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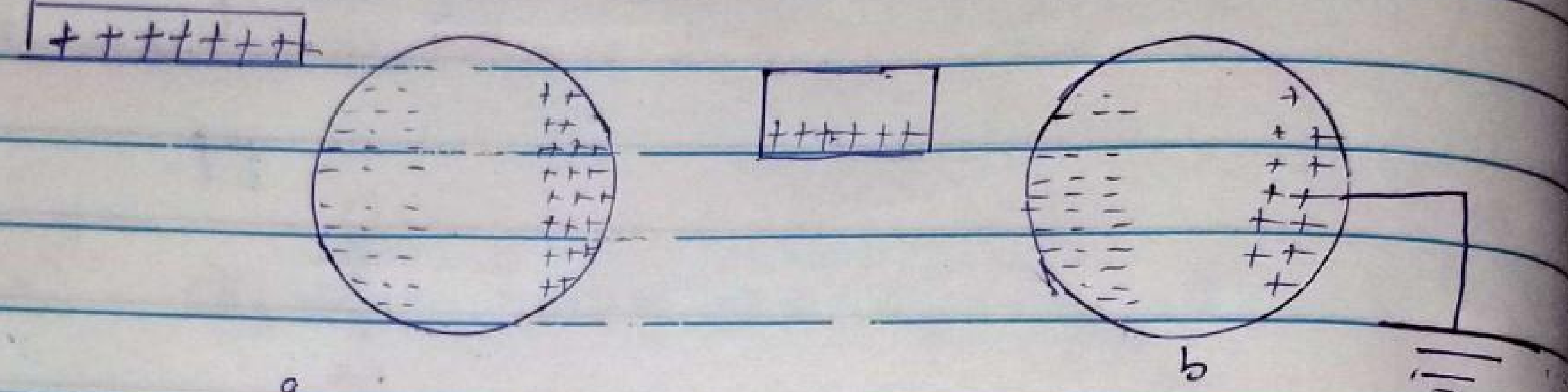
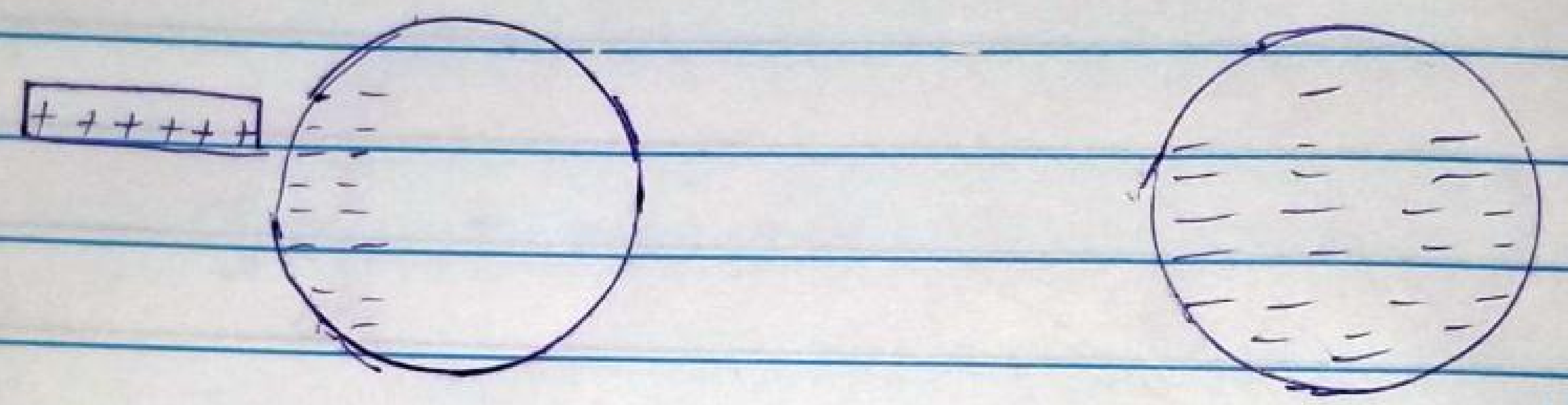
Electrical / Electronics Engineering
19/ENG04/030

1.



a b



c d

1b) $q_1 + q_2 = 5.0 \times 10^{-5}\,C$

$q_1 = 5.0 \times 10^{-5}\,C - q_2$

using

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

$$1 = \frac{9 \times 10^{9} (5.0 \times 10^{-5} - q_2) q_2}{2^2}$$

$$4 = 4.5 \times 10^{5} q_2 - 9 \times 10^{9} q_2^2$$

$$9 \times 10^{9} q_2^2 - 4.5 \times 10^{5} q_2 + 4 = 0$$

(ABUAD), The Road to Intellectualism, Quality and Excellence using

$$q_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad a = 9 \times 10^9 \quad b = -4.5 \times 10^5$$

$$q_2 = \frac{4.5 \times 10^5 \pm \sqrt{(-4.5 \times 10^5)^2 - 4(9 \times 10^9)(4)}}{2(9 \times 10^9)}$$

$$q_2 = \frac{4.5 \times 10^5 \pm \sqrt{2.025 \times 10^{11} - 1.44 \times 10^{11}}}{1.8 \times 10^{10}}$$

$$q_2 = \frac{4.5 \times 10^5 \pm \sqrt{5.85 \times 10^{10}}}{1.8 \times 10^{10}}$$

$$q_2 = \frac{4.5 \times 10^5 + \sqrt{5.85 \times 10^{10}}}{1.8 \times 10^{10}} \quad \text{or} \quad q_2 = \frac{4.5 \times 10^5 - \sqrt{\ }}{1.8 \times 10^{10}}$$

$q_2 = 3.84 \times 10^{-5}$ C

$q_2 = 1.16 \times 10^{10}$ C

4a. Magnetic flux shows the quantity or strength of magnetic lines produced by the magnet. It is a measurement of the total magnetic field which passes through a given area.

4b. Cyclotron frequency (F) $= \frac{qB}{2\pi m}$

$$F = \frac{1.6\times10^{-19} \times 3.5\times10^{-1}}{2\times\frac{22}{7}\times9.11\times10^{-31}}$$

$$f = 9.78\times10^{9}\ Hz$$

4c. We get the cyclotron frequency formula from the formula of a period $(T) = \frac{2\pi m}{qB}$ and we know that $f = \frac{1}{T}$. So that means cyclotron frequency becomes $\frac{qB}{2\pi m}$ where q is the charge of the electron, B is the magnetic flux, m is the mass and 2π is a constant.

6a. The strings of an electric guitar make electricity when you move them. Under the strings, there are electricity generating devices called pickups. Each one consists of one or more magnets with hundreds or thousands of coils of very thin wire wrapped around them. The magnets generate a magnetic field all around them that passes up through the strings. As a result, the metal strings becomes partially magnetized and when they vibrate, ~~a many~~ make a very small electric current flow through the wire pickups coils. The pickups are hooked up to an electric circuit and amplifier which boosts the current and sends it to a loudspeaker making the guitar sound.

6b. Using $\xi = -N\frac{d\Phi_B}{dt}$

$$\Phi_B = BA\cos\theta$$

$$\therefore \xi = -N\frac{d(BA\cos\theta)}{dt}$$

ξ - emf Φ - magnetic flux   N - number of [illegible]

$q_2 = 3.84 \times 10^{-5}$

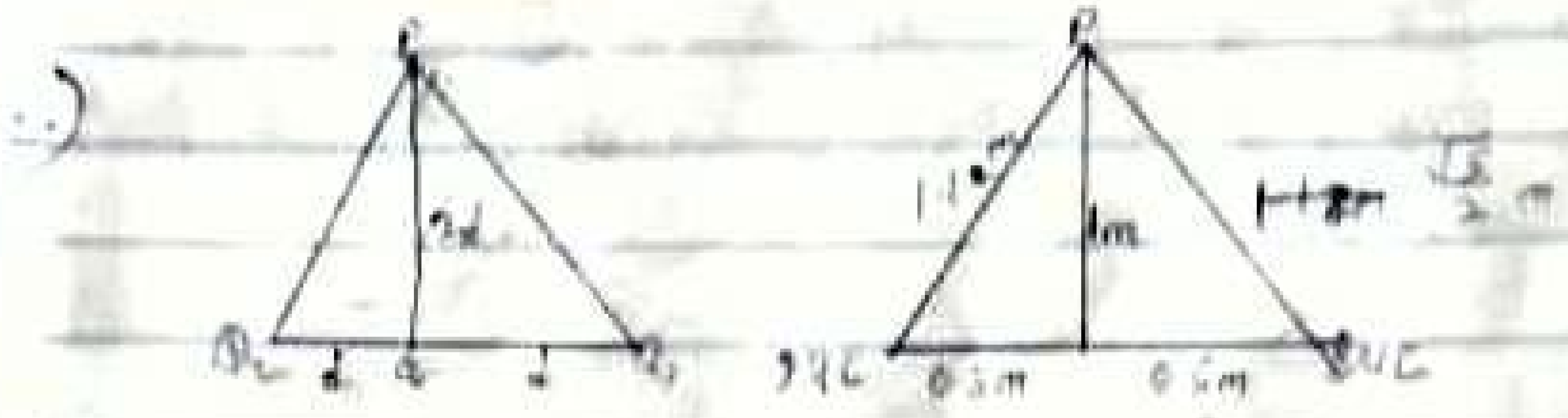
$\therefore q_1 = 5.0 \times 10^{-5} - 3.84 \times 10^{-5}$

$q_1 = 1.16 \times 10^{-5} C$

If $q_2 = 1.16 \times 10^{-5}$

$q_1 = 5 \times 10^{-5} - 1.16$

$q_1 = 3.84 \times 10^{-5} C$



$F = \frac{kQ_1Q_2}{r^2}$

$= \frac{9\times10^9(8\times10^{-6})^2}{(0.5)^2}$ $\quad F = \frac{9\times10^9(8\times10^{-6})^2}{(1)^2}$

$= 2.3 N$ $\quad F = 0.576 N$

$= \frac{kq}{r^2} = \frac{9\times10^9 \times 8\times10^{-6}}{(1.1)^2} = \frac{9\times10^9 \times 8\times10^{-6}}{(\frac{\sqrt{5}}{2})^2}$

= ~~5.74×10⁴ N/C~~ ~~54504 N/C~~ 57600 N/C

$= E_2 =$ ~~54504 N/C~~ 57600 N/C

Charge	x Component	y Component	
	~~5.74×10⁴ cos~~	~~5.74×10⁴ sin~~	

Charge	x Component	y Component	Angle
1	−57600 cos 63.4	57600 sin 26.6	
2	57600 cos 63.4	57600 sin 26.6	
	$E_x = 0$	$E_y = 51581.85$ N/C	

$E = \sqrt{0^2 + (51581.85)^2}$

$E = 51581.85$ N/C

$q = \frac{F}{E}$

$q = \frac{0.576}{51581.85}$

$q = 1.1\times10^{-5}$ NC⁻¹

$q = 11\times10^{-6} \to 11$ μC

$\therefore q = 11$ μC