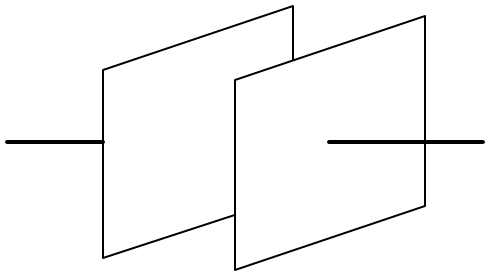
Name _____**Student ID** _____ **Score**_____

last *first*

Part I. [28 points] A parallel-plate capacitor has square plates ***L***=1.4 m on a side. There is a charging current flowing of 1.2 A at the instant we are looking at it.

$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/(Nm^2)$

$\mu_0 = 4p \times 10^{-7}\ N/A^2$



1. [4 points] What is the displacement current through the region between the plates?

   A. 0 A
   B. 0.61 A
   C. 0.86 A
   D. 1.2 A
   E. 2.4 A

2. [5 points] What is dE/dt in this region?

   A. 0.86 N/C-sec
   B. 3.5×10^{10} N/C-sec
   C. 6.9×10^{10} N/C-sec
   D. 1.4×10^{11} N/C-sec
   E. Not enough information

3. [5 points] What is the displacement current through a square region whose sides are L/2, and is center in the middle of the capacitor?

   A. 3.7 x 10-12 A
   B. 0.15 A
   C. 0.30 A
   D. 0.43 A
   E. 0.59 A

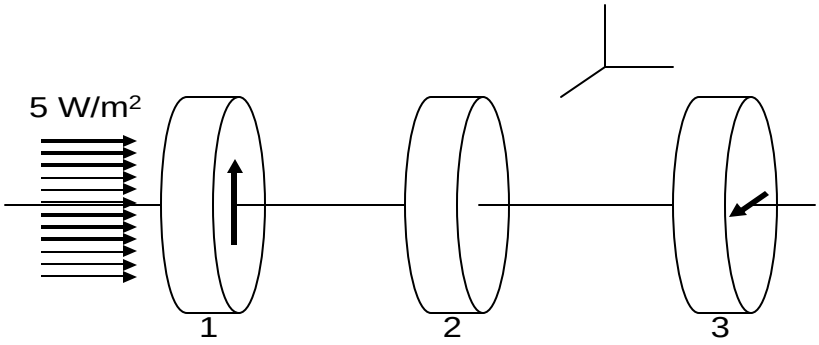
4. [4 points] What is the line integral of the magnetic field around this smaller square?

   A. 0.0 T-m
   B. 1.9×10^{-7} T-m
   C. 3.8×10^{-7} T-m
   D. 5.4×10^{-7} T-m
   E. 7.4×10^{-7} T-m

Name _____**Student ID** _____ **Score**_____

last *first*

Now consider the following three polarizer in series. The first polarizer has its polarization axis aligned along the vertical direction, and the third along the horizontal direction (as shown by the two arrows in the figure below). The middle can be rotated to an arbitrary angle. A parallel ray light source shines from the left with an intensity of $5 W/m^2$.



5. [5 points] To what angle should polarizer 2 be rotated to block all light getting through polarizer 3?

   A. $\pi/2$
   B. $\pi/4$
   C. $\pi/6$
   D. $\pi/8$
   E. No angle is possible

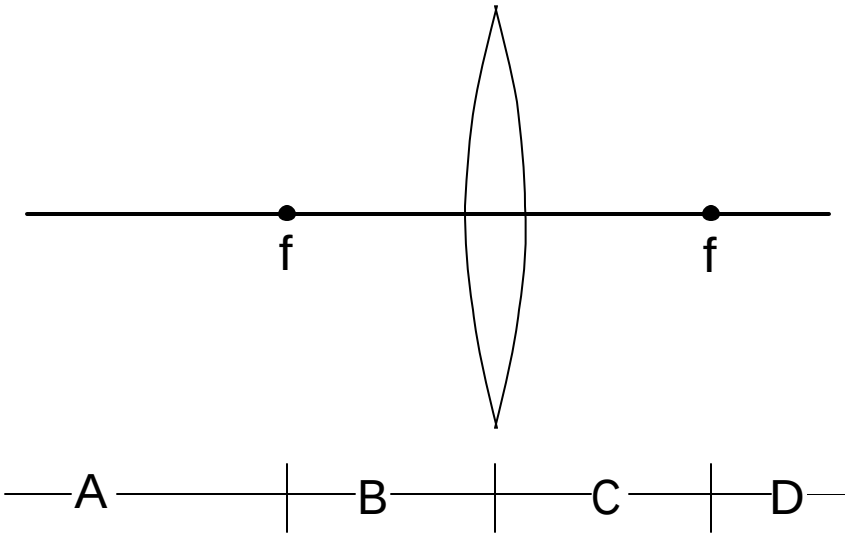
6. [5 points] To what angle should polarizer 2 be rotated to allow light of intensity $0.625 W/m^2$ to shine through polarizer 3?

   A. $\pi/2$
   B. $\pi/4$
   C. $\pi/6$
   D. π
   E. No angle

Name _____**Student ID** _____ **Score**_____

last *first*

Part II. [27 points] Consider the following simple lens with its focal points as shown.



7. [4 Points] In what region should we place an object to make a real image on the right side of the lens?
   - **A.** Region A
   - **B.** Region B
   - **C.** Region C
   - **D.** Region D
   - **E.** Not enough information

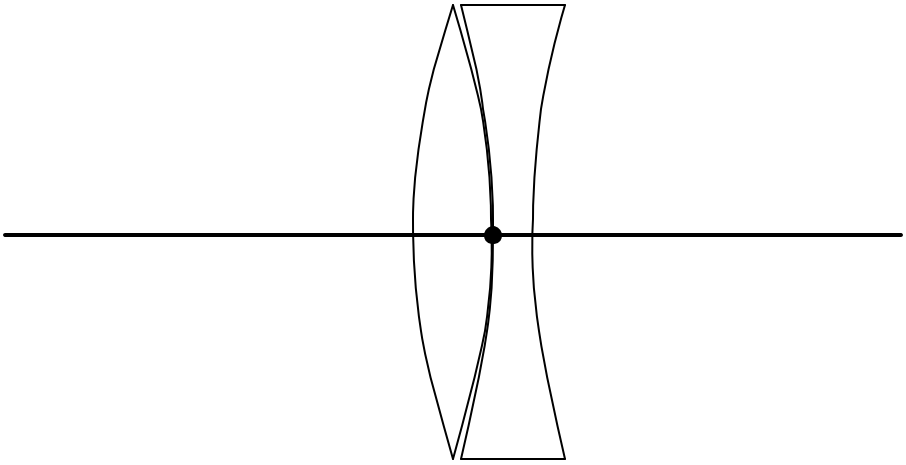
8. [4 Points] In what region should we place an object to make a virtual image on the right side of the lens?
   - **A.** Region A
   - **B.** Region B
   - **C.** Region C
   - **D.** Region D
   - **E.** Not enough information.

9. [4 Points] If I place an object in Region B, in what region will the resulting image appear?
   - **A.** Region A or B
   - **B.** Region C or D
   - **C.** Region A or C
   - **D.** Region B or D
   - **E.** Region B or C.

Name _____**Student ID** _____ **Score**_____

last *first*

Consider the following convex-concave compound thin lens for the next part of this question. The focal length of the convex lens is 16 cm; the concave lens is 30 cm.



10. [5 Points] Is the magnification of this combination of a convex and concave lens greater or less than or equal to that of just the convex lens alone?

    A. Greater Than
    B. Less Than
    C. The Same As
    D. Not Enough Information

11. [5 Points] If an object is located more than 40 cm to the left of the lens combination, then its image is

    A. Inverted and real
    B. Inverted and virtual
    C. Right side up and real
    D. Right side up and virtual
    E. Not enough information to tell

12. [5 Points] An object is placed 32 cm away from the central point on the right hand side of the lens, calculate the image distance to the central point.

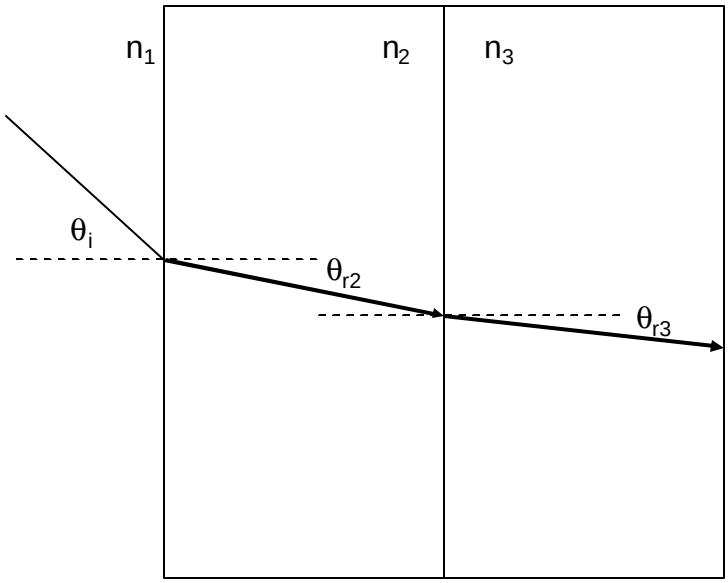
    A. 2.00 cm
    B. 10.4 cm
    C. 15.5 cm
    D. 32.0 cm
    E. 480 cm

Name _____**Student ID** _____ **Score**_____

last *first*

Part III. [25 Points] A light ray travels through three materials with indices of refraction n_1=1.5, n_2=1.7, and n_3=1.2.

13. [10 Points] If θ_i is 20 degrees, calculate θ_{r2} and θ_{r3}.



14. [10 Points] What minimum value θ_i will cause total internal reflection at the n_2-n_3 interface? If total internal reflection can't occur under any circumstances, please explain.

15. [5 Points] Will total internal reflection at the n_2-n_3 interface occur if it were the case that $n_1 > n_2 > n_3$? Please explain.