Exam 4

P202 Spring 2009,
Instructor: Prof. Abanov

04/23/08

Name______________ Section____________
(print)

517 Labs at 12:40-03:30 pm, TA: Wenlong Yang

518 Labs at 01:50-04:40 pm, TA: Jianping Xiao

519 Labs at 03:00-05:50 pm, TA: Kyle Damborsky

Your grade:

Problem 1.

Two speakers produce in-phase sound of frequency 330Hz. A student standing at some point hears destructive interference. When one of the speakers was moved 50.0cm towards the student, the interference became constructive.

What is the sound wavelength?________

What is the speed of sound?_________

What should be the distance the speaker is moved if the frequency of the sound were 200Hz?_____________

Problem 2.

A light passes through three slits separated by 0.50mm. In the resulting interference pattern on a screen 3.0m away, adjacent bright fringes are separated by 3.0mm.

What is the wavelength of the light?________________

How will the answer change if it is four slits?_____________

What will be the separation between the fringes if we double the frequency of the light?_________________

Problem 3.

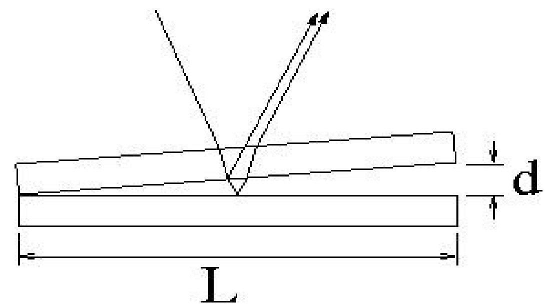
A transparent film (n = 1.3) is deposited on a glass lens (n = 1.5) to form a non-reflective coating.

What thickness of the film would prevent reflection of light with wavelength 600 nm in air?________

How will the answer change if we use a transparent film with refractive index n=1.6?_______

Problem 4.

Two microscopic slides L=10cm long are in contact at one end and are separated by a piece of paper d=0.020mm thick at the other. The monochromatic light with $\lambda = 600\text{nm}$ is used.



Is the fringe at the line of contact bright or dark?________

What is the separation between the dark interference fringes?_______

If we want to double the separation between the dark interference fringes what wavelength of light should we use?_______

Problem 5.

A laser emits light with a wavelength of 700nm in pulses that are 10.0ms in duration. The average power during each pulse is 0.8W.

How much energy is in each pulse?_________

What is the energy of one photon?_______________

How many photons are in each pulse?______________

Problem 6.

A spy satellite is in orbit at a distance of $1.5x10^6$ m above the ground. It carries a telescope that can resolve the two rails of a railroad track that are 1.4 m apart using light of wavelength 700 nm.

What is the smallest possible diameter of the lens in the telescope?

____

What is the the diameter of the lens if light of $\lambda = 400\text{nm}$ **is used?**

____

Problem 7.

A mixture of two coherent beams of light with different wavelength is incident normally on a transmission diffraction grating with line separation $d = 3\text{x}10^{-2}\,mm$ On the screen which is $L = 30\text{cm}$ away, the first order bright stripes for the two beams are 1mm apart.

What is the wavelength difference of the two beams?_______

What will be the separation between the stripes on the screen if we decrease the line separation of the grating by a factor of 2?_____

Problem 8.

An electron in an excited state of hydrogen makes a transition from the n=5 level to n=3 level. It takes 13.6eV to ionise the hydrogen atom.

What is the energy of the photon involved in transition?__________

Was the photon emitted or absorbed by the atom?_______________

How would the answers to the previous questions change if the transition were from n=4, to n=5 level?

Problem 9.

When ultraviolet light with $\lambda = 400.0\text{nm}$ falls on a certain metal surface, the maximum kinetic energy of the emitted photoelectrons is measured to be 1.10eV.

What is the maximum kinetic energy of the photoelectrons when light of wavelength 200.0nm falls on the same surface?

What is the maximum kinetic energy of the photoelectrons when light of wavelength 800.0nm falls on the same surface?

Problem 10.

An x-ray photon undergoes Compton scattering.

What is the maximum increase in photon wavelength that can occur?

What is the energy (in eV) of the smallest-energy x-ray photon which could double its original wavelength?

What will be kinetic energy of the electron after such scattering?