PHYS UN1602 Recitation Week 8 Worksheet

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Problem 1

a) Consider an infinite straight wire carrying current I. We know that the magnetic field outside the wire is $\vec{B} = (\mu_0 I / 2\pi r)\hat{\theta}$. There are no currents outside the wire, so $\nabla \times \vec{B} = 0$. Verify this by explicitly calculating the curl.

b) Since $\nabla \times \vec{B} = 0$, we should be able to write $\vec{B}$ as the gradient of a function, $\vec{B} = \nabla \psi$. Find ψ, but then explain why the usefulness of ψ as a potential function is limited.

Problem 2

A thin ring of radius a carries a static charge q. This ring is in a magnetic field of strength B_0, parallel to the ring's axis, and is supported so that it is free to rotate about that axis. If the field is switched off, how much angular momentum will be added to the ring? Suppose the mass of the ring is m. Show that the ring, if initially at rest, will acquire an angular velocity $\omega = qB_0/2mc$.