Prof. Yen-Chieh Huang
Dept of Electrical Engineering
National Tsing-Hua University

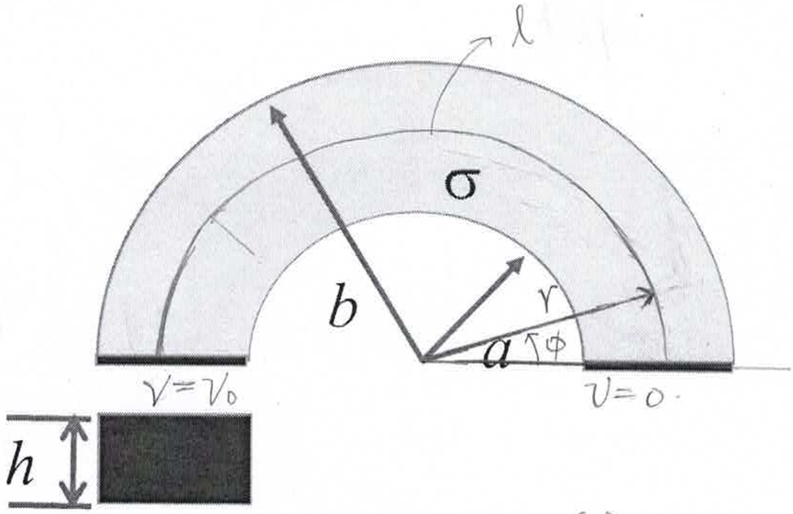
office: Delta 856
ext: 62340
email:ychuang@ee.nthu.edu.tw

EE214000 Electromagnetics, Fall 2020

Your name: ________________ ID: ________________ Dec. 5th, 2020

EE214000 Electromagnetics, Fall, 2020
Quiz #12-2, Open books, notes (10 points), due in class, Monday, Dec. 7th, 2020
Late submission won't be accepted!

1. Calculate the resistance of the conductor (conductivity σ) between the two black electrodes.



(1) $R \equiv \frac{l}{\sigma S} \Rightarrow G \equiv \frac{\sigma S}{l}$, where $l = \pi r$

$dG = \frac{\sigma ds}{l}$, where $ds = h dr$

so $dG = \frac{\sigma h dr}{\pi r}$

then $G = \int_a^b \frac{\sigma h}{\pi r} dr = \frac{\sigma h}{\pi} \ln \frac{b}{a}$

$R = \frac{1}{G} = \frac{\pi}{\sigma h \ln(\frac{b}{a})}$ ※.

(2) Set boundary condition $\begin{cases} V=0 \text{ at } \phi=0 \\ V=V_0 \text{ at } \phi=\pi \end{cases}$

By Laplace equation : $\nabla^2 V = 0$.

Since no variation in z and r,

$\nabla^2 V = \frac{d^2 V}{d\phi^2} = 0 \Rightarrow V = C_1\phi + C_2$

Apply boundary conditions, we can get $\begin{cases} C_1 = \frac{V_0}{\pi} \\ C_2 = 0 \end{cases}$

then $V = \frac{V_0}{\pi}\phi$,

$\vec{E} = -\nabla V = -\hat{a}_\phi \frac{\partial V}{r\partial\phi} = -\hat{a}_\phi \frac{V_0}{\pi r}$.

$\vec{J} = \sigma\vec{E} = -\sigma\frac{V_0}{\pi r}\hat{a}_\phi$

$I = \int_S \vec{J}\cdot d\vec{s}$, where $d\vec{s} = -h d\vec{r}$

$\Rightarrow I = \int_a^b \sigma \frac{V_0}{\pi r} h dr = \frac{\sigma h V_0}{\pi} \ln \frac{b}{a}$

And then $R = \frac{V_0}{I} = \frac{\pi}{\sigma h \ln \frac{b}{a}}$ ※