Assignment - 1.

1.(a) Show that ;
$$\int_0^{d_1} \frac{dz}{(z^2 + R^2)^{3/2}} = \frac{1}{R^2} \cdot \frac{d_1}{\sqrt{d_1^2 + R^2}} .$$

(b) then ; using the expression for finitely long cylindrical solenoid :

$$\bar{B} = \frac{\mu_0 n I}{2} \left[\frac{d_1}{\sqrt{d_1^2 + R^2}} + \frac{d_2}{\sqrt{d_2^2 + R^2}} \right] \hat{z}$$; take proper limit on d_1 and d_2 and obtain an expression for infinitely long solenoid .

2. (a) Show that for $\vec{r} = \vec{0}$;
$$\vec{\nabla} \cdot \left(\frac{\vec{r}}{r^3} \right) = 0 .$$

(b) Show that, $\vec{\nabla} \times \left(\frac{\vec{r}}{r^3} \right) = \vec{0}$.

3. Show that ;
$$\int_{\text{allspace}} \{ \bar{J}(\bar{r}') \cdot \bar{\nabla} \} \left(\frac{\vec{r}}{r^3} \right) dv' = 0 .$$

Hint : do it for any one component ; say x component which becomes :
$$\int_{\text{allspace}} \{ \bar{J}(\bar{r}') \cdot \bar{\nabla} \} \frac{x - x'}{r^3} dv' .$$

then use formula $\bar{\nabla} \cdot (\phi \bar{A}) = \phi \bar{\nabla} \cdot \bar{A} + (\bar{A} \cdot \bar{\nabla}) \phi$.
$$\Rightarrow (\bar{A} \cdot \bar{\nabla}) \phi = \bar{\nabla} \cdot (\phi \bar{A}) - \phi \bar{\nabla} \cdot \bar{A}$$

Then give the reason for each of the two terms equal to zero separately. If x component is zero ; then using the some logic ; y and z components also should vanish .