6a

Application of Faradys law in the production of Sound in electric guitar
- The coil in this case called the pickup coil is placed near the vibrating guitar string which is made of a metal that can be magnetized. A permanent magnet inside the coil magnetizes the portion of the string nearest the coil. When the string vibrates at some frequency, its magnetized segment produces a changing magnetic flux through the coil. The changing flux induces as emf in the coil that is fed to an amplifier. The output of the amplifier is sent to the loudspeakers, whic produces the sound waves we hear.

6b.

The magentic flux through the coil at $t=0$ is 0 because $B=0$ at the time

$$|\varepsilon| = N\, d\Phi_B/dt$$

$$|\varepsilon| = N\, \Delta\Phi_B/\Delta t$$

$$|\varepsilon| = N\, \Delta\Phi_B/\Delta t = N \frac{(\Phi_B(t_2) - \Phi_B(t_1))}{t_2 - t_1}$$

6c

4a

The magnetic flux through a surface is the surface integral of the normal component of the magnetic field with flux density B passing through the medium. Or Magnetic flux is the strength of magnetic field represented by lines of force

4b By deduction ~~[illegible]~~ $F = \frac{qB}{2\pi m}$

$\therefore q = 1.6 \times 10^{-19}$

$B = 8.5 \times 10^{-1}$

$m = 9.11 \times 10^{-31}$

$$F = \frac{1.6 \times 10^{-19} \times 8.5 \times 10^{-1}}{2(\pi)(9.11 \times 10^{-31})}$$

$$= \frac{1.6 \times 10^{-19} \times 8.5 \times 10^{-1}}{2(3.142)(9.11 \times 10^{-31})}$$

$$= \frac{1.6 \times 10^{-19} \times 8.5 \times 10^{-1}}{(6.284)(9.11 \times 10^{-31})}$$

$$F = 9.7 \times 10^{11} Hz$$

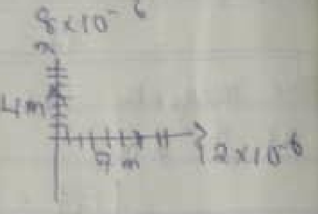
5) 2 Distinguish between the terms: electric field and electric field intensity
A positive charge $Q_1 = 8nC$ is at the origin, and a second positive charge $Q_2 = 12nC$ is on the x- axis at x = 4m. Find
i the net electric field at a point P on the x axis at x = 7m
ii. the electric field at a point Q on the y axis at y = 3m due to the charges

2a Solution
Electric field is a region of space in which electric charge is felt
when electric field intensity is the force per unit charge
mathematically:

$$E = \frac{F(N)}{q(C)}$$

(2b) $Q_1 = 8 \times 10^{-6}$
$Q_2 = 12 \times 10^{-6}$
$r_1 = 4m$

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



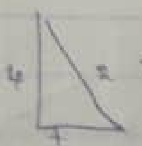
Note: Point P is a vector sum where $E_x(net) = \Sigma E_x = E_{x_1} + E_{x_2}$
$\therefore E_{net} = \sqrt{E_{x^2} + E_{y^2}}$

Obtaining the electric fields:

$$Q_1 = \frac{kq}{r^2} = \frac{9.0 \times 10^9 \times 8 \times 10^{-6}}{7^2} = 1467.75 = 1.47 \times 10^3 N/C$$

$E_2 = r?$ from the diagram

$$E_2 = \frac{kq}{r^2}$$



$= x^2 = \sqrt{4^2 + 7^2}$
$r = 8$

$$= \frac{9 \times 10^9 \times 12 \times 10^{-6}}{8^2} = 4.48 \times 10^1 N/C$$

$\therefore E_x = 2.219 N/C$

$E_y = 147.000 + 4.438 = 147004.438$

$E_{net} = \sqrt{E_x^2 + E_y^2}$
$= \sqrt{(2.219)^2 + (147004.438)^2}$
$= 1.47 \times 10^3 N/C$

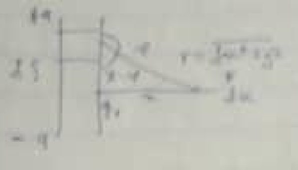
Calculating angle $\tan\theta = (y/x)$
$\theta = \tan^{-1}(y/x)$
$= \tan^{-1} 4/7$
$= 29.7 \simeq 30°$

$\therefore (E_2)_x = 4.48 \times \cos 29.7 = 2.219$
$(E_2)_y = 4.48 \times \sin 29.7 = 2.219$
$\Sigma\ 4.438$

5

a) Bio savarts law is an equation that describes the magnetic field created by a current carrying wire and allows one to calculate its strength

5b)



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

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

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

From diagram $r^2 = x^2 + y^2$ (pythagorean)

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

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

$= \frac{x}{(x^2 + y^2)^{1/2}}$ — (ii)

~~B = μ0 I~~ Sub. eqn (ii) in (i)

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

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

Recall $dl = dy$

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

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

Using integration

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

Equation (iii) becomes

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

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

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

when the length 2a of the conductor is very great in comparison to its distance x from point P. we consider it infinetly long. That is when a is much larger than x

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

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