Exam 4

P202 Spring 2007,

Instructor: Prof. Abanov

04/19/07

Name_______________ Section____________

(print)

Your grade:

Problem 1.

Two speakers produce in-phase sound of frequency 250Hz. A student standing at some point hears constructive interference. When one of the speakers was moved 68.0cm towards

the student, the interference became destructive.

What is the speed of sound?___________

What should be the distance the speaker is moved if the frequency of the sound were 300Hz?_______________

Problem 2.

A light passes through two slits separated by 0.460mm. In the resulting interference pattern on a screen 2.20m away, adjacent bright fringes are separated by 2.82mm.

What is the wavelength of the light?

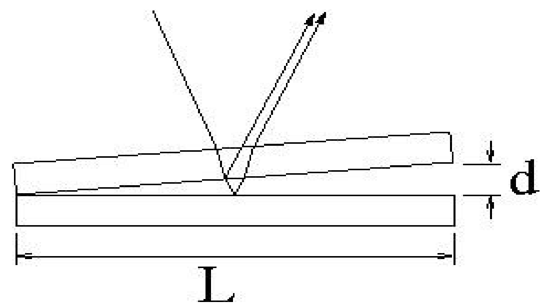
What will be the separation between the fringes if we double the frequency of the light?

Problem 3.

A transparent film (*n* = 1.4) 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 7.00×10^2 nm in air?__________

How the answer changes 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 $\lambda = 500\text{nm}$ 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.

Light of 600.0 nm is incident on a single slit of width 6.5 μm. The resulting diffraction pattern is observed on a nearby screen and has a central maximum of width 3.5 m.

What is the distance between the screen and the slit?

What will be the width of the central maximum if the light of $\lambda = 400\text{nm}$ **is used?**

Problem 6.

A spy satellite is in orbit at a distance of 1.0×10^6 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 600 nm.

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

What is the the diameter of the lens if the 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 $d = 2.5\text{x}10^{-2}\, mm$ On the screen which is $L = 25\text{cm}$ away, the first order bright spots for the two beams are 1mm apart.

What is the wavelength difference of the two beams?_________

What will be the separation between the spots if we decrease the line separation by a factor of 2?_______

Problem 8.

A laser emits light with $\lambda=620\text{nm}$ in pulses that are 20.0ms in duration. The average power expended during each pulse is 0.60W.

How much energy is in each pulse?

What is the energy of one photon?

How many photons are in each pulse?

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 300.0nm falls on the same surface?

What is the maximum kinetic energy of the photoelectrons when light of wavelength 830.0nm falls on the same surface?

Problem 10.

An x-ray photon undergoes a 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?