Friday, Feb. 27th, 2004

Phys 340: HOMEWORK ASSIGNMENT No. (3)
Due Date: MONDAY, FEB. 15th, 2004

To be handed on Monday, March 10th. Late assignments will not receive a mark

(1) STATIC EM Fields: This question has two parts, one dealing with your intuition for field configurations, the other with your conceptual understanding of them.

(a) Static field configurations: Sketch the static field configurations for the following situations:

(i) Show the electric field lines near a pair of electric charges, having charges q and $-q$ (an electric dipole). Assume the only fields around are those generated by these 2 charges.

(ii) Show the equipotential lines (contours of constant electric potential energy) for the same pair of charges as in (i).

(iii) Show the magnetic field lines near a single loop of wire carrying a current- assume there are no other magnetic fields around apart from that generated by the loop.

(iv) Now, see if you can plot the magnetic field lines when you have 2 current loops. Assume that the two loops are both wound around the same cylinder, but are some distance apart from each other. There are then 2 possible cases which you should draw, viz., when the currents in each loop are circulating in the same sense (eg., clockwise) as each other- and when they are circulating in opposite senses.

(b) Forces between currents: This is the conceptual part.

(i) Explain, using sketches if you wish, how you would go about investigating the magnetic interaction between 2 current carrying wires. Consider 2 parallel straight wires carrying currents I_1 and I_2 in the same direction, and then in opposite directions. One can thus vary both the *magnitudes* of these currents and their *directions*- explain how you would then investigate *experimentally* the way the interaction depends on these, ie., how you would find out how the interaction depends on I_1 and I_2. I am NOT asking how they would very- only how you would find out.

(ii) Now- how do you think that the force between the wires would depend on I_1 and I_2? You can actually figure this out if you look at the notes, and examine how the direction and magnitude of the field generated by a current depends on the direction and magnitude of the current. You might also try to guess how the strength of the interaction would vary with the distance between the wires.

(iii) Finally, how do we know that the forces between the wires are genuine forces, in the way defined originally by Newton?

(2) WAVE INTERFERENCE: Here we focus on just one aspect of the physics of waves- involving descriptive and conceptual aspects.

(a) Consider a screen which is illuminated through 2 different parallel slits. Show first what the intensity of the light will look like when both slits are open- we assume here that the slits are both very narrow, with width not much greater than the wavelength of light. Then, second, show what the intensity on the screen will look like if only one of these slits is open.

(b) Now, the conceptual part. Explain why it is that the results of this experiment are so hard to understand if light is considered to be simply a set of particles propagating through space according to Newtons's laws.

(3) **QUICK QUESTIONS on GRAVITY**

(a) Suppose you lived in an entirely 2-dimensional world- not only are you not aware of any higher dimensions, but there is no way even in principle for you to know about them directly. Can

you nevertheless explain 2 ways you might test to see whether the geometry of your 2-d world is flat (ie., Euclidean)?

(b) Can you see how you would adapt the 2 tests you used in 2 dimensions to a 3-d world, ie., to find out if space in a 3-d world is flat or not?

(c) Using web resources, write a short essay (no more than 350 words), on the binary pulsar PSR 1913+16, used by J. Taylor et al. to demonstrate the radiation of gravitational waves.