NAME: UGOCHUKWU CHIZITEREM PRECIOUS..

MATRIC NUMBER: 19/MHS01/414.

COURSE CODE: PHY 102.

DEPARTMENT: MEDICINE AND SURGERY.

SECTION: 2019/2020

COVID-19 HOLIDAY ASSIGNMENT.

NAME: UGOCHUKWU CHIZITEREM PRECIOUS

MATRIC NUMBER: 19/MHS01/414

COLLEDGE: MEDICINE AND HEALTH SCIENCES

DEPARTMENT: MEDICINE AND SURGERY

COURSE: PHYSIC 102

COVID-19 HOLIDAY ASSIGNMENT.

SECTION A

2(a) Distinguish between the terms electric field and electric field intensity.

Ans: Electric field is a region of space in which an electric charge will experience an electric force while electric field intensity or strength is the force per unit charge.

(b) $Q_1 = 8\times10^{-9}C$ $Q_2 = 12\times10^{-9}C$

$E_1 = \frac{KQ_1}{r^2} = \frac{9\times10^9\times8\times10^{-9}}{7^2} = 1.5N/C$

$E_2 = \frac{KQ_2}{r^2} = \frac{9\times10^9\times12\times10^{-9}}{7^2} = 12N/C$

$E_{net} = \vec{E_1} + \vec{E_2} = (1.5 \ast 12)N/C = 13.5N/C$

$E_1 = \frac{KQ_1}{r^2} = \frac{9\times10^9\times8\times10^9}{3^2} = 8N/C$

$E_2 = \frac{KQ_2}{r^2} = \frac{9\times10^9\times12\times10^{-9}}{5^2} = 4.3N/C$

Vector	Angle	x-component	y-component
$E_1 = 8N/C$	90^0	~~-3.1~~ 0	8
$E_2 = 4.32N/C$	36.87^0	-3.45	2.59
		-3.45	10.59

$E_{net} = \sqrt{\Sigma Fx^2 + \Sigma fy^2}$

$E_{net} = 11.12N/C$

3) (i) volume Charge density, $\rho = \frac{dQ}{dV} \rightarrow dQ = \rho dV$

(ii) surface charge density, $\sigma = \frac{dQ}{dA} \rightarrow dQ = \sigma dA$

(iii) Linear charge density, $\lambda = \frac{dQ}{dL} \rightarrow dQ = \lambda dL$

(b) Electric potential difference between two points in an electric field can be defined as the work done per unit charge against electrical forces when a charge is transported from one point to the other. It is measured in volt (V) or joules per coulomb (J/C).

$$V = \frac{\text{workdone (J)}}{q_0 \text{ Charge}}, \quad V_B - V_A = \frac{U_B - U_A}{q_0}$$

c) Point Charge $Q_1 = 10\mu C$ $Q_2 = 2\mu C$

$$V_P = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right] \quad \text{recall } \frac{1}{4\pi\varepsilon_0} = 9\times10^{9}$$

$$V_P = 9\times10^{9}\left[\frac{(10\times10^{-6})}{4+x} + \frac{(-2\times10^{-6})}{x}\right]$$

$$0 = 9\times10^{-9}\left[\frac{(10\times10^{-6})}{4+x} + \frac{(-2\times10^{-6})}{x}\right]$$

$$10\times10^{-6}x = (4+x)(2\times10^{-6})$$

$$10\times10^{-6} = 8\times10^{-6} + 2x \times 10^{-6}x$$

$$8\cancel{x}\, 10^{-6} = 8\times10^{-6}x \quad x = 1.$$

∴ The position along the x axis is 1m where $V = 0$

$$V = K\left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right]$$

$$0 = \left[(1.0\times10^{-6}) + \frac{(-2\times10^{-6})}{x}\right]$$

$$8\times10^{-6} = 12\times10^{-6}x$$

$$x = \frac{8\times10^{-6}}{12\times10^{-6}}$$

$$x = 0.67\,m.$$

SECTION B

4a) Magnetic flux is the strength of magnetic field represented by lines of force. It is usually represented by the symbol ϕ

b) $m = 9.11 \times 10^{-31}$ Kg $r = 1.4 \times 10^{-7}$ $B = 3.5 \times 10^{-1}$ T ~~f = ?~~
$\omega = ?$

$$V = \frac{rqB}{m} = \frac{(1.4 \times 10^{-7})(1.6 \times 10^{-19})(3.5 \times 10^{-1})}{(9.11 \times 10^{-31})}$$

$$= \frac{7.84 \times 10^{-27}}{9.11 \times 10^{-31}}$$

$$= 8.605 \times 10^{3} \text{ m/s}$$

$$\omega = \frac{V}{r} \quad \omega = \frac{8.605 \times 10^{3}}{1.4 \times 10^{-7}}$$

$$= 6.15 \times 10^{10} \text{ rad/s}$$

c) The angular speed ω is another name for cyclotron frequency.
$\therefore$ The change of angular displacement with respect to ~~distance~~ time is 6.15×10^{10} rad/s.

5a) Biot-Savart law states that the magnetic intensity at any point due to a steady current in an infinitely long straight wire is directly proportional to the distance from point to wire.

(b) $B = \frac{\mu_0 I}{2\pi r}$

$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} \frac{dL \sin\varphi}{r^2}$

$\sin(\pi - \varphi) = \sin\theta$

$\therefore B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} \frac{dL \sin(\pi-\varphi)}{r^2}$

$r^2 = x^2 + y^2$ (pythagoras theorem)

$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} \frac{dL \sin(\pi-\varphi)}{x^2+y^2}$ ---- (i)

But $\sin(\pi - \varphi) = \frac{x}{\sqrt{x^2+y^2}} = \frac{x}{(x^2+y^2)^{1/2}}$ ---- (ii)

Substituting (ii) into (i),

$$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} dL \frac{x}{(x^2+y^2)(x^2+y^2)^{1/2}}$$

$$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} dL \frac{x}{(x^2+y^2)^{3/2}}$$

Recall $dl = dy$

$$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} \frac{x}{(x^2+y^2)^{3/2}} dy$$

$$B = \frac{\mu_0 I x}{4\pi}\int_{-a}^{a} \frac{1}{(x^2+y^2)^{3/2}}\, dy \quad --- (iii)$$

using special integrals:

$$\int \frac{dy}{(x^2+y^2)^{3/2}} = \frac{1}{x^2}\,\frac{y}{(x^2+y^2)^{1/2}}$$

Equation (iii) therefore becomes

$$B = \frac{\mu_0 I x}{4\pi}\left[\frac{y}{x^2(x^2+y^2)^{1/2}}\right]_{-a}^{a}$$

$$B = \frac{\mu_0 I x}{4\pi}\left(\frac{2a}{x^2(x^2+a^2)^{1/2}}\right)$$

$$B = \frac{\mu_0 I}{4\pi x}\left(\frac{2a}{(x^2+a^2)^{1/2}}\right)$$

$(x^2+a^2)^{1/2} \cong a$, as $a \to \infty$

$$\therefore B = \frac{\mu_0 I}{2\pi x},$$