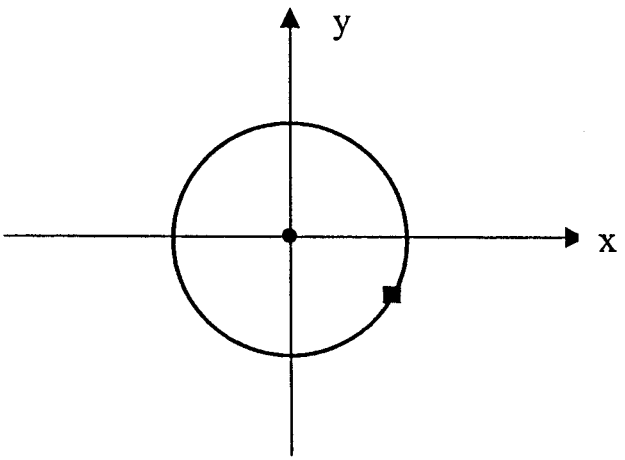
QMSpring01B

A spinless particle of charge q and mass M is confined to move on a circle of radius R which lies in the x-y plane, as shown in the figure. The z axis points out of the plane of the paper.



(a) Write down Schrödinger's equation for the particle and solve it to find the energies and corresponding normalized eigenfunctions.

(b) Now the system is perturbed by a uniform magnetic field B pointing along the positive z axis. To lowest nonvanishing order in perturbation theory, find the correction to the energies of the system. Use the units of your choice.

(c) Suppose instead that there is no magnetic field but that there is a uniform electric field F pointing along the x axis. To lowest nonvanishing order in perturbation theory, find the corrections to the energies for all states except for the first excited states of the unperturbed system.

(d) Continuing with the uniform electric field F and no magnetic field, find the first nonvanishing correction to the energies of the first excited states of the unperturbed system.

Useful information: $\int_0^{2\pi} e^{i(n-m)\theta} \cos\theta \, d\theta = \pi\left(\delta_{n,m-1} + \delta_{n,m+1}\right)$