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Physics 1314 Exam 2

Prof. T.E. Coan

Please PRINT your name so that we can READ it.

Name: ______________________________

Useful Formulae and Physical Data

$\mathcal{E} = -N(\Delta\Phi/\Delta t)$	$\Phi = BA$
$V = IR$	$f = R/2$
$1/d_0 + 1/d_i = 1/f$	$M = -d_i/d_0 = h_i/h_o$
$\lambda' = \lambda/n$	$v = c/n$
$n_1 \sin\theta_1 = n_2 \sin\theta_2$	$\sin\theta_{TIR} = n_2/n_1$
$d\sin\theta = m\lambda \quad n = 0, 1, 2\ldots$	$w\sin\theta = n\lambda \quad n = 1, 2\ldots$
$n_{\text{air}} = 1.00$	$n_{\text{water}} = 4/3$
$n_{\text{glass}} = 1.50$	$n_{\text{diamond}} = 2.42$

OPEN BOOK. OPEN NOTE.

5 pts What is the speed v of light in diamond?

- $v = 3.00 \times 10^8\,\mathrm{m/s}$;
- $v = 1.24 \times 10^8\,\mathrm{m/s}$;
- $v = 7.26 \times 10^8\,\mathrm{m/s}$;

5 pts I place a candle exactly at the focal point of a converging lens. Where is the candle's image focused?

- The image is focused at a point twice the focal length away from the lens;
- The image is focused at infinity;
- The image is focused at a point 1/2 of the focal distance away from the lens.

5 pts When I say that light from a particular lamp is "polarized in the vertical plane", what does this mean?

- The electric field $\vec{E}$ is oscillating up and down in the vertical plane;
- The magnetic field $\vec{B}$ is oscillating in the vertical plane;
- The light wave is traveling vertically.

5 pts You shine yellow light ($\lambda = 525$) from your flashlight into a pool of oil , $n_{\text{oil}} = 1.5$. What is the wavelength λ' of the yellow light inside the oil?

- $\lambda' = 350\,\mathrm{nm}$;
- $\lambda' = 788\,\mathrm{nm}$;
- $\lambda' = 525\,\mathrm{nm}$;

5 pts What is the magnification M of a lens that forms an image 0.30 m to the right when an object is places 0.10 m to the left?

- $M = -3.00$;
- $M = -1.30$;
- $M = +2.00$.

5 pts You shine red laser light through a small slit which then travels onto a screen 5 m away from the slit, much like I did in lecture. What do you see on the screen?

- You see a single bright spot and nothing else.;
- You see a broad band of red light;
- You see an alternating sequence of bright and dark spots.

5 pts You look into a polished convex mirror, such as the back of a spoon, only this mirror is larger. What do you see?

- You see a reduced inverted image;
- You see a reduced upright image;
- You see a magnified upright image.

5 pts You change the magnetic flux $\Delta\Phi = 1.0\,\text{T-m}^2$ piercing a coil during period of 2 seconds. The coil has just 2 turns. What is the induced electromotive force $\mathcal{E}$ in the coil? I want the magnitude only.

- $\mathcal{E} = 2.0\,\text{V}$;
- $\mathcal{E} = 1.0\,\text{V}$;
- $\mathcal{E} = 0.5\,\text{V}$;

5 pts A glass lens is placed in a long tube of a liquid that has the *same* index of refraction as the glass. You shoot light rays parallel to the lens axis. What does the lens do to the light rays? Think before you choose.

- The lens refracts the light as if it were in air and the light is focused to a point a focal distance away from the lens.
- The lens does nothing because the index of refraction between the lens and the surrounding medium is the same so that there is no refraction of the light. The light merely passes through the lens without being focused.
- The light rays diverge when they exit the lens. A virtual image is formed.

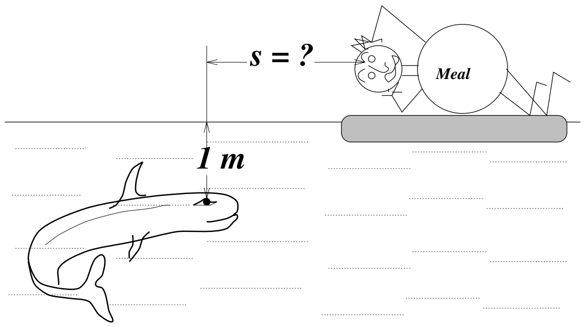
5 pts You shine laser light of wavelength λ_1 through a double slit which then travels onto a screen. You measure the angular position θ_1 of the first order bright spot. You next shine laser of a different wavelength λ_2 through the same double slit and measure the angular position θ_2 of the first order bright spot. You notice that neighboring bright spots have a greater relative separation for the second laser than they do for the first laser. (Symbolically, this means $\theta_2 > \theta_1$.) What can you say about the relative sizes of the wavelengths λ_1 and λ_2?

- $\lambda_2/\lambda_1 > 1$;
- $\lambda_2/\lambda_1 < 1$;
- $\lambda_2/\lambda_1 = 1$;

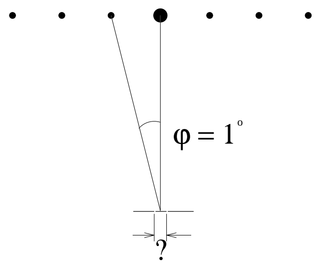
5 pts You are playing with a magnet near a coil of wire. You insert a magnet, N pole first, into the coil with a speed $v = 1\,\mathrm{m/s}$ and somehow measure the induced voltage $\mathcal{E}_1$. You then throw the magnet through the coil, again N pole first, with a speed $v = 2\,\mathrm{m/s}$, producing a voltage $\mathcal{E}_2$. What are the relative magnitudes of $\mathcal{E}_1$ and $\mathcal{E}_2$?

- $\mathcal{E}_1/\mathcal{E}_2 < 1$;
- $\mathcal{E}_1/\mathcal{E}_2 > 1$;
- $\mathcal{E}_1/\mathcal{E}_2 = 1$;

1. **15 total pts.** You are a shark swimming $d = 1\,\mathrm{m}$ beneath the surface of the water. You eye a tourist floating on a raft as your next meal. Assuming the tourist's head is just at the surface of the water, how close s can you come before the tourist will be able to see you? Refer to the diagram. Relevant indices of refraction are on the front sheet. (Hint: Trace the light rays from your nose to the tourist.)



2. **15 total pts.** You shine blue laser light $\lambda = 4.50 \times 10^{-7}$ m through a double slit which diffracts it. You notice that the angular separation between the central bright spot and its closest neighbor is $\theta = 1°$. What is the separation d between the two slits that will produce this pattern?



3. **15 total pts.** You place a diamond a distance $d_1 = 0.10\,\mathrm{m}$ in front of a converging lens. The image is formed a distance $d_2 = 0.30\,\mathrm{m}$ on the other side of the lens. What is the focal length f of the lens? If the radius of the diamond is $r = 0.05\,\mathrm{m}$, what is the radius R' of the diamond's *image*?