510 The current is given by  $\vec{J}(\vec{x}) = \vec{I} \delta(\rho - \alpha) \delta(z) \hat{\phi} = \vec{I} \delta(\rho - \alpha) \delta(z) (-smp \hat{i} + cosp \hat{j})$ The vector potential is given by  $\vec{J}(\vec{x}) = \frac{\mu_0}{4\pi} \int \frac{\vec{J}(\vec{x})}{|\vec{x}-\vec{x}|} d^3v$ (a) Using the expansion  $\frac{1}{|\vec{x}|} = \frac{2}{\pi} \int_{m=-\infty}^{\infty} \int_{0}^{\infty} dk \, e^{im(\phi-\phi')} cos[k(z-z')] \int_{m} (kf_{e}) \, K_{m}(kf_{e}),$ A(x) = MoI 2 ptwo dk ftw dz for p'dp' for db' eimed-b') cos[k(z-z')] [m(kpe) km/k/s) x f(p'-a) &(z') (-sinp'î + cosp'î) = MoIa To Products(kz) for do eim(b-b) Im(kf=) Kn(kf=) (-sin p'i + cos p'j) Only m=+1 terms win survive, and A(x) = moIn from ak cosh & for do' I, (pp.) k, (k/s) cos(p-p')(-sixp'ê+cosp'j) = MoIn Produce Coshe Jalby ) Kilkps) (- Singi + Cos \$\hat{g}) = 0 Which is the & component of the vector pocential (b) Very the expansion = = = the pto dk eimer o') Imlep) Imlep') e-k/2>-2e) A(x) = 401 7 dk Job Sto dz' fto ('d) Sta do' pim(b-d') Jm(kf) Jm(kf) Jm(kf) + k(2x-2c) x & [p'-a) diz') (-sind' i + outop i) = Mola Sto dk e-kizi Jo do' J, (hp) J, (ka) ws[p-o'] [-six \(p'\)\j + ws \(q'\)\j) = MoIn (+100 dk e-k12) Jilka) (-sinpî+cmpĵ) (c)  $\dot{B} = V / \dot{A} = \left( \frac{1}{\rho} \frac{\partial Az}{\partial \phi} - \frac{\partial A\phi}{\partial z} \right) \hat{\rho} + \left( \frac{\partial A\phi}{\partial z} - \frac{\partial Az}{\partial r} \right) \hat{\phi} + \frac{1}{\rho} \left( \frac{\partial}{\partial r} (\rho A\phi) - \frac{\partial Az}{\partial \phi} \right) \hat{Z}$ For (a) Bp = - 2/2 = MoJa for ksin(k2)], (kfc) K, (kfs) dk Bz = 1 3/ (PA4)