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 $L=10\text{cm}$ long are in contact at one end and are separated by a piece of paper $d=0.020\text{mm}$ 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 $1.5 \times 10^6$ 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 700 nm.

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

What is the diameter of the lens if light of $\lambda = 400$ 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 $d = 3 \times 10^{-2} \text{mm}$.
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 $200.0\text{nm}$ falls on the same surface?

What is the maximum kinetic energy of the photoelectrons when light of wavelength $800.0\text{nm}$ 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?