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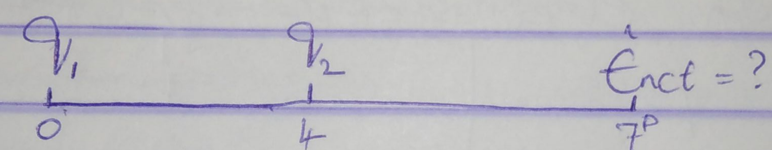
2a) An Electric field is a region in space where an electric charge will experience an electric force, while electric field intensity is the force per unit charge acting on a charged particle in an electric field.

b.)



$q_1 = 8\times10^{-9}C$, $q_2 = 12\times10^{-9}C$, $r_1 = 7m$, $r_2 = 3m$

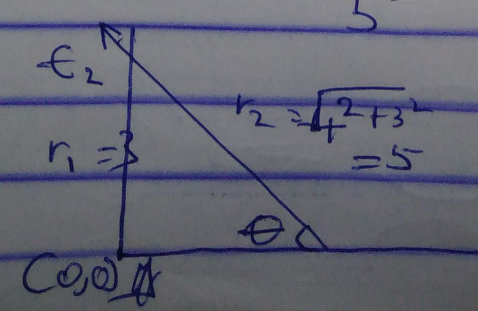
$E_1 = \frac{kq}{r_1^2} = \frac{9\times10^9 \times 8\times10^{-9}}{7^2} = 1.47N/C$

$E_2 = \frac{kqe}{r_2^2} = \frac{(9\times10^9)(12\times10^{-9})}{3^2} = 12N/C$

$\therefore E_{net} = E_1 + E_2 = 13.47N/C = 13.5N/C$

bii) $E_1 = kq/r_1^2 = \frac{(9\times10^9)(8\times10^{-9})}{3^2} = 8N/C$

$E_2 = \frac{kq_2}{r_2^2} = \frac{(9\times10^9)(12\times10^{-9})}{5^2} = 4.32N/C$



E	θ	x	y
E_1	90°	$+8\cos 90 = 0$	$+8\sin 90 = 8$
E_2	37°	$-4.32\cos 37 = -3.45$	$+4.32\sin 37 = 2.59$

$$\underline{\Sigma E_x} = -3.45 \quad \Sigma E_y = 10.59$$

$$E_{net} = \sqrt{(-3.45)^2 + (10.59)^2} = \sqrt{124}$$

$$= \underline{11.14\ N/C}$$

3a.i) Volume Charge density $P = dQ/d_v \rightarrow dQ = p\,dv$

ii) Surface charge density $\sigma = \dfrac{dQ}{dA} \rightarrow dQ = \sigma\,dA$

~~iii) Lin~~

iii) Linear Charge density $\lambda = dQ/dL \rightarrow dQ = \lambda\,dL$

b) In moving a charge from a point A to another point B along an arbitary path in an electric field, an external force, $F = -q_0 E$ must act to counter the force $F = q_0 E$ which the field exerts on the charge

Workdone on the charge dW is given as,

$$dW = \vec{F}.d\vec{L} \quad \text{---} \quad (1)$$

$$dW = -q_0 E\,dL \quad \text{---} \quad (2) \quad [F = -q_0 E]$$

Total Workdone in moving test charge from A to B

$$W(A \rightarrow B)_q = -q_0 \int_A^B E\,dL \quad \text{---} \quad (3)$$

From the definition of potential difference.

$$V_B - V_A = \frac{W(A \to B)_{AS}}{q_0} \quad \text{--- (1)}$$

Putting (4) into (3)

$$V_B - V_A - \int_A^B E\,dl$$

c.)

$Q_1 = 10\,\mu C$ $\quad Q_2 = -2\,\mu C$

4

Let the point where $V = 0$ be x

$\therefore r_1 = |x|,\ r_2 = |4-x|$ $\quad V = x\left[\frac{Q_1}{r_1^2} + \frac{Q_2}{r_2}\right] = 0$

$$\frac{Q_1}{r_1} = \frac{-Q_2}{r_2}, \quad \frac{10\times10^{-6}}{|x|} = -\frac{(-2\times10^{-6})}{|4-x|}$$

$$\frac{2\times10^{-6}|x|}{2\times10^{-6}} = \frac{10\times10^{-6}|4-x|}{2\times10^{-6}}; \quad |x| = 5|4-x|$$

4.) Magnetic flux, ϕ is defined as the strength of Magnetic field, represented by lines of force

$$\phi_B = \int \vec{B}\cdot d\vec{A} = BA\cos\theta$$

b.) $M_e = 9.11\times10^{-31}\,kg$

$B = 0.35\ \text{Weber}/m^2$

$q = 1.60\times10^{-19}\,C$

$\omega = ?$

∴ ω (angular speed / cyclotion frequency)

$$= \frac{1.6\times10^{-19} \times 0.35}{9.11\times10^{-31}}$$

$$\omega = 6.15\times10^{10} \text{ rad/s}$$

The electron oscillates at an angular frequency of 6.15×10^{10} rad/s

6a) In an electric guitar, the coil (the pick up coil) is placed near the vibrating guitar string which is made up of a metal that can be magnetised. A permanent magnet inside the coil magnetizes of the string nearest to the coil. When the string vibrates at some frequency it's magnetized segment produces a changing magnetic flux through the coil. The changing flux induces an emf in the coil that is fed to an amplifier. The output of the amplifier is sent to the loudspeaker, which produces the soundwaves we hear.

b) $N = 300$ $A = (0.1)^2 = 0.01m^2$ $|e| = ?$

$R = 2.0\Omega$ $\Delta\Phi_B = 10T$ $\Delta t = 0.5s$

i) Induced emf $|e| = \frac{N A \Phi}{\Delta t} = \frac{300\times0.01\times10}{0.5} = 60\times$

ii) Induced Current $= \frac{|e|}{B} = \frac{60}{2} = 30A$

c) $A = 0.05 \times 0.08 = \cancel{4\times} \; 4\times10^{-3} m^2$ $I = 0.1A$

$N = 75$ $R = 8\Omega$ $\Delta\phi_B = ?$ Δb]

$I = \frac{|e|}{R}$ $|e| = 8 \times 0.1A = 0.8V$

$|e| = \frac{N A B}{\Delta t}$: $\frac{\Delta B}{\Delta t} = \frac{0.8}{75 \times 4 \times 10^{-3}} = 2.7 T/s$