PHY112

SPECIAL GRADED ASSIGNMENT 02

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SECTION-04

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PHY 112_Section-04

Special Graded Assignment-02

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Ans. To The Q. No. (2.1)

a) Here,

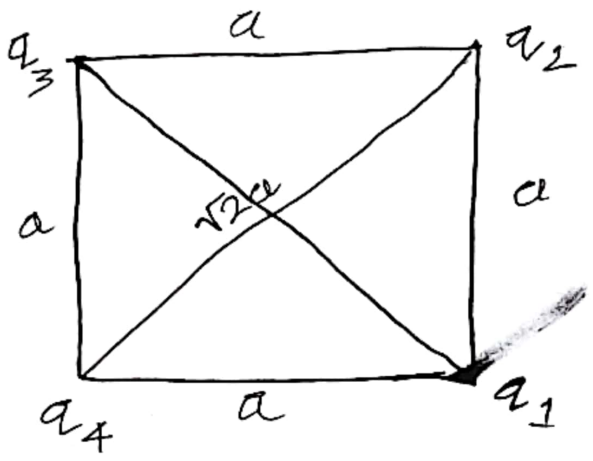
$q_1 = 21 \times 10^{-9}\ C$

$q_2 = 59 \times 10^{-9}\ C$

$q_3 = 16 \times 10^{-9}\ C$

$q_4 = -40 \times 10^{-9}\ C$

$a = 0.13\ m$



$$U_1 = \frac{k q_1 q_2}{r_{1,2}(a)} = \frac{8.987 \times 10^9 \times (21 \times 10^{-9})(59 \times 10^{-9})}{0.13}$$

$$= 8.5253 \times 10^{-5}\ J$$

$$U_2 = \frac{k q_1 q_3}{r_{1,3}(\sqrt{2}a)} = \frac{8.987 \times 10^9 \times (21 \times 10^{-9})(16 \times 10^{-9})}{\sqrt{2} \times 0.13}$$

$$= 1.6425 \times 10^{-5}\ J$$

$$U_3 = \frac{k q_1 q_4}{r_{1,4}(a)} = \frac{8.987 \times 10^9 \times (21 \times 10^{-9})(-40 \times 10^{-9})}{0.13}$$

$$= -5.8078 \times 10^{-5}\ J$$

$$V_4 = \frac{k q_2 q_3}{r_{2,3}(a)} = \frac{8.987 \times 10^9 \times (59 \times 10^{-9})(16 \times 10^{-9})}{0.13}$$

$$= 6.5259 \times 10^{-5} \text{ J}$$

$$V_5 = \frac{k q_2 q_4}{r_{2,4}(-\sqrt{2}a)} = \frac{8.987 \times 10^9 \times (59 \times 10^{-9})(-40 \times 10^{-9})}{\sqrt{2} \times 0.13}$$

$$= -1.1536 \times 10^{-4} \text{ J}$$

$$V_6 = \frac{k q_3 q_4}{r_{3,4}(a)} = \frac{8.987 \times 10^9 \times (16 \times 10^{-9})(-40 \times 10^{-9})}{0.13}$$

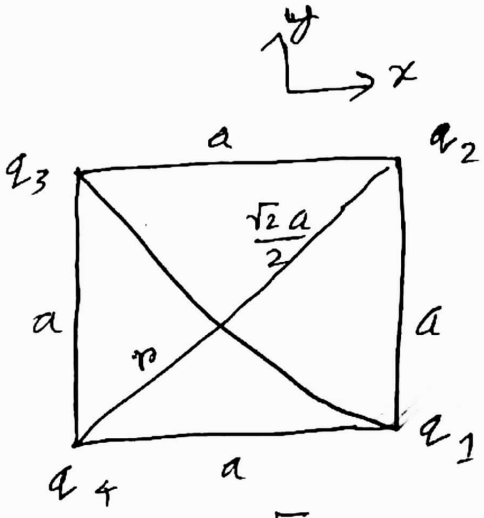
$$= -4.4244 \times 10^{-5} \text{ J}$$

$$V = V_1 + V_2 + V_3 + V_4 + V_5 + V_6$$

$$= -5.033099 \times 10^{-5} \text{ Joules}$$

(Ans)

b) Here,



$q_1 = 21\,nC = 21 \times 10^{-9}\,C$

$q_2 = 59\,nC = 59 \times 10^{-9}\,C$

$q_3 = 12\,nC = 12 \times 10^{-9}\,C$

$q_4 = -40\,nC = -40 \times 10^{-9}\,C$

$a = 13\,cm = 0.13\,m$ $\quad r = \frac{\sqrt{2}\,a}{2} = 0.0919$

$$V_1 = \frac{1}{4\pi\epsilon_0}\frac{q_1}{r} = k\frac{q_1}{r} = 8.987 \times 10^9 \times \frac{21 \times 10^{-9}}{\frac{\sqrt{2} \times 0.13}{2}}$$

~~$= 2053.0794$~~

$$V_2 = k\frac{q_2}{r} = \frac{8.987 \times 10^9}{\frac{\sqrt{2} \times 0.13}{2}} \times 59 \times 10^{-9}$$

$$V_3 = k\frac{q_3}{r} = \frac{8.987 \times 10^9}{\frac{\sqrt{2} \times 0.13}{2}} \times 12 \times 10^{-9}$$

$$V_4 = \frac{k}{r}q_4 = \frac{8.987 \times 10^9}{\frac{\sqrt{2} \times 0.13}{2}} \times (-40 \times 10^{-9})$$

$$V = V_1 + V_2 + V_3 + V_4$$

$$= \frac{8.987 \times 10^9}{\frac{\sqrt{2} \times 0.13}{2}} \times \{(21 \times 10^{-9}) + (59 \times 10^{-9}) + (12 \times 10^{-9}) + (-40 \times 10^{-9})\}$$

$= 5474.8776$ volts (Ans)

c)

$$Q$$

$$\text{Net charge, } = q_1 + q_2 + q_3 + q_4$$

$$= \{21 \times 10^{-9} + 47 \times 10^{-9} +$$

$$= (21 \times 10^{-9} + 59 \times 10^{-9} + 12 \times 10^{-9} + (-40 \times 10^{-9}))$$

$$= 5.2 \times 10^{-8} \text{ C}$$

We know,

$$\Phi_E = \frac{Q}{\epsilon_0} = \frac{5.6 \times 10^{-8}}{8.854 \times 10^{-12}} \text{ Nm}^2/\text{C}$$

$$= 6324.8249 38 \text{ Nm}^2/\text{C}$$

(Ans)

Ans. To The Q. No. (2.2)

b) Here,

$$\rho = 4\,\mu C/m^3 = 4 \times 10^{-6}\ C/m^3$$

$$R = 31\,cm = 0.31\ m$$

We know,
Net enclosed charge,

$$Q_{net} = \rho \times \frac{4}{3}\pi R^3$$

$$= 4 \times 10^{-6} \times \frac{4}{3}\pi \times (0.31)^3$$

$$= 4.9915 \times 10^{-7}\ C$$

(Ans)

a) We know,

$$\text{Net electric flux, } \Phi = \frac{Q_{net}}{\epsilon_0}$$

$$= \frac{4.9915 \times 10^{-7}}{8.854 \times 10^{-12}}\ Nm^2/C$$

$$= 56375.9878\ Nm^2/C$$

(Ans)

c) Electric field,

$$E = \frac{k Q_{net}}{r^2}$$

Here, $r = 14\,m$

$$= \frac{8.987 \times 10^9 \times 4.9915 \times 10^{-7}}{(14)^2}$$

$$= 22.887\ N/C$$

(Ans)

Ans. To The Q. No. (2.3)

Here,

$$L_A = 40\,cm = 0.4\,m$$

$$\lambda_A = 23\,\mu C/cm = -23 \times 10^{-6} \times 100$$

$$= -23 \times 10^{-4}\ C/m$$

$$k = 8.987 \times 10^9\ N$$

$$d = 8\,cm = 0.08\,m$$

a) $$E_{x_1} = \frac{k \lambda_A L_A}{d(L_A + d)}$$

$$= \frac{8.987 \times 10^9 \times (-23 \times 10^{-4}) \times 0.40}{0.08(0.08 + 0.40)}$$

$$= -220098287\ N/C$$

(Ans)

$$E_{y_1} = 0\ N/C$$

(Ans)

b) Here,

$L_B = 24cm = 0.24\ m$

$y = 8\ cm = 0.08\ m$

$\lambda_B = +41\mu C/cm = +41 \times 10^{-4}\ C/m$

$E_0 = 8.854 \times 10^{-12}$

$E_{x_2} = 0\ N/C$ (Ans)

$$E_{y_2} = \frac{2\lambda_B}{4\pi\varepsilon_0 y}$$

$$= \frac{2 \times (+41 \times 10^{-4})}{4\pi \times 8.854 \times 10^{-2} \times 0.08}$$

$= 92124359.9\ N/C$ (Ans)

c) $E_x = E_{x_1} + E_{x_2}$

$= -220098287\ N/C$ (Ans)

$E_y = E_{y_1} + E_{y_2}$

$= 92124359.9\ N/C$ (Ans)