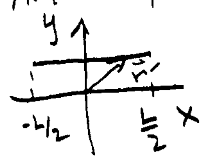
4. (10 pts) A square wire of side L with current I_0 is located symmetrically about the origin with its sides aligned with the xy coordinates. Find an expression for the vector potential far from the loop.

Principles	Method	Check
Defn: $\vec{A} = \frac{\mu_0}{4\pi}\int \frac{I d\vec{l}}{r}$	Find $r = \lvert\vec{r}\rvert = \lvert\vec{r} - \vec{r}'\rvert$ where $\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$ USE CARTESIAN UNIT VECTORS FOR INTEGRAL SINCE THEY COME OUTSIDE. BREAK INTEGRAL INTO 4 parts one for each side. $\vec{r}' = \frac{L}{2}\hat{y} + x\hat{x}$ $\quad d\vec{r}' = d\vec{l} = dx\,\hat{x}$  Integrate $\frac{\mu_0}{4\pi}\int_{-L/2}^{L/2} \frac{I_0 d\vec{l}}{r}$	If L → 0 then A → 0 If r → ∞ then A → 0 If I_0 → 0 then A → 0

5. (10 pts) Show that a free electron could or could not be accelerated while confined to circular motion in a solenoid with slowly varying current $I(t)$.

Principles	Method	Check
$\vec{F} = q\vec{v}\times\vec{B} + q\vec{E} = m\vec{a}$ E from Faraday's Law B from Ampere's Law	Find $\vec{E}$ from Faraday's Law $\oint \vec{E}\cdot d\vec{l} = -\frac{d}{dt}\int \vec{B}\cdot d\vec{a}$ where B comes from Ampere's Law applied to the solenoid. Put into Newtons 2nd using the Lorentz force. $qvB\,\hat{r} + qE\,\hat{\phi} = -\frac{mv^2}{r}\hat{r} + m\frac{dv}{dt}\hat{\phi}$ Coeff. of $\hat{r}$ must be equal as well as $\hat{\phi}$ coeff. $qvB = -\frac{mv^2}{r}$ $\qquad qE = m\frac{dv}{dt}$ Put in expressions for B & E. Then see if these two equations are consistent (They are not it turns out).	If I(t) → 0 then no motion of electron if it was at rest.