Assignment 2  (marked out of 50 but worth 10% of the final mark)

Due date – Friday Lecture in Week 13  (28 Oct., 2005)
All answers must be fully justified with all working shown.

**Question 1 [10 marks]**  A loop of wire carries an electric current of 100 A, as shown in the diagram, Calculate the magnetic induction B (in Tesla) at the point P, due only to the semi-circular part of the loop. Indicate the direction of B.

![Diagram of a loop of wire with a current of 100 A, showing point P and the semi-circular part of the loop.]

**Question 2 [20 marks]**  Griffiths 5.6

(a)  A phonograph record (the big black vinyl discs you play on turntables ☺) carries a uniform density of ‘static electricity’ σ. If it rotates at an angular velocity ω, find the surface current density K at a distance r from the centre.

(b)  A uniformly charged solid sphere, of radius R and total charge Q, is centred at the origin and spinning at a constant angular velocity ω about the z-axis. Find the current density J (n.b. vector !) at any point (r, θ, φ) within the sphere.

**Question 3 [20 marks]**  Griffiths 6.12.

An infinitely long circular cylinder of radius R carries a “frozen-in” magnetization \( \mathbf{M} = k s \hat{z} \) parallel to its axis. Here, s is the distance from the axis and k is a constant. There is no free current anywhere. Find the magnetic induction \( \mathbf{B} \) both inside and outside the cylinder by two different methods:

(a)  Locate all the bound currents and calculate the magnetic induction they produce

(b)  Use Ampère’s law (eq. 6.20) to find \( \mathbf{H} \) and then get \( \mathbf{B} \).