Physics 116b Test 4a November 13, 2008

Name: Correction & Key Seat/Row: 3 or 4 / H

This is a 75 minute, closed book examination. Put answers in the boxes provided (if any). If numerical answers are needed, you must include units. Any work needed to justify the answer must be shown in the space provided, or as indicated on a separate piece of paper or elsewhere on the test. A correct answer without the necessary justifying work may not receive any credit. **DO NOT** tear the formula sheet off the back of the exam.

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You must do all the problems on this test.

Problem	Description	Max Score	Score
1	Short Ans	20	
2	EM waves, Polarization	10	
3	Lenses, Mirrors	10	
Total		40	

1) Short Answer (Show Your Work!)

a) One of the reasons diamond is so desirable is because the high index of refraction of diamond causes lots of internal reflections. The diamond appears to sparkle! If the critical angle for diamond is about 24 degrees, what is the index of refraction of diamond? (3 pts)

I) 0.91
II) 23.8
III) 1.09
IV) 0.41
V) 2.45

see test 4
for all ans not here

b) If you built 2 identically shaped converging lenses, but you made one out of flint glass (n=1.66) and you made the other out of crown glass (n=1.52), which one has the longest focal length? (explain) (2 pts)

c) A diffraction grating has 2000 lines/cm. Light of wavelength 560nm is incident perpendicular to the plane of the grating. At what angle is the 2nd order maxima found? (3 pts)

I) 34.1 degrees
II) 16.2 degrees
III) 6.4 degrees
IV) 12.9 degrees
V) 0.128 degrees

1) Short Answer cont'd (Show Your Work!)

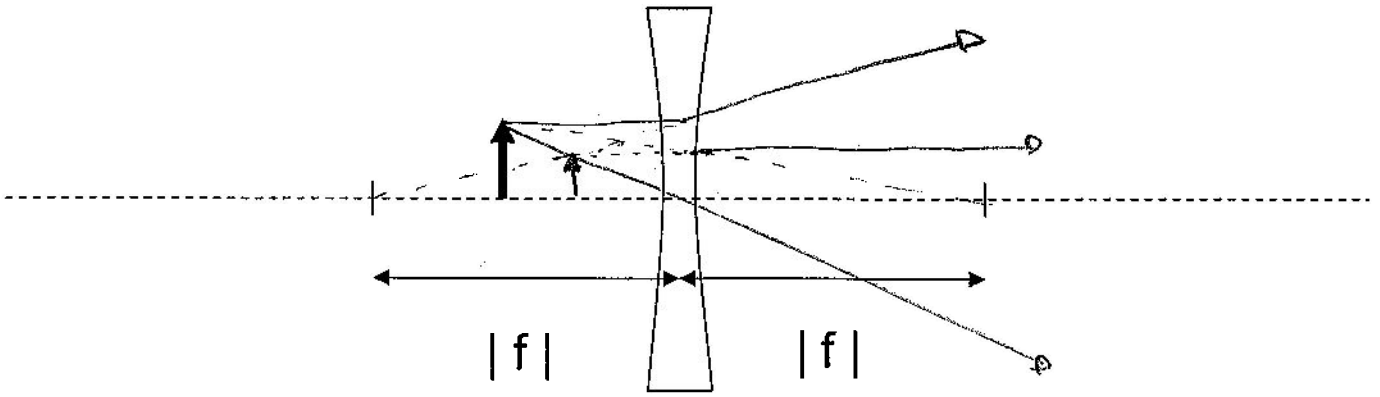
d) What is the separation between 2 slits if the first minima is found at an angle of 2.3 degrees when light is incident normally on 2 slits and a diffraction / interference pattern forms? Assume the wavelength of the laser you used was 632.8 nm and that the actual width of each silt is irrelevant. (3 pts)

I) 7.9 μm
II) 23.7 μm
III) 0.32 μm
IV) 31.5 μm
V) 15.8 μm

e) About how thick does the wall of a soap bubble need to be in order for you to see a bright spot if 550 nm light is incident normally on the soap bubble? (Assume the soap bubble is mostly water with n=1.33) (3 pts)

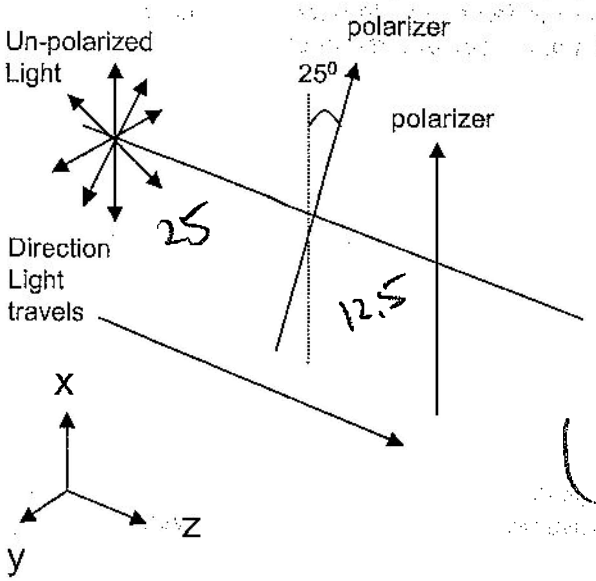
I) 414 nm
II) 275 nm
III) 103 nm
IV) 206 nm
~~V) 103 nm~~ 138 nm

f) Find the image for the object in air and plastic lens shown below using graphical methods (ray tracing) (4 pts.) Is the image real or virtual? (2 pts)



2) Polarization (Show your work!)

Un-polarized light is incident upon 2 polarizers. These polarizers have their polarizing axes oriented at 25 degrees relative to each other (as shown below). If the incident light has an average intensity of I = 25 W/m^2, what is the average intensity of the transmitted light? (Light is moving in the z direction as shown.)



Transmitted I = $10.27\ W/m^2$ (5 pts)

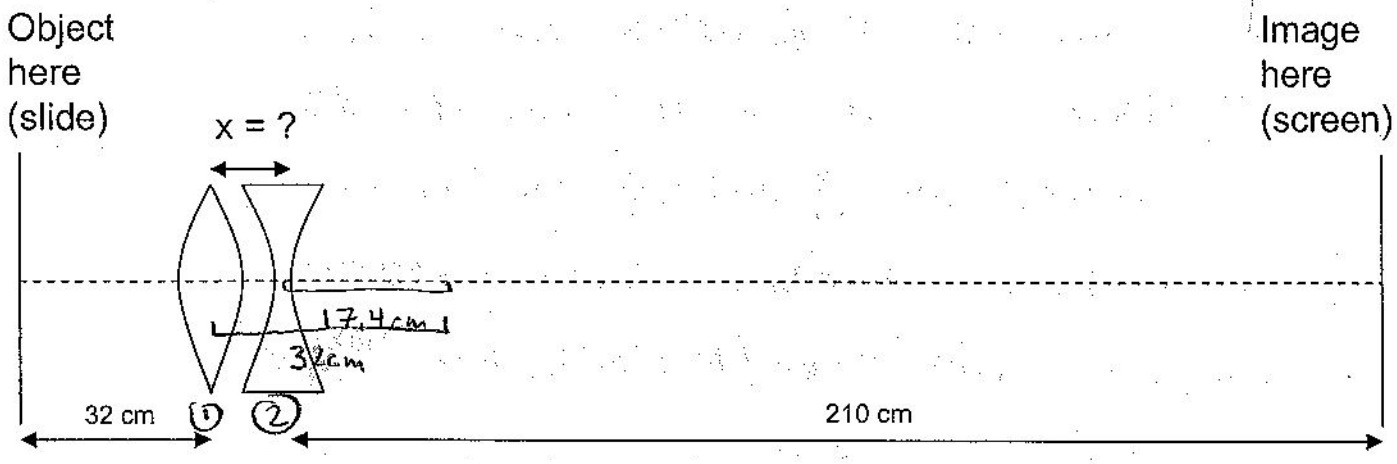
$$\left(12.5\frac{W}{m^2}\right)(\cos^2 25^\circ) = 10.27\ W/m^2$$

Describe quantitatively (with an equation for a traveling wave) the Electric field portion of the transmitted light as a single traveling wave. (Assume the wave travels at a speed of c and has a wavelength of 600nm.) (5pts)

$$\vec{E}(position,time) = 88.0\ N/C\ \hat{x}\ \sin\left(1.05\times10^{7}\frac{\pi}{m} - 3.14\times10^{15}\frac{t}{s}\right)$$

3) Lenses (Show your work!)

An overhead projector is being made with a diverging and a converging lens as shown in the figure below. The |focal length| of the converging lens is |f|= 16 cm, and the |focal length| of the diverging lens is |f|= 19 cm. If the distance from the slide to the first lens is 32cm, and the distance from the second lens to the screen is 210cm, what must the separation, x, between the 2 lenses be in order to make this design work? (5 pts.) What is the overall magnification of the system? (5 pts) (Do not change the 32 cm or the 210 cm, just x!)



$s_1' = 32\text{cm}$

$s_2 = \left(-\frac{1}{19\text{cm}} - \frac{1}{210\text{cm}}\right)^{-1} = -17.4\text{cm}$

want s_1' & s_2' @ same pt

$x = 14.58\text{cm}$

$x = 14.6\text{cm}$

Overall M = -12.1

$M = \left(-\frac{32\text{cm}}{32\text{cm}}\right)\left(-\frac{210\text{cm}}{-17.4\text{cm}}\right) = -12.1$

Physics 116b Test 4b November 13, 2008

Name:_____

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Problem	Description	Max Score	Score
1	Short Ans	20	
2	EM waves, Polarization	10	
3	Lenses, Mirrors	10	
Total		40	

1) Short Answer (Show Your Work!)

a) One of the reasons diamond is so desirable is because the high index of refraction of diamond causes lots of internal reflections. The diamond appears to sparkle! If the critical angle for diamond is about 24 degrees, what is the index of refraction of diamond? (3 pts)

I) 23.8
II) 2.45
III) 1.09
IV) 0.914
V) 0.407

b) If you built 2 identically shaped converging lenses, but you made one out of crown glass (n=1.52) and you made the other out of flint glass (n=1.66), which one has the longest focal length? (explain) (2 pts)

less bending

c) A diffraction grating has 2000 lines/cm. Light of wavelength 560nm is incident perpendicular to the plane of the grating. At what angle is the 2nd order maxima found? (3 pts)

I) 0.128 degrees
II) 6.4 degrees
III) 12.9 degrees
IV) 16.2 degrees
V) 34.1 degrees

1) Short Answer cont'd (Show Your Work!)

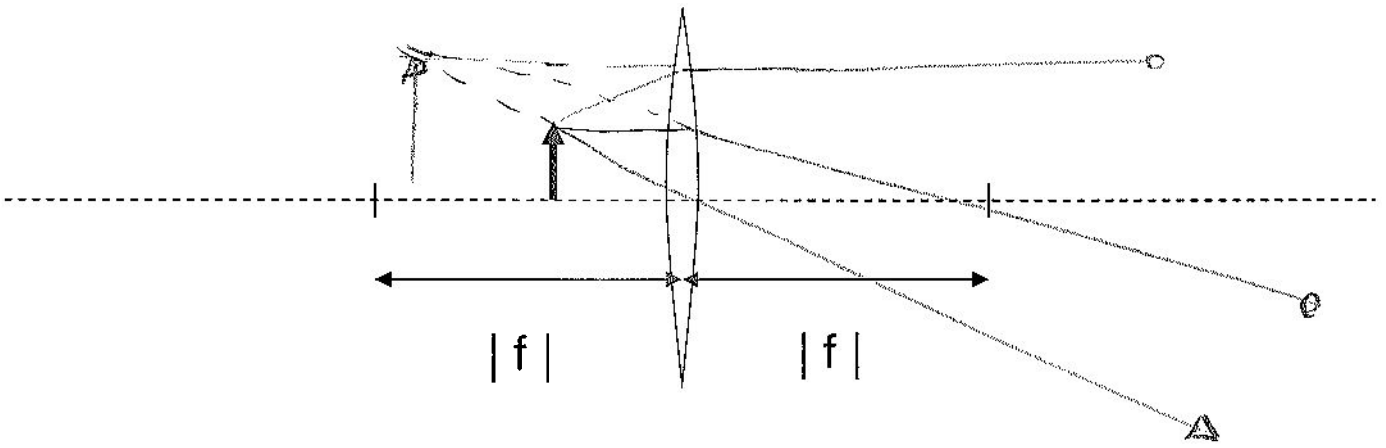
d) What is the separation between 2 slits if the first minima is found at an angle of 2.3 degrees when light is incident normally on 2 slits and a diffraction / interference pattern forms? Assume the wavelength of the laser you used was 632.8 nm and that the actual width of each slit is irrelevant. (3 pts)

I) 0.32 μm
II) 7.9 μm
III) 15.8 μm
IV) 23.7 μm
V) 31.5 μm

e) About how thick does the wall of a soap bubble need to be in order for you to see a bright spot if 550 nm light is incident normally on the soap bubble? (Assume the soap bubble is mostly water with n=1.33) (3 pts)

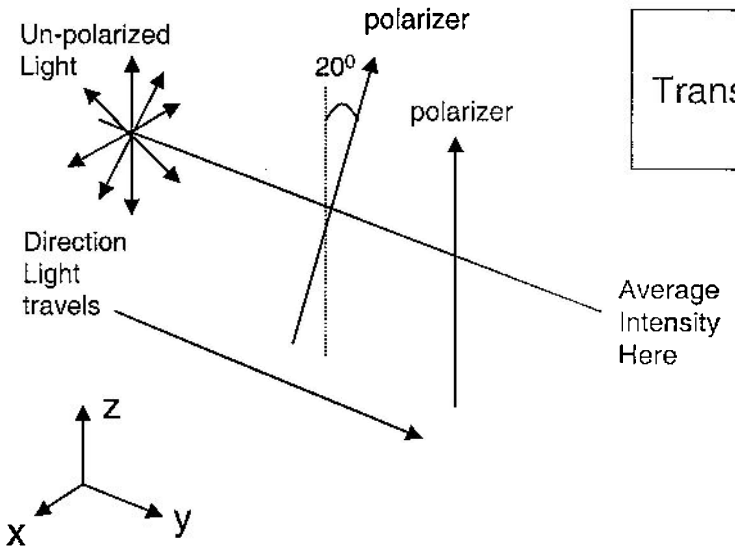
I) 103 nm
II) 138 nm
III) 206 nm
IV) 275 nm
V) 414 nm

f) Find the image for the object in air and plastic lens shown below using graphical methods (ray tracing) (4 pts.) Is the image real or virtual? (2 pts)



2) Polarization (Show your work!)

Un-polarized light is incident upon 2 polarizers. These polarizers have their polarizing axes oriented at 20 degrees relative to each other (as shown below). If the incident light has an average intensity of I = 20 W/m^2, what is the average intensity of the transmitted light? (Light is moving in the y direction as shown.)



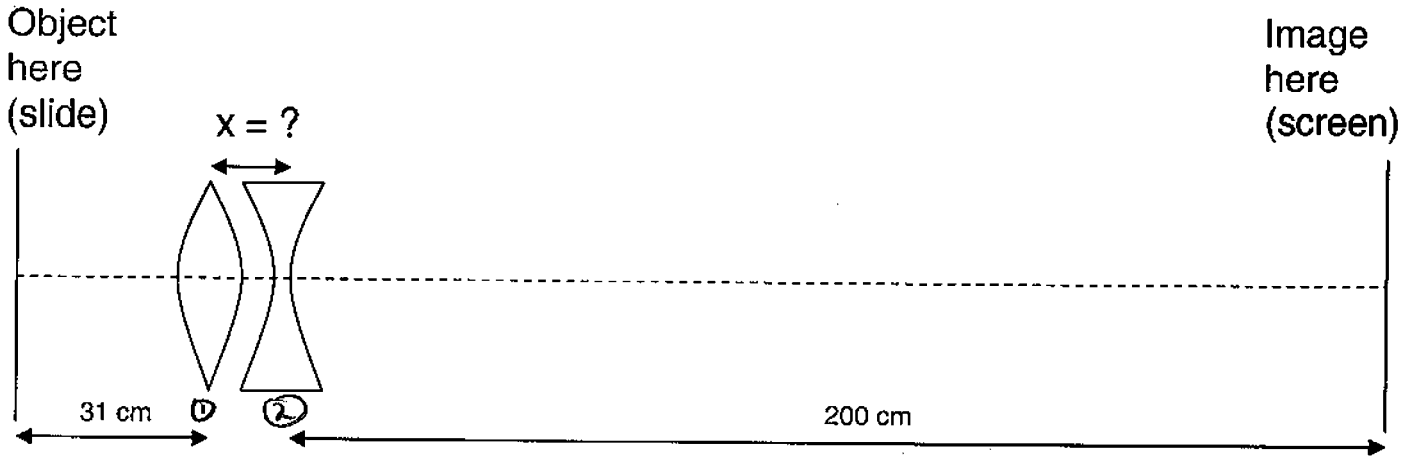
Transmitted I = (5 pts)

Describe quantitatively (with an equation for a traveling wave) the Electric field portion of the transmitted light as a single traveling wave. (Assume the wave travels at a speed of c and has a wavelength of 500nm.) (5pts)

$$\vec{E}(position, time) =$$

3) Lenses (Show your work!)

An overhead projector is being made with a diverging and a converging lens as shown in the figure below. The |focal length| of the converging lens is |f|= 15 cm, and the |focal length| of the diverging lens is |f|= 20 cm. If the distance from the slide to the first lens is 31cm, and the distance from the second lens to the screen is 200cm, what must the separation, x, between the 2 lenses be in order to make this design work? (5 pts.) What is the overall magnification of the system? (5 pts) (Do not change the 31 cm or the 200 cm, just x!)



$s_1' = \frac{31cm \cdot 15cm}{31cm - 15cm} = 29.06cm$

$s_2 = \left(\frac{-1}{20cm} - \frac{1}{200cm}\right) = -\frac{200cm}{11}$

$= -18.18cm$

will be same pt if $x = 10.96cm$

$x = 10.96cm$

Overall M = -10.3

$M = \left(-\frac{29.06cm}{31cm}\right)\left(-\frac{200cm}{-18.18cm}\right)$

$= -10.31$

Physics 116b Test 4c November 13, 2008

Name: Correction & Key Seat/Row: 8/I

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Problem	Description	Max Score	Score
1	Short Ans	20	
2	EM waves, Polarization	10	
3	Lenses, Mirrors	10	
Total		40	

1) Short Answer (Show Your Work!)

a) One of the reasons diamond is so desirable is because the high index of refraction of diamond causes lots of internal reflections. The diamond appears to sparkle! If the critical angle for diamond is about 24 degrees, what is the index of refraction of diamond? (3 pts)

I) 2.45
II) 0.91
III) 0.41
IV) 1.09
V) 23.8

b) If you built 2 identically shaped converging lenses, but you made one out of crown glass (n=1.52) and you made the other out of flint glass (n=1.66), which one has the shortest focal length? (explain) (2 pts)

↳ bend more

c) A diffraction grating has 2000 lines/cm. Light of wavelength 560nm is incident perpendicular to the plane of the grating. At what angle is the 2nd order maxima found? (3 pts)

I) 6.4 degrees
II) 0.128 degrees
III) 34.1 degrees
~~IV) 6.4 degrees~~ 12.9 degrees
V) 16.2 degrees

1) Short Answer cont'd (Show Your Work!)

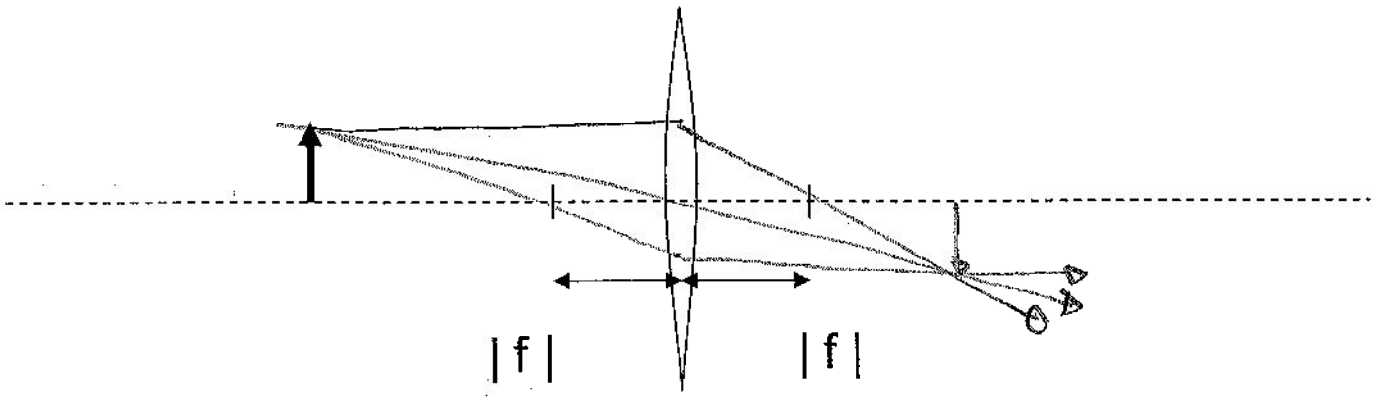
d) What is the separation between 2 slits if the first minima is found at an angle of 2.3 degrees when light is incident normally on 2 slits and a diffraction / interference pattern forms? Assume the wavelength of the laser you used was 632.8 nm and that the actual width of each silt is irrelevant. (3 pts)

I) 23.7 μm
II) 0.32 μm
III) 7.9 μm
IV) 15.8 μm
V) 31.5 μm

e) About how thick does the wall of a soap bubble need to be in order for you to see a bright spot if 550 nm light is incident normally on the soap bubble? (Assume the soap bubble is mostly water with n=1.33) (3 pts)

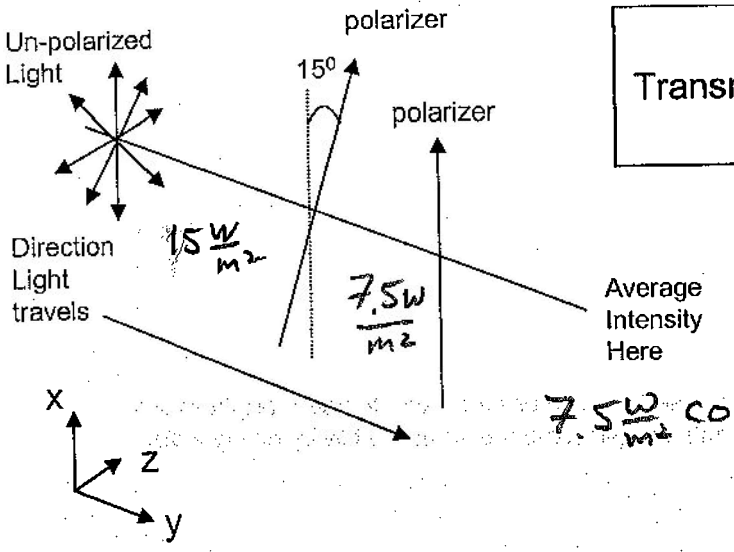
I) 275 nm
II) 103 nm
III) 414 nm
IV) 138 nm
V) 206 nm

f) Find the image for the object in air and plastic lens shown below using graphical methods (ray tracing) (4 pts.) Is the image real or virtual? (2 pts)



2) Polarization (Show your work!)

Un-polarized light is incident upon 2 polarizers. These polarizers have their polarizing axes oriented at 15 degrees relative to each other (as shown below). If the incident light has an average intensity of I = 15 W/m², what is the average intensity of the transmitted light? (Light is moving in the y direction as shown.)



Transmitted I = $7 \frac{W}{m^2}$ (5 pts)

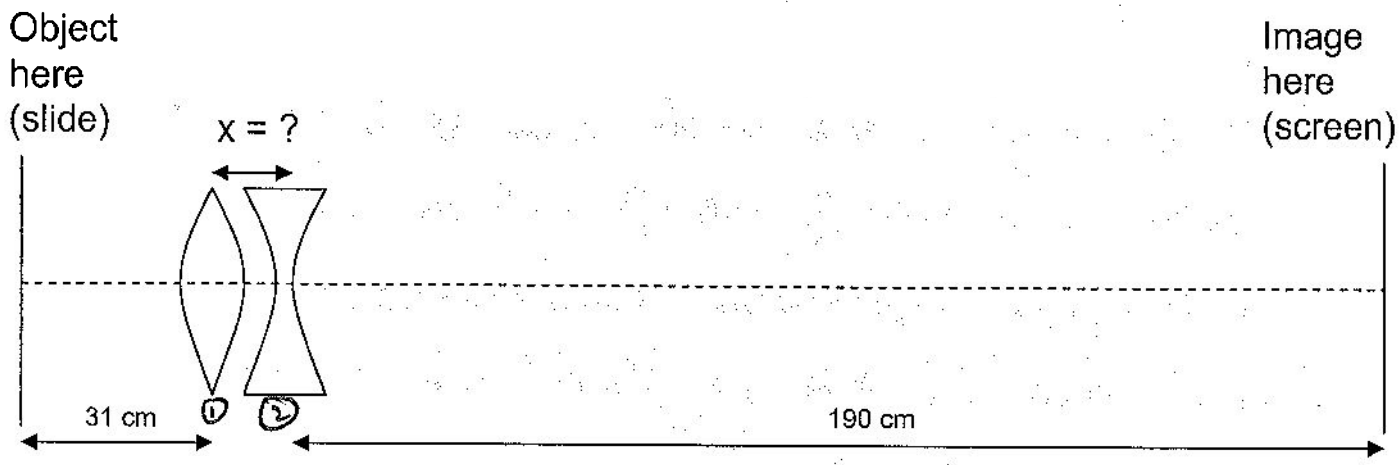
$7.5 \frac{W}{m^2} \cos^2 15^\circ = 6.998 \frac{W}{m^2}$

Describe quantitatively (with an equation for a traveling wave) the Electric field portion of the transmitted light as a single traveling wave. (Assume the wave travels at a speed of c and has a wavelength of 550nm.) (5pts)

$$\vec{E}(position, time) = \left(72.7 \frac{N}{C}\hat{x}\right) \sin\left(1.14 \times 10^7 \frac{1}{m} - 3.43 \times 10^{15} \frac{t}{s}\right)$$

3) Lenses (Show your work!)

An overhead projector is being made with a diverging and a converging lens as shown in the figure below. The |focal length| of the converging lens is |f|= 16 cm, and the |focal length| of the diverging lens is |f|= 18 cm. If the distance from the slide to the first lens is 31cm, and the distance from the second lens to the screen is 190cm, what must the separation, x, between the 2 lenses be in order to make this design work? (5 pts.) What is the overall magnification of the system? (5 pts) (Do not change the 31 cm or the 190 cm, just x!)



$s_1' = \frac{31cm\ 16cm}{31cm - 16cm} = 33.07cm$

$s_2 = \left(\frac{1}{-18cm} - \frac{1}{190cm}\right)^{-1} = -16.44cm$

x when s_1' & s_2 @ same point

$x = 16.6cm$

$x = 16.6cm$

Overall M = -12.33

$M = \left(-\frac{33.07cm}{31cm}\right)\left(-\frac{190cm}{-16.44cm}\right)$

$= -12.33$

Physics 116b Test 4d November 13, 2008

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Problem	Description	Max Score	Score
1	Short Ans	20	
2	EM waves, Polarization	10	
3	Lenses, Mirrors	10	
Total		40	

1) Short Answer (Show Your Work!)

a) One of the reasons diamond is so desirable is because the high index of refraction of diamond causes lots of internal reflections. The diamond appears to sparkle! If the critical angle for diamond is about 24 degrees, what is the index of refraction of diamond? (3 pts)

I) 1.09
II) 0.41
III) 2.45
IV) 23.8
V) 0.91

b) If you built 2 identically shaped converging lenses, but you made one out of flint glass (n=1.66) and you made the other out of crown glass (n=1.52), which one has the shortest focal length? (explain) (2 pts)

more bend for n=1.66

c) A diffraction grating has 2000 lines/cm. Light of wavelength 560nm is incident perpendicular to the plane of the grating. At what angle is the 2nd order maxima found? (3 pts)

I) 12.9 degrees
II) 34.1 degrees
III) 0.128 degrees
IV) 16.2 degrees
V) 6.4 degrees

1) Short Answer cont'd (Show Your Work!)

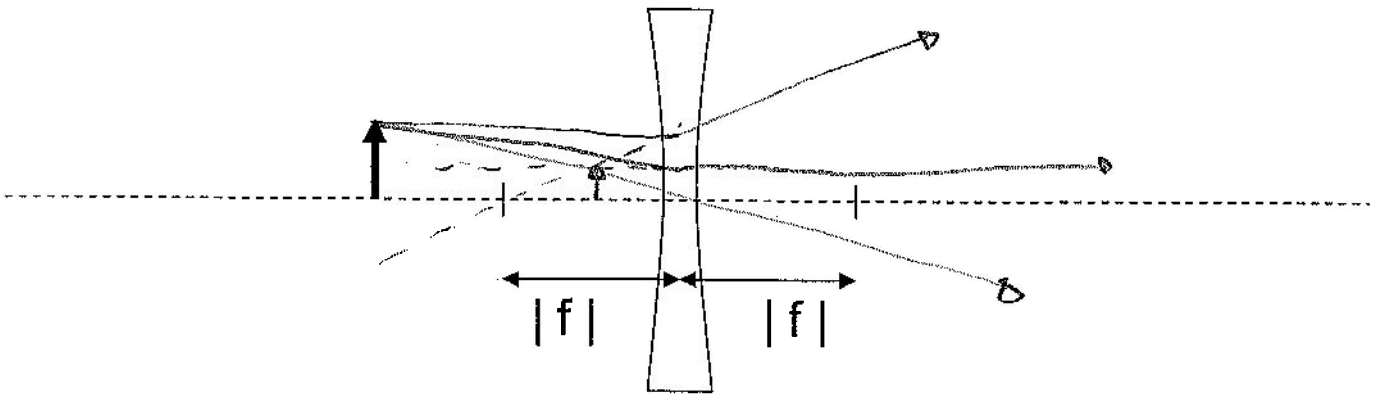
d) What is the separation between 2 slits if the first minima is found at an angle of 2.3 degrees when light is incident normally on 2 slits and a diffraction / interference pattern forms? Assume the wavelength of the laser you used was 632.8 nm and that the actual width of each silt is irrelevant. (3 pts)

I) 15.8 μm
II) 31.5 μm
III) 23.7 μm
IV) 0.32 μm
V) 7.9 μm

e) About how thick does the wall of a soap bubble need to be in order for you to see a bright spot if 550 nm light is incident normally on the soap bubble? (Assume the soap bubble is mostly water with n=1.33) (3 pts)

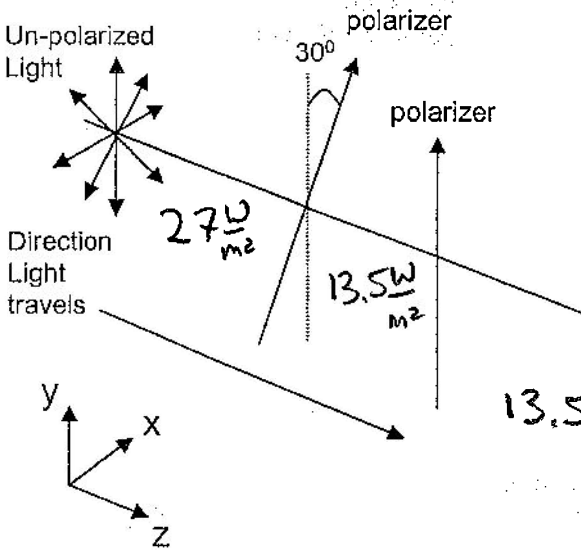
I) 206 nm
II) 414 nm
III) 275 nm
IV) 103 nm
V) 138 nm

f) Find the image for the object in air and plastic lens shown below using graphical methods (ray tracing) (4 pts.) Is the image real or virtual? (2 pts)



2) Polarization (Show your work!)

Un-polarized light is incident upon 2 polarizers. These polarizers have their polarizing axes oriented at 30 degrees relative to each other (as shown below). If the incident light has an average intensity of I = 27 W/m^2, what is the average intensity of the transmitted light? (Light is moving in the z direction as shown.)



Transmitted I = $10.13 \frac{W}{m^2}$ (5 pts)

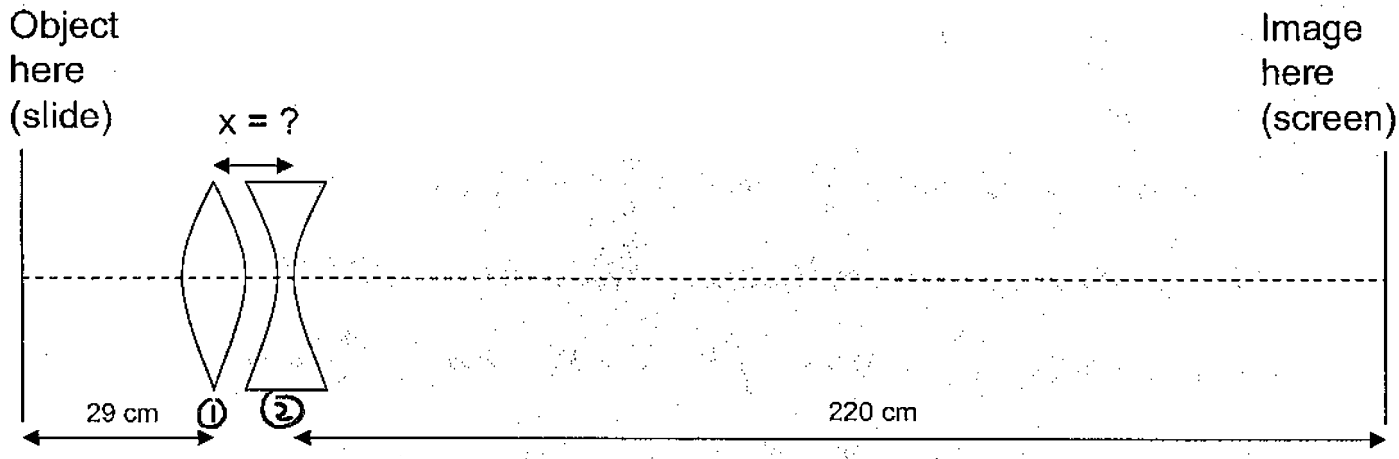
$13.5 \frac{W}{m^2} \cos^2 30^\circ = 10.13 \frac{W}{m^2}$

Describe quantitatively (with an equation for a traveling wave) the Electric field portion of the transmitted light as a single traveling wave. (Assume the wave travels at a speed of c and has a wavelength of 530nm.) (5pts)

$$\vec{E}(position, time) = 87.4 \frac{N}{C} \hat{y} \sin\left(1.19 \times 10^7 \frac{z}{m} - 3.56 \times 10^{15} \frac{t}{s}\right)$$

3) Lenses (Show your work!)

An overhead projector is being made with a diverging and a converging lens as shown in the figure below. The |focal length| of the converging lens is |f|= 14 cm, and the |focal length| of the diverging lens is |f|= 18 cm. If the distance from the slide to the first lens is 29cm, and the distance from the second lens to the screen is 220cm, what must the separation, x, between the 2 lenses be in order to make this design work? (5 pts.) What is the overall magnification of the system? (5 pts) (Do not change the 29 cm or the 220 cm, just x!)



$$s_1' = \frac{29\text{cm}\ 14\text{cm}}{29\text{cm} - 14\text{cm}} = 27.07\text{cm}$$

$$s_2 = \left(\frac{1}{-18\text{cm}} - \frac{1}{220\text{cm}}\right)^{-1} = -16.64\text{cm}$$

Coincide when $x = 10.43\text{cm}$

$$M = \left(-\frac{27.07\text{cm}}{29.0\text{cm}}\right)\left(-\frac{220\text{cm}}{-16.64\text{cm}}\right)$$

$$= -12.34$$

$x = 10.43\text{cm}$

Overall M = −12.34