Physics 380H - Wave Theory **Homework #07**

Fall 2004 Due 12:01 PM, Monday 2004/11/08

[50 points total]

"Journal" questions:
– What physics material do you recall from your elementary school experiences (up to about age 12)? How was it presented? What was your perception of the instructor's attitude toward the material? What about other non-physics sciences? Math?
– Any comments about this week's activities? Course content? Assignment? Lab?

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1. What experimental evidence of the wavelike nature of light led to the abandonment of the then accepted corpuscular theory by Poisson? What effect revived a modified corpuscular theory in the early 20th century due to a new theoretical framework of electromagnetic waves? Limit your discussion to about 50 words or so. [10]

2. (From Towne P11-11, pg 252)A yacht club Y is located on the semicircular shoreline of a harbour protected by a breakwater BW (see Towne, Figure 11-32). it is found that the most damaging storms are associated with swells which come from due north and have a wavelength of 20 ft. To give the yacht club maximum protection from these storms, it is decided to have two openings in the breakwater at C and C' equidistant from the centre O. (Consistent with the fictitious nature of the problem, simplifications should be made as desired.)
   (a) What should the spacing be betwen the openings? [10]
   (b) Along how much of the shoreline on either side of Y will the wave amplitude during a storm be less than half of what it would be with only a single opening? (Take the radius $OY = 1500\,\text{ft}$. [10]

3. (From Towne P11-27, pg 256) It is desired to exhibit localized interference fringes in sodium yellow light by forming a thin air wedge between two optical flats. The flats are 5 cm long and the wedge is formed by inserting a think piece of paper between the flats along one edge. How thick must the paper be if the fringes are to be 1 mm wide? Hint: you will need to determine the optical path difference between light reflected off of the top of the triangular air wedge and off of the bottom of the air wedge, and how that path difference is a function of the distance from the corner, where the two flats come into contact. [10]

4. When tuning a piano, "Middle A" should be at 440 Hz. Using a Middle A tuning fork you determine that the piano that you are working on is a little bit "sharp" and when Middle A is played, you hear beat interference between the piano and the tuning fork of about 10 cycles in about 7 seconds. What is the frequency that the piano is tuned to? [10]

Headstart for next week, Week 08, starting Monday 2004/11/08:
– Read Chapter 12 "Continuous Distribution s of Coherent Sources; the Fraunhofer Approximation" in Towne, omit 12-15
– – Section 12-1 "Introduction"
– – Section 12-2 "Radiation pattern from coherent sources continuously distributed along a line segment"
– – Section 12-3 "The Fraunhofer approximation"
– – Section 12-4 "Study of the Fraunhofer pattern"
– – Section 12-5 "Vibration curve for the Fraunhofer approximation"
– – Section 12-6 "Diffraction by an extremely narrow slit"
– – Section 12-7 "Diffraction by an extremely long slit"
– – Section 12-8 "The Fraunhofer approximation applied to a rectangular distribution of coherent point sources"
– – Section 12-9 "Diffraction by a rectangular aperture"