Using $B = \frac{\mu_0 I}{2\pi r}$ to find B where μ_0 is ... I is current in ampere. r is distance which was not given so I used it as 0.05m.

i.e $= r = 0.05m$, $I = 0.1A$.

$\pi = 3.142$, $\mu_0 = 4$

$$B = \frac{4\pi \times 10^{-7}(0.1)}{2(3.142)(0.05)}$$

$$B = 4 \times 10^{-7} T_4.$$

∴ to find E using $\mathcal{E} = \frac{N.d\phi_B}{dt}$.

$$\mathcal{E} = \frac{N.BA}{dt}$$

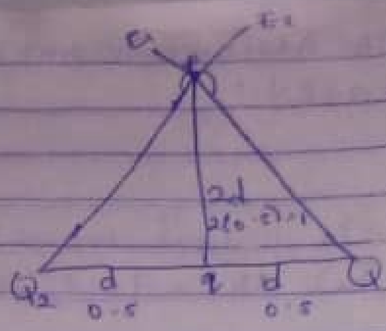
$$0.8 = \frac{75.4 \times 10^{-7}(0.05 \times 0.08)}{dt}$$

$$0.8dt = 1.2 \times 10^{-7}$$

$$dt = \frac{1.2 \times 10^{-7}}{0.8}$$

$$dt = 1.5 \times 10^{-7} s.$$

1(c)

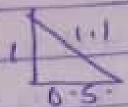


taking a part of the triangle ie 

Using Pythagoras theorem.

$x^2 = 1^2 + 0.5^2$.

$x = 1.1$.



Using SOHCAHTOA to get the angle.

$\tan\theta = \frac{opp}{adj} : \frac{1}{0.5} =$

$\theta = 63.4°$

$E = \frac{kQ}{r^2}$ $\quad E_p = E_1 + E_2 + E_3 + E_4$

$Eq_1 = \frac{kQ_1}{r^2} : \frac{9\times10^9(8\times10^{-6})}{(1.1)^2} = 59504\ N/C$.

$Eq_2 = \frac{kQ_2}{r^2} : \frac{9\times10^9(8\times10^{-6})}{(1.1)^2} = 59504\ N/C$.

$Eq_3 = \frac{kQ_3}{r^2} : \frac{9\times10^9 Q_3}{(1)^2} = 9\times10^9 Q_3\ N/C$.

Resolve into vertical and horizontal components.

Vector (N/C)	Angle (θ)	X-Component $E\cos\theta$	Y-component
$Eq_1 = 59504$	63.4°	59504 cos 63.4 = −26644 N/C	59504 sin 63.4 = 53206 N/C
$Eq_2 = 59504$	63.4	59504 cos 63.4 = 26644 N/C.	59304 sin 63.4 = 53206 N/

6a) Faraday's law in the ~~application~~ Production of Sound in an electric guitar is by a changing magnetic field produces electricity. So a guitar string will produce electricity only for as long as the magnetic field is changing. i.e the metal string is in motion. Once the string stops vibrating, the sound stops.

Section B

4a) Magnetic flux is simply the strength of the magnetic field that can be represented by lines of force. Mathematically $\phi = B \cdot da$

4b) $M_e = 9.11 \times 10^{-31}$ kg, $q = 1.6 \times 10^{-19}$ C, $r = 1.4 \times 10^{-7}$ m, $B = 3.5 \times 10^{-1}$ T
$f = ?$

$F = |q| v B \sin\theta$ where $\theta = 90°$ because of perpendicularity

$\therefore F = qvB$, $f = \frac{mv^2}{r}$

$$qvB = \frac{mv^2}{r}$$

$$\frac{qvBr}{\cancel{r}} = \frac{mv^2}{\cancel{r}} , \quad qBr = mv$$

$$* \quad v = \frac{qBr}{m} \quad *$$

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

$$v_e = 8605.93 \text{ m/s}$$

Using $T_e = \frac{2\pi r}{v_e}$ where T_e = Cyclotron frequency of the electron.

$$T_e = \frac{2(3.142)(1.4 \times 10^{-7})}{(8605.93)}$$

$$T_e = \frac{8.7976 \times 10^{-7}}{8605.93}$$

$$T_e = 1.0223 \times 10^{-10} \, s^{-1}$$

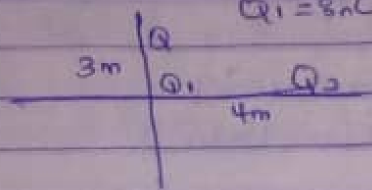
4c) With the parameters given above. To find cyclotron frequency (T) we first have to find Velocity (m/s) i.e speed at which the electrons which is gotten by $F = |q| vB\sin\theta$ where $\theta = 90$ because it is perpendicular as stated by the question. F is also equal to $\frac{mv^2}{r}$ when qvB and $\frac{mv^2}{r}$ are equated

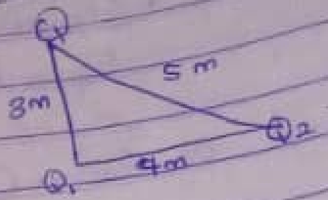
2a Electric field

Region of space in which an electric force is felt by electric charges.

Electric field intensity: It is the force felt by electric charges per unit charge mathematically. $E = \frac{F}{q_0}$

2b $Q_1 = 8nC,\ Q_2 = 12nC,\ x = 4m$





$$E = \frac{Kq}{r^2}$$

$$E_1 = \frac{Kq_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{3^2} = 8n/C$$

$$E_2 = \frac{Kq_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} = 4.32n/C$$

Resolve into vertical and horizontal axis.

Vector	Angle (θ)	x-Component $E\cos\theta$	y-Component $E\sin\theta$
$E_1 = 8n/C$	$90°$	$E_x = 8\cos 90$ 0	$E_{y_1} = 8\sin 90$ $E_y = 8$
$E_2 = 4.32n/C$	$36.9°$	$4.32\cos 36.9$ $= -3.45$	$4.32\sin 36.9$ $= 2.59$
		$\Sigma E_x = -3.45$	$\Sigma E_y = 10.59$

$$|E| = \sqrt{\Sigma E_x^2 + \Sigma E_y^2}$$

$$|E| = \sqrt{(-3.45)^2 + (10.59)^2}$$

$$E = 11.14N/C$$

$E_{q3} = 9\times10^9 q$	90°	$9\times10^9 q\cos 90$ 0 $\Sigma f x: 0$	$9\times10^9 q\sin 90$ $9\times10^9 q$ $\Sigma f y: 106412 + 9\times10^9 q$

$$|E_p| = \sqrt{\Sigma f x^2 + \Sigma f y^2}$$

$$|E_p| = \sqrt{(0)^2 + (106412 + 9\times10^9 q)^2}$$

$$E_p = 0 + 106412 + 9\times10^9 q$$

$$E_p = 106412 + 9\times10^9 q$$

at $E_p = 0$.

$$106412 + 9\times10^9 q = 0$$

$$9\times10^9 q = -106412$$

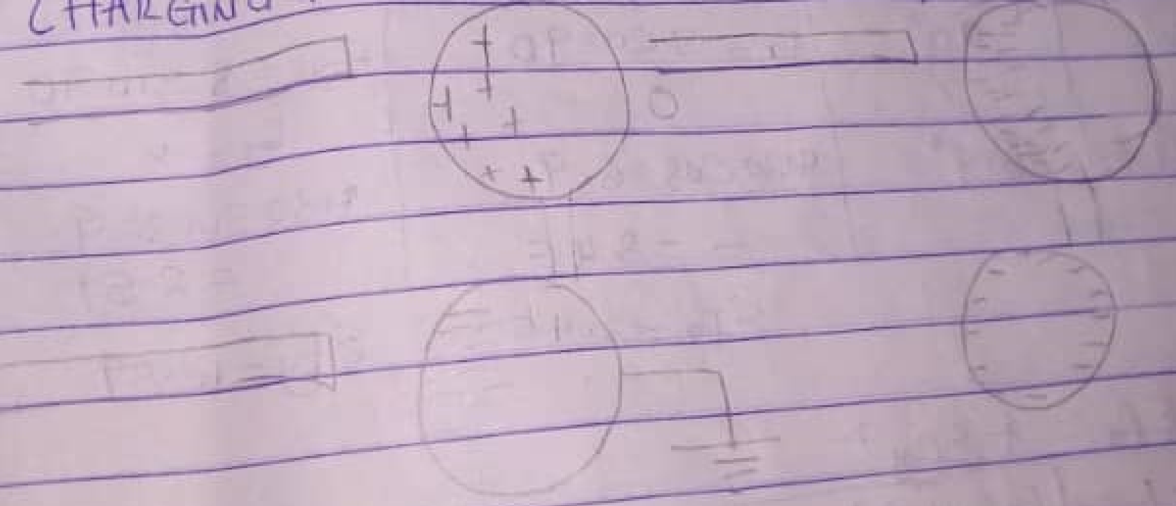
Divide by 9×10^9.

$$\frac{9\times10^9 q}{9\times10^9} = \frac{-106412}{9\times10^9}$$

$$q = -1.18\times10^{-5}\,C$$

$$q = -12\mu C$$

CHARGING A NEGATIVELY CHARGED SPHERE BY INDUCTION



$\frac{4\pi\times10^{-7}(0.1)}{2(3.142)(0.05)}$

$B = 4\times10^{-7}\ T$.

... using $\mathcal{E} = N.\frac{d\phi_B}{}$

and V is made the subject of the equation we can get V. Velocity can then be used to find the Cyclotron frequency by either finding angular speed using the formula

$\omega = \frac{qB}{m}$ or $\omega = \frac{v}{r}$ and then putting into the formula $T = \frac{2\pi}{\omega}$ or simply cyclotron frequency can be gotten straight by $T = \frac{2\pi r}{v}$ as shown in 4b above.

... current V
... ation frequency
... the formula
... ng into the

... ation frequency

... as shown

6a) $N = 300$ turns, $R = 2.0\Omega$, $L = 10cm$ (0.1m), $\theta = 0$ (because it is perpendicular). $t_1 = 0s$, $t_2 = 0.5s$, $B = 10T$.

⇒ Equation: $\varepsilon = N \cdot \frac{d\phi_B}{dt}$.

where N = number of turns, $dt = t_2 - t_1$ (time in seconds)

ε = induced emf

$\phi_B = BA\cos\theta$. recall $\theta = 0°$ because of perpendicularity

$\therefore \phi_B = BA$. where A = area. and according to the question the object is a square $\therefore$ ~~Area~~ Area of a square $(L \times L)$.

(i) $\therefore \varepsilon = N \cdot \frac{dBA_{square}}{t_2 - t_1}$

$\varepsilon = 300 \cdot \frac{10(0.1)(0.1)}{0.5 - 0}$

$\varepsilon = \frac{30}{0.5}$

$\varepsilon = 60\ Tm/s$.

$R = 2.0\Omega$ $\varepsilon = 60Tm/s$. $I = ?$ (current)

(ii) $\varepsilon = IR$.

$I = \frac{\varepsilon}{R}$.

$I = \frac{60}{2}$

$I = 30A$ //

6c) Area of rectangle: width x height = 5cm x 8cm. (0.05 x 0.08). $R = 8\Omega$, $B = ?$ $I = 0.1$, $N = 75$ turns, $\theta = 0°$ (perpendicularity)

Using: $\varepsilon = IR$.

$\varepsilon = 0.1 \times 8$.

$\varepsilon = 0.8\ Tm/s$

$\phi_B = BA$

$\varepsilon = N \cdot \frac{d\phi B}{dt}$

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SECTION A

1(a) $q_1+q_2=5.0\times10^{-5}C$, $q_1=5.0\times10^{-5}-q_2$, $f=1.0al$, $r=2.0m$, $k=9\times10^9$

$F=\frac{kq_1q_2}{r^2}$; $F.0 = \frac{9\times10^9(q_1q_2)}{(2)^2}$; $4=9\times10^9(q_1q_2)$.

$q_1q_2=\frac{4}{9\times10^9}$; $q_1q_2=4.44\times10^{-10}$.

Recall: $q_1+q_2=5.0\times10^{-5}$ ∴ $q_1=5.0\times10^{-5}-q_2$ — (1).

$q_1q_2=4.44\times10^{-10}$ — (2).

Input (1) into (2).

i.e. $(5.0\times10^{-5}-q_2)q_2=4.44\times10^{-10}$

$5.0\times10^{-5}q-q_2^2=4.44\times10^{-10}$

$q_2^2-5.0\times10^{-5}q+4.44\times10^{-10}=0$

Using $q=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

where: $a=1$, $b=-5.0\times10^{-5}$, $c=4.44\times10^{-10}$.

$q=\frac{-(-5.0\times10^{-5})\pm\sqrt{(-5.0\times10^{-5})^2-4(1)(4.44\times10^{-10})}}{2(1)}$

$q=\frac{5\times10^{-5}\pm2.69\times10^{-5}}{2}$.

for $q=\frac{5\times10^{-5}+2.69\times10^{-5}}{2}$; $q=3.845\times10^{-5}C$.

for $q=\frac{5\times10^{-5}-2.69\times10^{-5}}{2}$; $q=1.15\times10^{-5}C$

Replacing values into eqn (1).

$q_1=5.0\times10^{-5}-3.845\times10^{-5}C=1.15\times10^{-5}C$

$q_2=5.0\times10^{-5}-1.15\times10^{-5}=3.845\times10^{-5}C$

∴ $q_1=1.15\times10^{-5}C$, $q_2=3.845\times10^{-5}C$ or vise vorse.