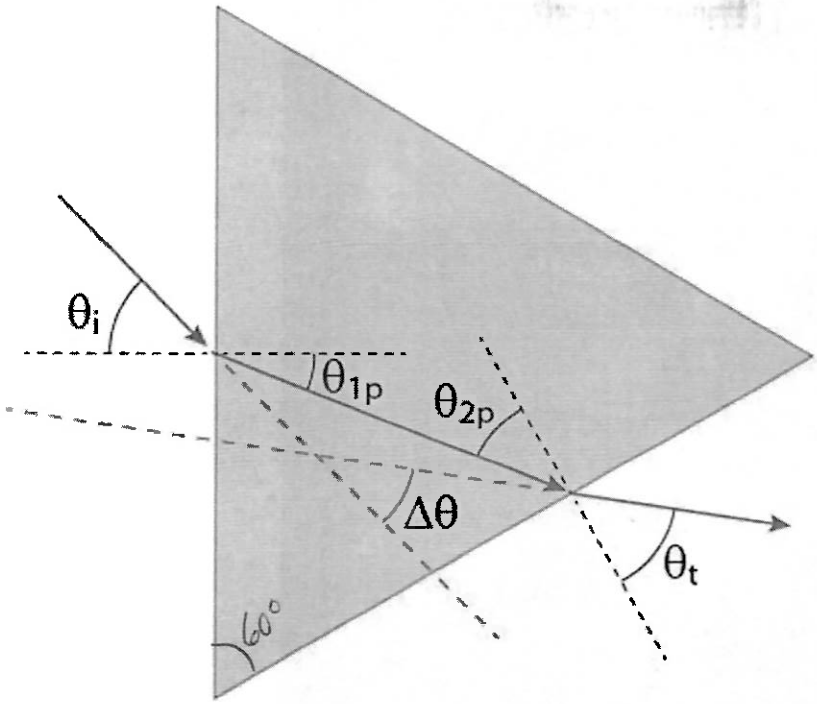
# Problem #2




$n_1 \sin\theta_1 = n_2 \sin\theta_2$

Light of wavelength 640nm in air is incident on the face of a large prism (n = 1.59 at this frequency) at an incident angle of $\theta_i = 44.0^o$. The apex angle of the prism is $60.0^o$. What is (a) the angle of refraction $\theta_{1p}$, (b) the angle of incidence at the second surface $\theta_{2p}$, (c) the angle of refraction at the second surface $\theta_t$, (d) and the acute angle between the incident and emerging rays $\Delta\theta$?

(a) 25.9 o ☑ Answer part (a)

(b) 34.1 o ☑ Answer part (b)

(c) 63.0 o ☑ Answer part (c)

(d) 47.05 o ☑ Answer part (d)

Submit

a) $1\sin 44 = 1.59 \sin\theta_{1p} \Rightarrow \theta_{1p} = 25.9^o$

b) GEOMETRY: $90 - \theta_{1p}$, $90 - \theta_{2p}$, $60$ (3 INTERIOR ANGLES OF APICAL TRIANGLE)

$\Sigma = 180 \Rightarrow \theta_{1p} + \theta_{2p} = 60$

$\theta_{2p} = 34.1^o$

c) $1\sin\theta_t = 1.59 \sin\theta_{2p}$

$\Rightarrow \theta_t = 63.05^o$

d) $\Delta\theta = (\theta_i - \theta_{1p}) + (\theta_t - \theta_{2p})$

$= \theta_i + \theta_t - 60$

$= 44.0 + 63.05 - 60 = 47.05$

Attempted part (a) 0 times, part (b) 0 times, part (c) 0 times, and part (d) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

There have been no attempts to answer part (c)

There have been no attempts to answer part (d)

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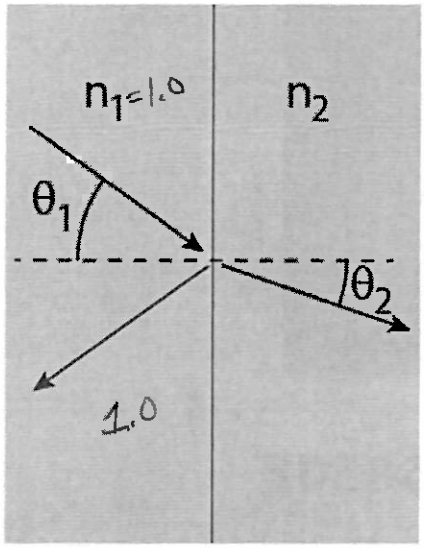
# Problem #3




a) $n_2 = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} = 1.27 + \frac{5.32\times10^4}{(570)^2} + \frac{3.3\times10^8}{(570)^4}$

$n_2 = 1.437$

b) $\theta_B = \tan^{-1}\left(\frac{n_2}{n_1}\right) = \tan^{-1}\left(\frac{1.437}{1.0}\right)$

$\theta_B = 55.2^\circ$

Often times the index of refraction can be represented by a Cauchy model when below the resonant frequency, $n(\lambda) = A + B/\lambda^2 + C/\lambda^4$. The first material is air with a refractive index of $n_1 = 1.00$ and the refractive index of the second material shown in the above diagram is given by the Cauchy model with A = 1.27, B = $5.32\times10^4 nm^2$, and C = $3.30\times10^8 nm^4$. A laser beam with a peak wavelength of $\lambda$ = 570nm is incident at the material interface. (a) What is the refractive index of the second material? (b) At what angle does the p-polarization exhibit perfect transmission through the interface (Brewester's angle)?

(a) 1.437 ✓ Answer part (a)

(b) 55.2 ° ✓ Answer part (b)

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

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# Problem #4

Suppose there is light traveling down a communications grade optical fiber with an index of refraction of 1.53. (a) What is the critical angle for light to stay inside the fiber when surrounded by air? (b) If the fiber is submerged in water (n = 1.33), what is the critical angle?

(a) 40.8 ° ☑ Answer part (a)

(b) 60.37 ° ☐ Answer part (b)

Submit

a) $\sin\theta_c = \frac{1}{n} = \frac{1}{1.53}$

$\theta_c = 40.8°$

b) $\sin\theta_c = \frac{n_w}{n} = \frac{1.33}{1.53}$

$\theta_c = 60.37$

STEEPER INCIDENCE ANGLE MEANS MORE OF A GRAZING ANGLE TO INTERFACIAL PLANE

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

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# Problem #5

$f = R/2 = 12.0\,cm$

$R =$

A concave spherical mirror has a radius of curvature of magnitude 24.0cm. What is the distance from the object to the mirror for which the resulting image is upright and 2.6 times larger that the object as viewed from the object's position?

NOTE SIGN!

$\frac{h_i}{h_o} = 2.6 = \frac{d_i}{d_o}$

$\Rightarrow d_i = 2.6\, d_o$

7.38 cm ☑ Answer the question

Submit

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{12} = \left(1 + \frac{1}{-2.6}\right)\frac{1}{d_o}$

$d_o = 7.38$

Attempted the problem 0 times.

There have been no attempts to answer the problem

# Problem #6

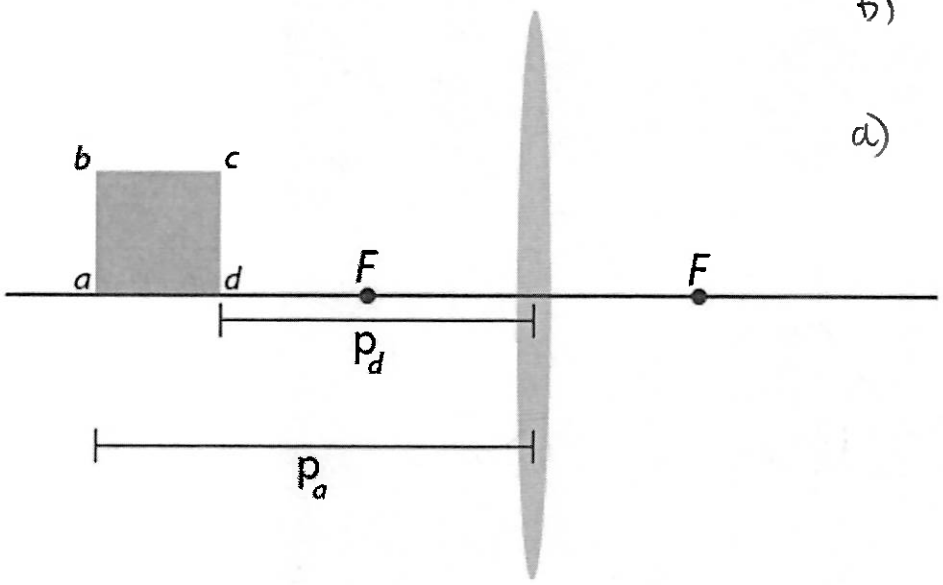
$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

So b) $\frac{1}{f} = \frac{1}{p_d} + \frac{1}{q_d}$

$q_d = 37\text{cm}$

a) $\frac{1}{f} = \frac{1}{p_a} + \frac{1}{q_a}$

$q_a = 22.4\text{ cm}$




In the above figure, a thin converging lens of focal length 13.0cm forms an image of the square *abcd*, which has a height $h_c = h_b = 11.0$cm. The square lies between the distances $p_d = 20.0$cm and $p_a = 31.0$cm from the lens. Here *a'*, *b'*, *c'*, and *d'* represent the respective corners of the image. Let $q_a$ represent the image distance for points *a'* and *b'*, $q_d$ represent the image distance for points *c'* and *d'*, $h'_b$ represent the height of the image at *b'*, and $h'_c$ represent the height of the image at *c'*. Find (a) $q_a$ , (b) $q_d$ , (c) $h'_b$ , and (d) $h'_c$.

(a) 22.4 cm ✓ Answer part (a)

(b) 37 cm ✓ Answer part (b)

(c) 7.95 cm ✓ Answer part (c)

(d) 20.35 cm ✓ Answer part (d)

c) $\frac{h_b'}{h_b} = \frac{q_a'}{p_a} = \frac{22.4}{31.0}$

($h_b = 11$) $h_b' = 7.95\text{cm}$

d) $\frac{h_c'}{h_c (= 11)} = \frac{q_d}{p_d} = \frac{37}{20}$

$h_c' = \frac{37}{20} \cdot 11 = 20.35$

Submit

Attempted part (a) 0 times, part (b) 0 times, part (c) 0 times, and part (d) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

There have been no attempts to answer part (c)

There have been no attempts to answer part (d)

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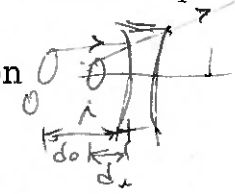
# Problem #7

An object is located 19.0cm from a diverging lens having a focal length of $f$ = -33.0cm. Determine the location of the image. (hint: the position is negative when a virtual image is on the same side of the lens with respect to the object)

44.7 cm ✓ Answer the question



$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$d_i = \frac{1}{\frac{1}{-33} + \frac{1}{19}}$

$d_i = 44.7$ cm

Submit

Attempted the problem 0 times.

There have been no attempts to answer the problem

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# Problem #8

An orthodontist uses a spherical mirror to examine a tooth. The tooth is 1.00cm in front of the mirror, and the image is formed 12.0cm behind the mirror. What is (a) the mirror's radius of curvature and (b) the magnification of the image?

(a) ~~0.923~~ 1.85 cm ✓ Answer part (a)

a) $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{f} = \frac{1}{1} + \frac{1}{12}$

$f = 0.923$

$R/2 = f$

(b) 12 ✓ Answer part (b)

b) $\frac{h_i}{h_o} = \frac{d_i}{d_o} = M$

$M = \frac{12}{1}$

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)