

PHYS 703 - Field Momenta.

1. [Griffiths 8.14] A point charge q is held fixed at a distance $a > R$ from the axis of an infinite solenoid (radius R , n turns per unit length, current I). Find the *total* linear momentum and the angular momentum in the fields.

Hints: Put q on the x -axis, with the solenoid along z ; treat the solenoid as a non-conductor, so you don't need to worry about induced charges on its surface. Handy integrals:

$$\int_0^{2\pi} \frac{d\theta \cos \theta}{[A + B \cos \theta]} = \frac{2\pi}{B} \left(1 - \frac{A}{\sqrt{A^2 - B^2}} \right)$$

$$\int_0^{2\pi} \frac{d\theta}{[A + B \cos \theta]} = \frac{2\pi}{\sqrt{A^2 - B^2}}$$