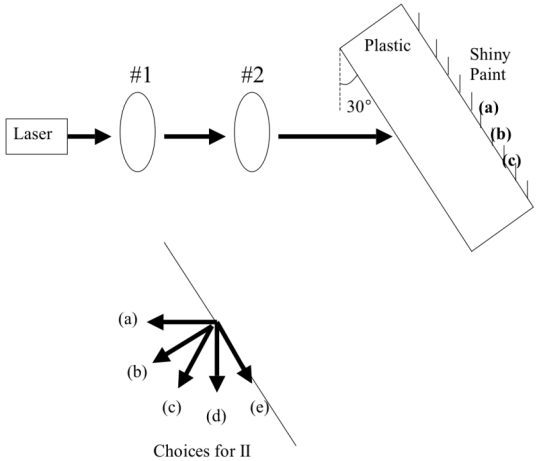
Physics 8B – Summer 2014 – Midterm 2

Correct Answers without supporting work or justification will receive NO CREDIT, except Mult. Choice

1. (20 pts)



Choices for II

A laser emits vertically (i.e. up and down in the plane of the page) polarized light in a beam of diameter, d, in direction shown. It passes through two polarizers whose transmission axes are 30° apart. The beam emerging from polarizer #2 is found to have a magnetic field that oscillates vertically (i.e. up and down in the plane of the page) with amplitude B_{max}.

a) (2 pts) What is the amplitude of the electric field emerging from polarizer #2?
b) (2 pts) What is the intensity of the wave emerging from polarizer #2?
c) (4 pts) What are the orientations of the two polarizers as measured from the vertical axis? Explain how you know.
d) (8 pts) What is the power of the laser?
e) **MULT. CHOICE – (2 pts each) - NO PARTIAL CREDIT**

The light emerging from polarizer #2 hits a cheap mirror like you used in lab. Cheap mirrors are a slab of plastic with a shiny paint on the back side as shown.

I. At which point on the shiny paint will the beam hit (see figure) (a , b , c , or d = need to know value of $n_{plastic}$.)

II. When the light re-emerges into the air, which direction will it be traveling? (see choices…I've shown the surface of the plastic as a reference) (a , b , c , d , e , or f = need to know value of $n_{plastic}$.)

Possibly useful trig:

$\cos(30°) = \sqrt{3}/2$, $\cos(45°) = \sqrt{2}/2$, $\cos(60°) = 1/2$

$\sin(30°) = 1/2$, $\sin(45°) = \sqrt{2}/2$, $\sin(60°) = \sqrt{3}/2$

2. (30 pts)

You may recall from class that in doing lens and mirror demos, I would often have to play around with the positions of the devices to get the image to clearly form on the wall. Let's see if you can do any better.

You have a converging mirror with radius of curvature |r| = 20 cm located at x = 0 cm. There is a wall at x = 100 cm. You have a 4 cm tall candle. Your mission (should you choose to accept it) is to get the light which bounces off the mirror to pass through a lens and form an image of the candle on the wall.

a) (2 pts) What is the focal length of the mirror? Include sign.

Parts b), c) d) ... you place the candle in front of the mirror at x = 15 cm

b) (3 pts) At what x-location does the mirror form an image of the candle?
c) (5 pts) What focal length lens should you place at x = 50 cm so that a clear image of the candle forms on the wall?
d) (7 pts) Using qualitatively accurate ray tracing diagrams, show that your answers to part b) & c) do what you want (i.e. forms an image on the wall). Is the image on the wall real or virtual? Explain (based on your diagram) how you know.

HINT: For clarity and more chance at partial credit, use multiple diagrams as necessary and don't make them little tiny diagrams.

Parts e), f) ... you place the candle in front of the mirror at x = 12 cm

e) (8 pts) What focal length lens can you place at x = 50 cm so that a clear image of the candle forms on the wall?
f) (5 pts) What is the height of the image on the wall? Is it same orientation or inverted compared to the original candle?