Physics 380H - Wave Theory **Homework #04**

Fall 2004 Due 12:01 PM, Tuesday 2004/10/12

[30 points total]

"Journal" questions:
– Give an example of a time you made use of physics knowledge you gained from a physics course, outside of schoolwork. What physics phenomena have you noticed outside of the classroom? Have you noticed or made use of *waves* outside of class? In what context?
– Any comments about this week's activities? Course content? Assignment? Lab?

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1. (From Towne P3-4, pg 60) A piston is located at $x = 0$, adjacent to a fluid extending throughout $x > 0$. The piston is initially at rest, and there is no disturbance in the fluid. At $t = 0$ the piston starts to move with constant negative acceleration: $B(t) = -at^2/2$. Describe the condition of the fluid at some later time. [10]

2. (From Towne P3-9, pg 60) Start with the boundary condition of a free surface, $p(0, t) = 0$, and apply this directly (in a manner similar to the method of Section 3-2) to deduce $p(x, t)$ and $\dot{\xi}(x, t)$. [10]

3. (From Towne P4-1, pg 81) Find the exact expression for the potential energy density W_{pot} of an *ideal gas*. Show that this reduces to the correct form when the acoustic approximation is made. (Note: Since the desired quantity contains second-order terms in s, a more accurate expression than $s = -\partial\xi/\partial x$ is required to show the equivalence.) [10]

Headstart for next week, Week 05, starting Tuesday 2004/10/12:
– Read Chapter 4 "Energy in a Sound Wave; Isomorphisms" in Towne, omit 4-7
– – Section 4-8 "Interference between superposed waves"
– – Section 4-9 "Measurement of intensity in decibels"
– – Section 4-10 "Energy definitions for transverse waves on a string"
– – Section 4-11 "Energy relations for transverse waves on a string; isomorphisms"
– – Section 4-12 "Bountry value problems for transverse waves on a string"
– Read Chapter 6 "The Electromagnetic Plane Wave" in Towne, omit 6-4, 6-5
– – Section 6-1 "Maxwell's equations"
– – Section 6-2 "A solution to Maxwell's equations for a special situation"
– – Section 6-3 "Implications of the electromagnetic theory of light"
– – Section 6-6 "A linearly polarized transverse plane wave"
– Read Chapter 7 "Analytical Description of Polarized Electromagnetic Plane Waves" in Towne
– – Section 7-1 "Introduction"
– – Section 7-2 "More complete description of the linearly polarized sinusoidal plane wave"
– – Section 7-3 "Reflection from a dielectric surface obtained by appeal to an isomorphism"
– – Section 7-4 "Reflection from a perfect conductor; direct evidence of standing waves"
– – Section 7-5 "Consideration of a more general sinusoidal plane wave"