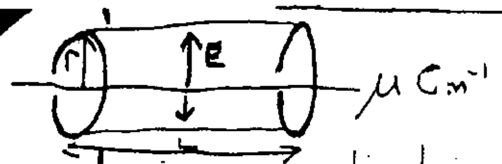
Q3 Answer

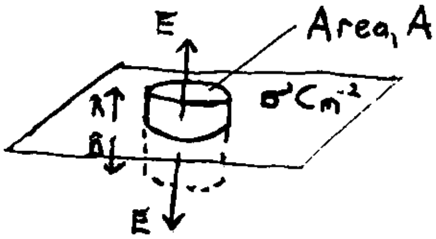


From the symmetry of the problem E is clearly radially directed.

a) Considering a cylindrical gaussian surface as shown we use $\int \underline{E} \cdot d\underline{a} = \frac{Q}{\epsilon_0}$ (no contribution from end surface

$$= E.2\pi r L = L\mu/\epsilon_0 \quad \therefore \; E = \frac{\mu}{2\pi r\epsilon_0}$$

b)



From the symmetry of the problem E is clearly perpendicular to the sheet.

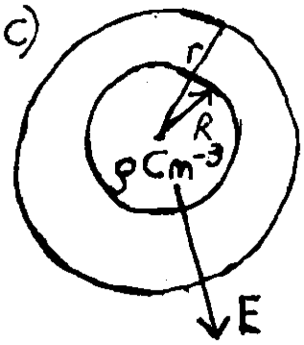
Considering a "pill-box" shaped surface as shown we apply

$\int \underline{E} \cdot d\underline{a} = \frac{Q}{\epsilon_0}$ (no contribution from curved surface

$$E \cdot 2A = \frac{\sigma A}{\epsilon_0} \quad \therefore \; E = \frac{\sigma}{2\epsilon_0}$$

[E is simply doubled between the plates of a capacitor]

c)

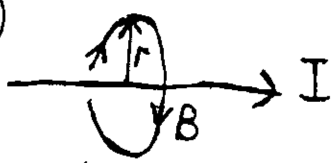


From the symmetry of the problem E is clearly directed in a radial direction. Considering a spherical surface of radius $r > R$ we apply

$$\int \underline{E} \cdot d\underline{a} = \frac{Q}{\epsilon_0}$$

$$E.\,4\pi r^2 = \frac{\frac{4}{3}\pi R^3 \cdot \rho}{\epsilon_0} \quad \therefore \; E = \frac{R^3\rho}{3\epsilon_0 r^2}$$

d)

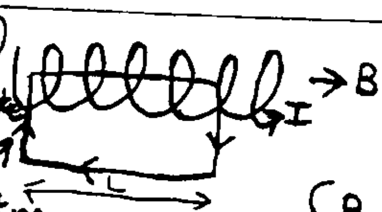


From the symmetry of the problem B is directed around the wire as shown.

Considering a circular loop as shown we have that

$\left[(\nabla \times \underline{B}) \cdot d\underline{a} = \mu_0 \int \underline{J} \cdot d\underline{a}\right]$ $\quad \int \underline{B} \cdot d\underline{l} = \mu_0 I, \quad B \cdot 2\pi r = \mu_0 I, \quad B = \frac{\mu_0 I}{2\pi r}$

e)



integrate in this direction because current flowing into sheet

From the symmetry of the problem B is in the direction shown.

Considering a loop as shown we have that

$\int \underline{B} \cdot d\underline{l} = \mu_0 \times$ total current through loop

$$B \cdot L = \mu_0 \times N \qquad \therefore \; B = \mu_0 N I$$

(B inside solenoid only)