Level 2 EM question 2 2002/3

a) An infinite straight wire of radius $R$ carries a steady current, $I$, which is assumed to be uniformly distributed throughout its circular cross-section. By considering an imaginary circular loop with radius $r < R$ centred on the axis of the wire perform an appropriate integration of $\nabla \times \underline{B} = \mu_o \underline{J}$ to obtain an expression for the magnetic induction, $B(r)$, inside the wire.

b) Charge is uniformly distributed with density $\rho$ within an infinite cylinder of radius $R$. Beginning with $\nabla \cdot \underline{E} = \dfrac{\rho}{\varepsilon_o}$ perform an appropriate integration involving an imaginary cylinder of radius r and length $L$ to obtain an expression for the electric field, $E(r)$, within the cylinder.