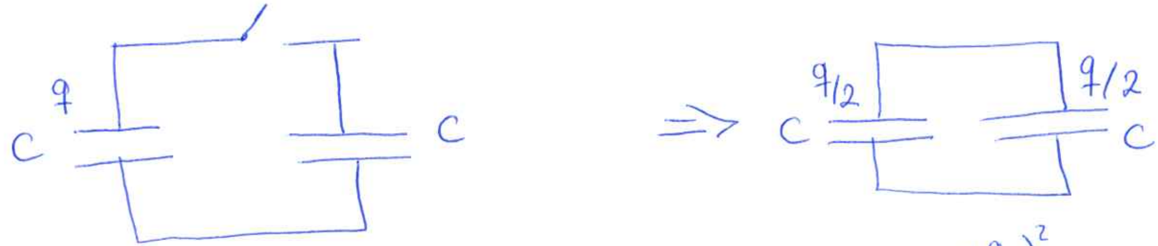
Q1. 2016.F.



$$U_i = \frac{1}{2}\frac{q^2}{c} + 0$$

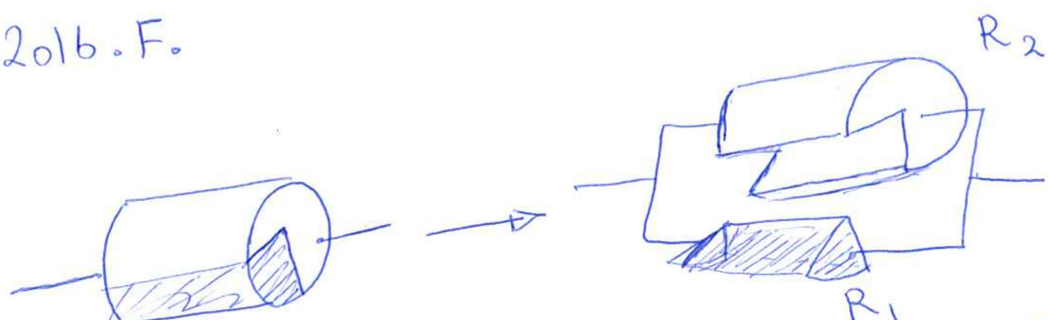
$$= \frac{1}{2}\frac{q^2}{c}$$

$$U_f = \frac{1}{2}\frac{(q/2)^2}{c} + \frac{1}{2}\frac{(q/2)^2}{c}$$

$$= \frac{1}{2}\left[\frac{1}{2}\frac{q^2}{c}\right]$$

$$\Rightarrow U_i = 2U_f \Rightarrow U_f = \frac{4J}{2} = 2J$$

Q2. 2016.F.

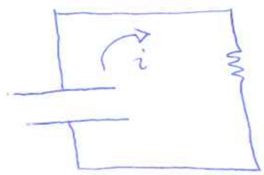


$$R_1 = \rho_1 \frac{L}{A_1} = 2.35\times10^{-8} \times \frac{L}{\frac{1}{3}\pi(55\times10^{-6})^2} = 7.42\,L$$

$$R_2 = \rho_2 \frac{L}{A_2} = 9.68\times10^{-8} \times \left(\frac{L}{\frac{2}{3}\pi(55\times10^{-6})^2}\right) = 15.27\,L$$

$$\left.\begin{array}{l} R_1 + R_2 \Rightarrow R_1 \| R_2 \Rightarrow R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1} = 5L \\ \text{Also we know } R_{eq} = 1.5\ \Omega \end{array}\right\} \Rightarrow L = 0.3^{m}$$

Q3. 2016.F.



$$V_C - iR = 0$$

$$\frac{q}{C} = iR = \frac{dq}{dt}R$$

$$\Rightarrow \frac{dq}{q} = (RC)^{-1} dt \Rightarrow q(t) = A e^{-t/RC}$$

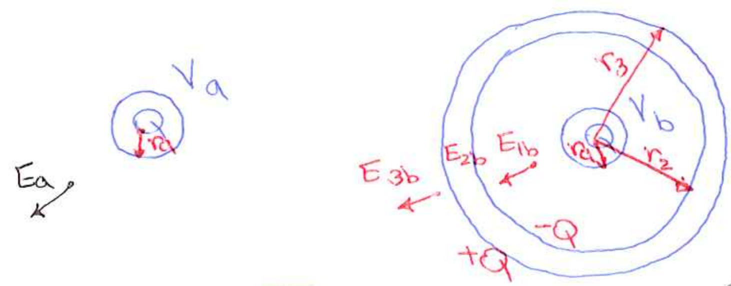
$$A = CV = C\mathcal{E}$$

$$\Rightarrow q(t) = C\mathcal{E}e^{t/RC}$$

$$\Rightarrow q(t = 10^{ms}) = 1\times10^{-6} \times 100 \times e^{-[10\times10^{-3}/(1\times10^{3}\times 1\times10^{-6})]} = 4.5\ nC$$

Q7. 2016.F. → loosing energy → loosing speed

Q10. 2016.F.



$$E_a = k\frac{Q}{r^2}$$

$$\boxed{\begin{aligned}\Delta V = V_\infty - V_a &= -\int E.dl \\ \text{or } -\Delta V = V_a - V_\infty &= \int E.dl\end{aligned}}$$

$V_\infty = 0$

$$\Rightarrow V_a - V_\infty = \int_{r_a}^{\infty} E.dl$$

$$= \int_{r_a}^{r_2} E.dl + \int_{r_2}^{r_3}\frac{kQ}{r^2}dr + \int_{r_3}^{\infty}\frac{kQ}{r^2}dr$$

$$E_{1b} = k\frac{Q}{r^2}, \quad E_{2b} = 0 \text{ inside the conductor}$$

$$E_{3b} = k\frac{Q}{r^2}$$

$$V_b - V_\infty = \int_{r_a}^{\infty} E.dr = \int_{r_a}^{r_2} E_1 dr + \int_{r_2}^{r_3} E_2 dr + \int_{r_3}^{\infty} E_3 dr$$

$$= \int_{r_a}^{r_2}\frac{kQ}{r^2}dr + \int_{r_2}^{r_3} 0 . dr + \int_{r_3}^{\infty}\frac{kQ}{r^2}dr$$

the same

0

the same

This term exist in the calculation For V_a however goes to zero For V_b

$$\Rightarrow V_a > V_b$$

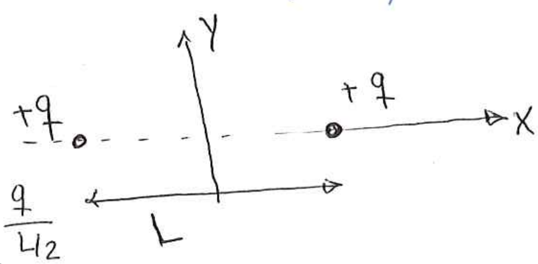
Q14. 2016.F

in General $V_\infty = 0$

Here the question set $V_\infty \equiv$ Unknown

since they set $V(x=0) = 0$

if $V_\infty = 0$ then:



$$V(\text{at } x=0) = \frac{1}{4\pi\epsilon_0}\frac{q}{L/2} + \frac{1}{4\pi\epsilon_0}\frac{q}{L/2}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{4q}{L}$$

Setting $V(\text{at } x=0) = 0$ means we are subtracting $\frac{1}{4\pi\epsilon_0}\frac{4q}{L}$ from it

$$\Rightarrow V(\text{at } x=0) = \frac{1}{4\pi\epsilon_0}\frac{4q}{L} + V_s = 0 \Rightarrow V_s = -\frac{1}{4\pi\epsilon_0}\frac{4q}{L}$$

$$\Rightarrow V(x=\infty) = 0 + V_s = 0 - \boxed{\frac{1}{4\pi\epsilon_0}\frac{4q}{L}}$$

Q16. 2016.F. $\vec{dl} = dx\,\hat{i}$ & $\vec{E} = y^2\hat{i} + 2xy\hat{j}$

$$\vec{E}\cdot\vec{dl} = y^2\,dx$$

$$V_{ab} = -\int \vec{E}\cdot\vec{dl} = -\int_a^b y^2\,dx = -y^2\int_{a=1}^{b=3} dx = -2^2(3-1) = -8\text{ V}$$

Q.24.2016.F.

$$i(t) = \frac{\mathcal{E}}{R}\left(1 - e^{-t/\tau}\right) \qquad \tau = \frac{L}{R} = 12$$

$$i(t) = 2.4$$

$$2.4 = \frac{15}{5}\left(1 - e^{-t/12}\right) \Rightarrow \ln\left(e^{-t/12} = 0.2\right)$$

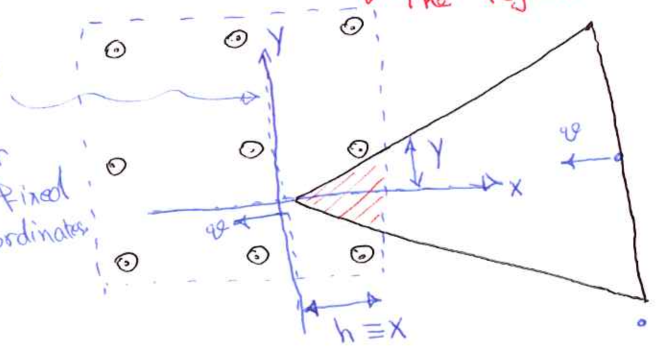
$$\Rightarrow -t/_{12} = \ln(0.2) \Rightarrow t = 12 \times \ln(0.2)$$

$$\Rightarrow \boxed{t = 19.3\ s}$$

Q.25.2016.F.

The coordinate is ~~xx~~ moving with the triangle. The corner of triangular wire is fixed at the origin of coordinates

The region with B.Field!



$$\mathcal{E} = -\overbrace{N}^{N=1}\frac{d\Phi}{dt} = -\frac{d(B.A)}{dt} = -B\frac{dA}{dt}$$

$$A\left(\overset{\text{area}}{\text{inside the B field}}\right) = \left[\text{red regein in the Fig}\right] = \frac{1}{2}\left[x.2y\right] = xy$$

in general $y = mx$ where m is the slope.

$\Rightarrow A = x.mx = mx^2$

since the change on x depend on velocity: $x(t) = \upsilon t$

$$\Rightarrow A = m\upsilon^2 t^2 \Rightarrow \mathcal{E}(t) = -B\frac{dA}{dt} = -m\upsilon^2 B\frac{dt^2}{dt} = \boxed{-2m\upsilon^2 Bt}$$

linear relation to $\mathcal{E}(t)$

$i(t) = \frac{\mathcal{E}(t)}{R}$ & $\Rightarrow$

- $t < t_1 \to$ No change of flux $\Rightarrow \mathcal{E} = 0 \Rightarrow \underline{i = 0}$
- $t_1 < t < t_2$ $\boxed{|i(t)| = |+2m\upsilon^2 B|t}$ $\to$ linear increase
  - using Lenz's Law $\to$ induced in positive direction defined by question!
- $t > t_2 \to$ No chang of flux $\to \mathcal{E} = 0 \Rightarrow \underline{i = 0}$