MID-TERM Examination

Fall-2023

Name : TASNIM RAHMAN MOUMITA

ID : 22301689

Course Title : Principles of Physics II

Course code : PHY112

Section : 02

Date : 09. 11. 2023

Tasnim Rahman Moumita
09. 11. 2023

Signature

Answer to the Question NO - 03 (a)

As per the theory,

The Electric Field outside a uniformly charged sphere at distance from the center,

$$E = \frac{q}{4\pi\epsilon_0 r^2}$$

here,
q = net charge on the sphere

Given,
radius = 10 cm = 0.1 m
d = 15 cm = 0.15 m
(distance)
magnitude, $E = 3\times10^3$ N/C

$$\Rightarrow q = 4\pi\epsilon_0 r^2 \times E$$

$$\Rightarrow q = 4\pi \times 8.85\times10^{-12} \times (0.15)^2 \times 3\times10^3$$

$$= 7.50 \times 10^{-9} \text{ C}$$

(Ans:)

Answer to the Question NO - 03 (b)

Know,
the net electric flux through the surface of a

...rce,

$$\varphi = \frac{Q}{\epsilon_0} = \frac{q}{\epsilon_0}$$

$$\Rightarrow \varphi = \left(\frac{7.50\times10^{-9}}{8.85\times10^{-12}}\right) = 847.4576 \text{ Nm}^2/\text{C}$$

net flux is 847.4576 Nm^2/C

(Ans:)

Ans. to the Q. NO - 04 (a)

For Electric Field,

negative gradient,

the components are,

$$E_x = -\frac{\partial V}{\partial x}$$

$$E_y = -\frac{\partial V}{\partial y}$$

$$E_z = -\frac{\partial V}{\partial z}$$

Given,

$$V = (2.0x^2 + 3.0y^2 + 5) \text{ volt.}$$

~~$\therefore E_x =$~~ $\therefore \Delta V = \left(\frac{\partial V}{\partial x}\right)\hat{i} + \left(\frac{\partial V}{\partial y}\right)\hat{j} + \left(\frac{\partial V}{\partial z}\right)\hat{k}$

$\Rightarrow$ i) $\frac{\partial V}{\partial x} = 4.0x$

$\Rightarrow$ ii) $\frac{\partial V}{\partial y} = 6.0y$

iii) $\frac{\partial V}{\partial z} = 0$

$E_x = -4.0x$

$E_y = -6.0y$

$E_z = 0$

$\therefore$ At the point, $(3.0\,m, 2.0\,m, 1.0\,m)$,

$E_x = -4.0 \times 3 = -12$ N/C

$E_y = -6.0 \times 2.0 = -12$ N/C

$E_z = 0 \times 1.0 = 0$ N/C

(Ans.)

Answer to the Q. NO - 4(b)

The electric field is non - uniform (non - constant) in the xy- plane.

Because,
the components in xy direction are not dependant on position or direction.

The given figure's magnitude and direction depend on the x and y's.

$\therefore$ The electric field is not uniform.

(Ans:)

Answer to the Question NO - 01 (a)

Given,

$q_1 = +5e$
$= -5\times -1.6\times10^{-19}$ C
$= 8\times10^{-19}$ C

$q_2 = +5e$
$= 5\times -1.6\times10^{-19}$ C
$= -8\times10^{-19}$ C

$d = 20.0$ cm
$= 0.2$ m

To place a proton in equilibrium, the net force on it must be 0 (zero)

We know,

from the Coulomb's Law,

$$F = \frac{q_1 q_2}{r^2}$$

let, for q_1,

$$F_1 = K\left(\frac{q_1}{d_1^2}\right)$$

for q_2,

$$\cancel{F_2 = K\left(\frac{q_2}{d_2}\right)}$$

$$F_2 = K\left(\frac{q_2}{(d_2-x)^2}\right)$$

For equilibrium,

$$F_1 = F_2$$

$$\Rightarrow K\left(\frac{q_1}{d_1^2}\right) = K\left(\frac{q_2}{(d_2-x)^2}\right)$$

$$\Rightarrow K.\frac{8\times10^{-19}}{(0.2)^2} = K\left(\frac{-8\times10^{-19}}{(0.2-x)^2}\right)$$

$$\cancel{\Rightarrow 6x^2 - 2x + 0.04 = 0}$$

$$\Rightarrow x = 0.05 \text{ m} \quad \text{and} \quad x = 0.15$$

$$\left[x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}\right]$$

$\therefore$ Ans:- 0.05 m, 0.15 m (Ans:)

Answer to the Question NO - 1(b)

to determine two points where electric field will be 0,

we need to use coulomb's law,

we know,

$$E = K.\frac{q}{r^2} \quad \Big| \quad K = \text{coulomb's constant.}$$

for $q_1 = K\frac{q_1}{r^2} = K.\frac{q_1}{x^2} = E_1$ —— (i)

for $q_2 = K.\frac{q_2}{(d-x)^2} = E_2$ —— (ii)

(i) & (ii) ⇒

$$K.\frac{q_1}{x^2} = K.\frac{q_2}{(d-x)^2}$$

$$\Rightarrow \cancel{K.}\frac{q_1}{x^2} = \frac{q_2}{(d-x)^2}$$

$$\Rightarrow \frac{-5e}{x^2} = \frac{\cancel{q_2}\,5e}{(0.2-x)^2}$$

$$\Rightarrow 6x^2 - 2x + 0.04 = 0$$

$$\Rightarrow x = 0.3119 \text{ m},$$

$$x = 0.213 \text{ m}$$ (Ans:)