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Department: Nursing

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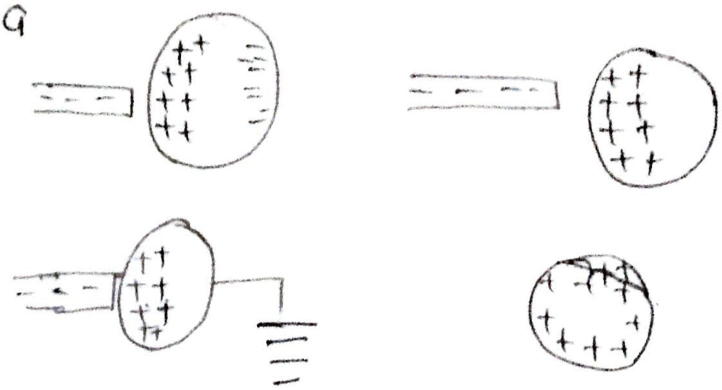


$F = 1.0N$ $k = 9\times10^9$ $r = 2.0m$

b $q_1 + q_2 = 5.0\times10^{-5}C$ --- (1)

$F = \frac{kq_1q_2}{r^2}$ --- (2)

$q_1 = 5.0\times10^{-5} + q_2$ --- (3)

$1 = \frac{9\times10^9(5.0\times10^{-5} - q_2)q_2}{2^2}$

$1 = \frac{9\times10^9\times(5.0\times10^{-5} - q_2)q_2}{}$

$1 = \frac{4.5\times10^5 q - 9\times10^9 q^2}{4}$

$4 = 4.5\times10^5 q - 9\times10^9 q^2$ (Transfer the R.H.S to the L.H.S

$= 9\times10^9 q^2 - 4.5\times10^5 q + 4$

~~quadrati~~ quadratic equtions

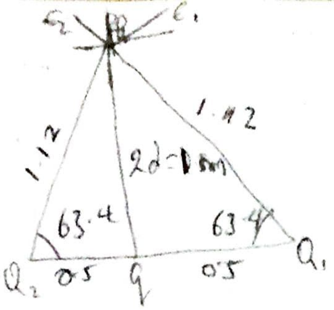
$q_1 = 3.84\times10^{-5}C$ or $1.15\times10^{-5}C$

6 7

$\tan\theta = \frac{opp}{Adj}$

$\tan\theta = \frac{1}{0.5}$

$\theta = 63.4$



$x^2 = 1^2 + 0.5$

$\sqrt{x} = \sqrt{1.25}$

$x = 1.12$

$Q_1 = Q_2 = 8\times10^{-6}C$

$E_p = E_1 + E_2 + E_q$

$E_1 = \frac{kq_1}{r_1^2}$ $E_2 = \frac{kq_2}{r_2^2}$ $E_q = \frac{kq_2}{r_q}$

$E_1 = \frac{9\times10^9 \times 8\times10^{-6}}{1^2} = 7.2\times10^4$

$E_2 = \frac{9\times10^9\times8\times10^{-6}}{1^2} = 7.2\times10^4$

$E_q = \frac{9\times10^9\times q}{1} = 9\times10^9 q$

Vector	angle	x-Component	y-Component
7.2×10^4	63.4°	$E_1 = 7.2\times10^4\cos63.4$ $= -32{,}238.65$	$E_1 = 7.2\times10^4\sin63.4$ $= 64379.10$
$= 7.2\times10^4$	63.4°	$E_2 = 7.2\times10^4\cos63.4$ $= 32238.65$	$E_2 = 7.2\times10^4\sin63.4$ $= 64379.10$
$= 9\times10^9 q$	90°	$E_q = 9.2\times10^9 q\cos90$ $= 0^\circ$	$E_q = 9.2\times10^9 q\cos90$ $= 9.2\times10^9 q$
		$\Sigma f_x = 0$	$\Sigma f_y = 128758.2$

$\text{magnitude} = \sqrt{(Ex^2) + (E_y)^2}$

$E_q = \sqrt{(0)^2 + (128758.2)^2}$

$= \sqrt{(128758.2)^2}$

$= 128758.2$

since $E = 0$

$0 = 9.2\times10^9 q + 128758.2$

$\frac{-9.2\times10^9 q}{-9.2\times10^9} = \frac{-128758.2}{9.2\times10^9}$

$|q| = +1.3\times10^{13}$

(a) Distinguish between electric field and electric field intensity

Ans. Electric field is a region around a charge in which it exerts electrostatic force on another charges while the strength of electric field at any point in space is called electric field intensity.

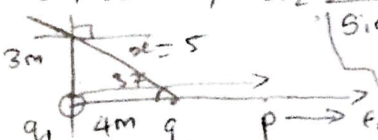
(b) A positive charge $Q_1 = 8nC$ is at the origin, and a second positive charge $Q_2 = 12nC$ is on the x-axis at $x = 4m$. Find

(i) the net electric field at point P on the x-axis at $x = 7m$

(ii) The electric field at a point Q on the y axis at $y = 3m$ due to the charge.

Ans

$Q_1 = 8\times10^{-9}C$, $Q_2 = 12\times10^{-9}C$, $k = 9\times10^9$ $r_1 = 7m$ $r_2 = 3m$



$\sin\theta = \frac{3}{5}$

$\theta = 37°$

$\vec{E_p} = \vec{E_1} + \vec{E_2}$

$E_1 = \frac{kq_1}{r_1^2} = \frac{9\times10^9 \times 8\times10^{-9}}{7^2}$

$= 1.489 N/C$

$= \frac{kq_2}{r_2^2} = \frac{9\times10^9 \times 12\times10^9}{3^2}$

$= 12 N/C$

$1.469 + 12 = 13.5 N/C$

(ii) $E_1 = \frac{kq_1}{r_1^2} = \frac{9\times10^9 \times 8\times10^{-9}}{3^2}$

$= 8 N/C$

To Solve for $r = x^2 = y^2 + h^2$

$r^2 = 3^2 + 4^2$

$r^2 = \sqrt{25}$

$r = 5$

$E_2 = \frac{kq_2}{r_2^2} = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} = 4.3$

vector	Angle	x-Component	y-Comp
$E_1 = 8N/C$	90°	$E_1 = 8\cos 90 = 0°$	$E_2 = 8\sin$ $= 8$
$E_2 = 4.32$	37°	$E_2 = 4.32\cos 37° = 3.450°$	$E_2 = 4.3$ $= 2.5$
	ΣF	3.450°	10.5

$F = \sqrt{\Sigma f_x^2 + \Sigma f_y^2}$

$= \sqrt{(3.450^2) + (10.599)^2}$

$= \sqrt{124.241}$

$11.15 NC$

(5) State the formulation of the following identities of charges

(i) volume charge density: $\rho = q/v$
where q = charge, v = volume of distribution

(ii) Surface charge density: $\sigma = q/A$
where q = charge, A = Area of the surface

(iii) Linear charge density: $\lambda = q/l$
where q = charge, l = Length

(6) Explain with appropriate equation, the electric potential difference

Ans: $dw = F.dl$ ---- (1)

l to represent displacement

$F = -q_0E$ ---- (2) Substituting equ (2) into (1)

$dw = -q_0E.dl$

$dw = -q_0E\,dl$ ---- (3) total work done in moving the test charge from A to B is

$W(A \to B)_{Ag} = -q_0\int_L^B E\,dl$ ---- (5)

from the definition of equation potentional difference

$V_B - V_A = \frac{W(A \to B)_{Ag}}{q_0}$ Put equation (4) in 5

$\boxed{V_B - V_A = -\int_A^B E\,dl}$ ---- (6)

) Two point charge $Q_1 = 10\mu C$ and $Q_2 = -2\mu C$ are arranged along the x-axis at $x=0$ and $x = 4m$ respectively. find the position along the x-axis where $V=0$

$Q = 10\times10^{-6}C$ $\quad Q_2 = -2\times10^{-6}C$, $k = 9\times10^9$ $\quad V = 0, r_2 = ?, r_1 = 4+x$

$\overrightarrow{\quad 4 \quad}P$ $\quad Q \xleftrightarrow{x} V=0$

$V_p = k\left(\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right)$

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

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

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

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

$\frac{10\times10^{-6}}{4+x} \times \frac{2\times10^{-6}}{x}$

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

C.L.T

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

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

$x = 1m$

$x_4 \therefore 4+x = 4+1$

$= 5m$

(1)(a) What is magnetic flux!

Ans: It is the strength of magnetic field represented by lines of force.

(b) An electron with a rest mass of 9.11×10^{-31} kg moves in a circular orbit of radius 1.4×10^{-7} m in a uniform magnetic field of 3.5×10^{-1} tesla, perpendicular to the speed of light with which electron moves. Find the cyclotron frequency of the moving electron

Ans:

$B = 3.5\times10^{-1}\,T$, $m = 9.11\times10^{-31}$, $q = 1.6\times10^{-19}$, $r = 1.4\times10^{-7}$ m

$f = ?$

$$T = \frac{2\pi m}{qB}$$

$$T = \frac{2\times3.142\times9.11\times10^{-31}}{1.6\times10^{-19}\times3.5\times10^{-1}}$$

$$= \frac{5.7247\times10^{-30}}{5.6\times10^{-20}} = 1.022\times10^{-50}$$

where $f = \frac{1}{T}$

$$f = \frac{1}{1.022\times10^{-50}} = \underline{9.78\times10^{-51}}$$

(c) Discuss your answer

Since we know that $f = 1/T$ and we are to find cyclotron frequency. $T = \frac{2\pi m}{qB}$, we were given m, q, and B so we make use of it to get our answer. I would say we are not going to make use of the radius here because there is no velocity. To back up my point $\omega = \frac{v}{r}$, $T = \frac{2\pi r}{v} = \frac{2\pi}{\omega} = \boxed{\frac{2\pi m}{qB}}$

So there is no use of the radius here.

(5) (a) State the Biot - Savart law

This law state that the magnetic field (dB) at point P due to small current element Idl of current carrying conductor is (i) Directly proportion to the Idl (Current) element of the conductor

(ii) Directly proportional to $\sin\theta$ $dB \propto \sin\theta$

(iii) Inversely proportional to the square of the distance of point P from the current element

b) Using the Biot - Savart law, show that the magnitude of the magnetic field of straight current - carrying conductor is given as $B = \frac{\mu_0 I}{2\pi r}$

Ans

$$\frac{1}{2} B = I \frac{\mu_0}{4\pi} \int_{\frac{\pi}{2}}^{0} \left(\frac{\sin^3\theta}{R^2} \right) \left(-\frac{R}{\sin^2\theta} \right) d\theta$$

$$\frac{1}{3} B = \frac{I \mu_0}{4\pi R} \int_{\frac{\pi}{2}}^{0} - \sin\theta \, d\theta$$

$$B = \frac{2I \mu_0}{4\pi R} [\cos\theta]_{\frac{\pi}{2}}^{0}$$

$$B = \frac{\mu_0 I}{2\pi R}$$