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Assignment - 2

Ans 1a) Volume $= \int_{Vol} \rho \, d\rho \, d\phi \, dz$

$$\text{Volume} = \int_{3}^{4.5} \int_{100}^{130} \int_{3}^{5} \rho \, d\rho \, d\phi \, dz$$

$$\text{Volume} = \frac{1}{2} \left[\rho^2\right]_3^5 \left[\phi\right]_{100}^{130} \left[z\right]_3^{4.5}$$

$\left(1^\circ = \frac{\pi}{180} \text{ radian}\right)$

$$\text{Volume} = \frac{25-9}{2} \times (130-100) \times (4.5-3)$$

$$\text{Volume} = 8 \times 0.5235 \times 1.5$$

$$\text{Volume} = 6.282.$$

The enclosed volume = 6.282

b) Total area enclosed $= 2 \int_{100}^{130} \int_{3}^{5} \rho \, d\rho \, d\phi \, \hat{a_z}$

$$\text{Total area} = \int_{3}^{4.5} \int_{100}^{130} 3 \, d\phi \, dz + \int_{3}^{4.5} \int_{100}^{130^\circ} 5 \, d\phi \, dz + 2 \int_{3}^{4.5} \int_{3}^{5} d\rho \, dz$$

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Ans-2: $E_P = \frac{2k\lambda}{r}$

$E_0 = \frac{2k\lambda}{r}$

$\Rightarrow \frac{2 \times 9 \times 10^3 \times 0.4 \times 10^{-6}}{\sqrt{16+16}}$

$\Rightarrow \frac{2 \times 9 \times 0.4 \times 10^3}{4\sqrt{2}} = 9\sqrt{2} \times 10^2$ Ans

$E_A = \frac{2k\lambda}{r} = \frac{2 \times 9 \times 10^9 \times 0.4 \times 10^{-6}}{4\sqrt{2}}$

$E_A = 9\sqrt{2} \times 10^2$

$E_{Net} = E_A \cos 45^\circ - E_0 \cos 45^\circ$

$E_{Net} = 9\sqrt{2} \times 10^2 \times \frac{1}{\sqrt{2}} + 9\sqrt{2}$

$E_{Net} = 9 \times 10^2 + 9 \times 10^2$

$E_{Net} = 18 \times 10^2$ N/C Ans.

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Ans-3- $\varepsilon = 2.4\varepsilon_0$

a) $E = -\Delta V$ $\quad V = 300 z^2 V$

$E = -600 z a_z$

$D = \varepsilon E$

$D = (2.4\varepsilon_0)(-600 z) a_z$

$D = -12.75 z a_z \quad nc/m^2$

$\rho_v = \Delta \cdot D$

$\rho_v = -12.75 nc/m^3$

b) $P = \chi_e \varepsilon_0 E$

$P = (1 - \varepsilon_r)\varepsilon_0 E$

$P = (1-2.4)\varepsilon_0 (-600 z) a_z$

$P = -7.43 z a_z \quad nc/m^2$

$\rho_{pv} = -\Delta \cdot P$

ρ_{pv}

$\rho_{pv} = -\Delta \cdot P$

$\rho_{pv} = -7.43 nC/m^3$ Ans

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Ans 4- $I = \int J \cdot dS$ $\quad dS = \rho \, d\rho \, d\phi \, \hat{a}_z$

$$I = \int_{\phi=0}^{2\pi} \int_{\rho=0}^{1.6m} \frac{500}{\rho} \rho \, d\phi \, d\rho$$

$$\boxed{I = 5.026 \text{ A}} \quad \text{Ans}$$

Total current = 5.026 A

Ans 5- Let v be potential on surface
Let E be electric field and dir^n of electric field is $\perp$ to equipotential surface.

$F = qE$ $\quad$ Let $q = 1C$

$F = E$ ——— (1)

$W_{BA} = F \cdot dn$

$W_{BA} = F \, dn \cos\theta$

$W_{BA} = E \, dn \cos\theta$ {using (1)}

$W_{BA} = -E \, dn$ ——— (A)

$W_{BA} = V_A - V_B$

$W_{BA} = V - (V - dV) = dV$ ——— (B)

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from (A) and (B)

$$dV = -E\,dx.$$

$$E = -\frac{dV}{dx}$$

$$\int dV = -\int E\,dx$$

$$\Delta V = V_A - V_B = -\int E\,dx \quad \underline{\text{Ans}}.$$