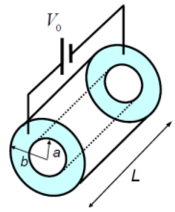
期末考題

1.(20%)

Ex. Calculate the end-to-end DC resistance of a cylindrical conductor shell

77



Sol : $\sigma = \text{const.}$

$$dR_\ell = \frac{\ell}{\sigma S} = \frac{dz}{\sigma 2\pi r dr}$$

$$dG_s = \int_{r=a}^{b} \frac{\sigma 2\pi r}{dz} dr = \sigma\pi\left(b^2 - a^2\right)\frac{1}{dz}$$

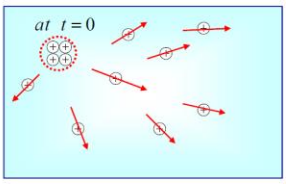
$$dR_s = \frac{1}{dG_s} = \frac{1}{\sigma\pi\left(b^2 - a^2\right)} dz$$

$$R = \int_{z=0}^{z=L} dR_s = \int_{z=0}^{L} \frac{1}{\sigma\pi\left(b^2 - a^2\right)} dz = \frac{1}{\sigma\pi\left(b^2 - a^2\right)} L$$

2.(20%)題目改 i(t)=0.15e^-25t

EX.

127

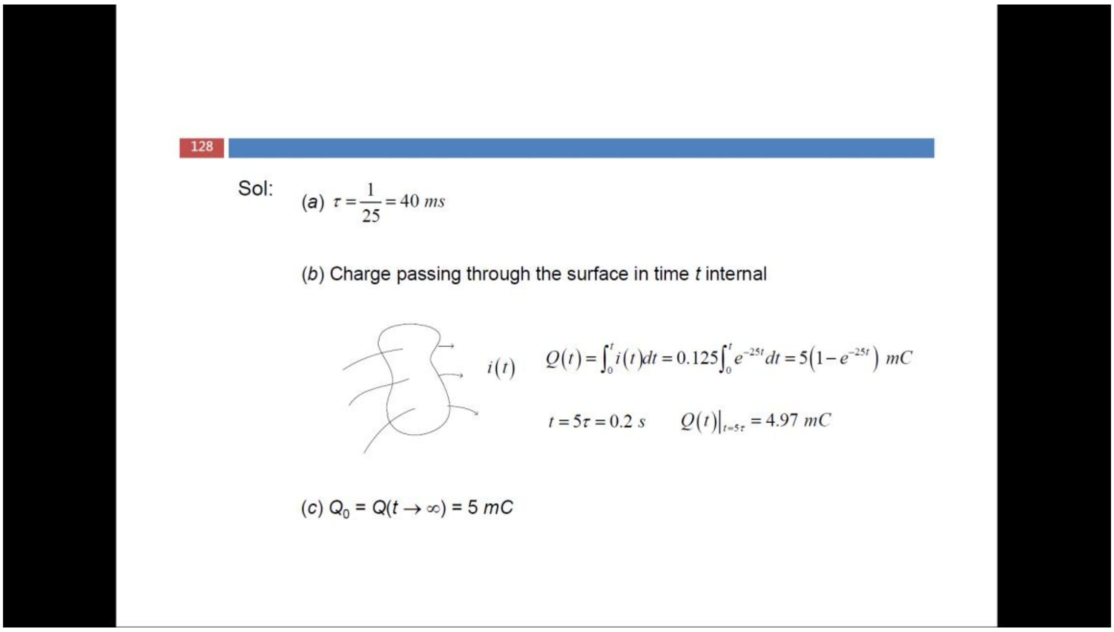


$i(t) = 0.125e^{-25t}$

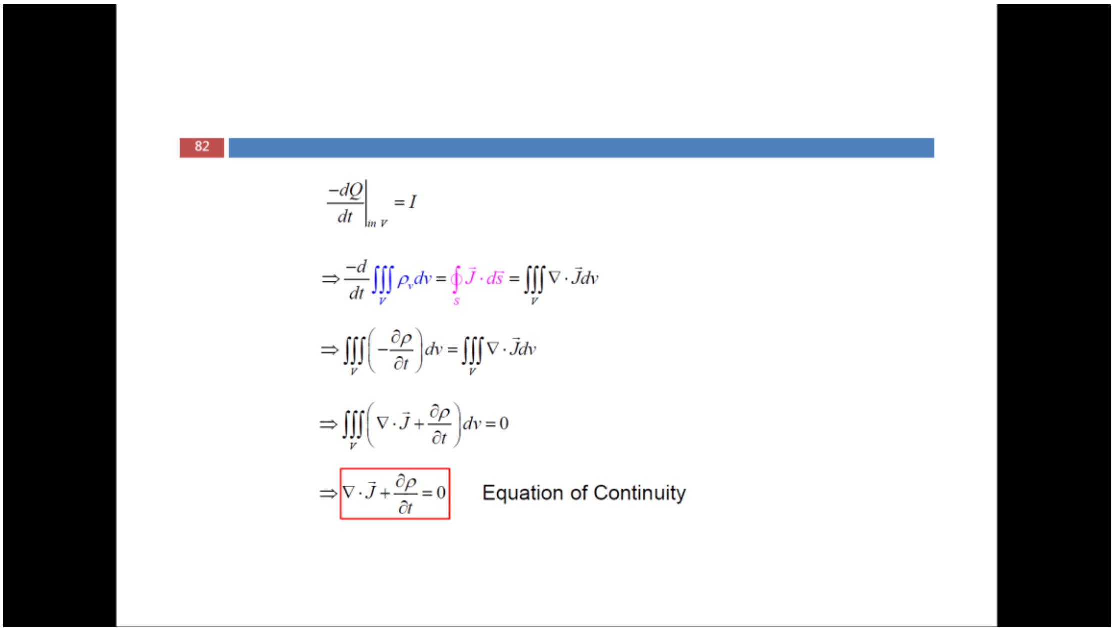
(*a*) τ = ?

(*b*) Charge transported through the surface in time $t = 5\tau$

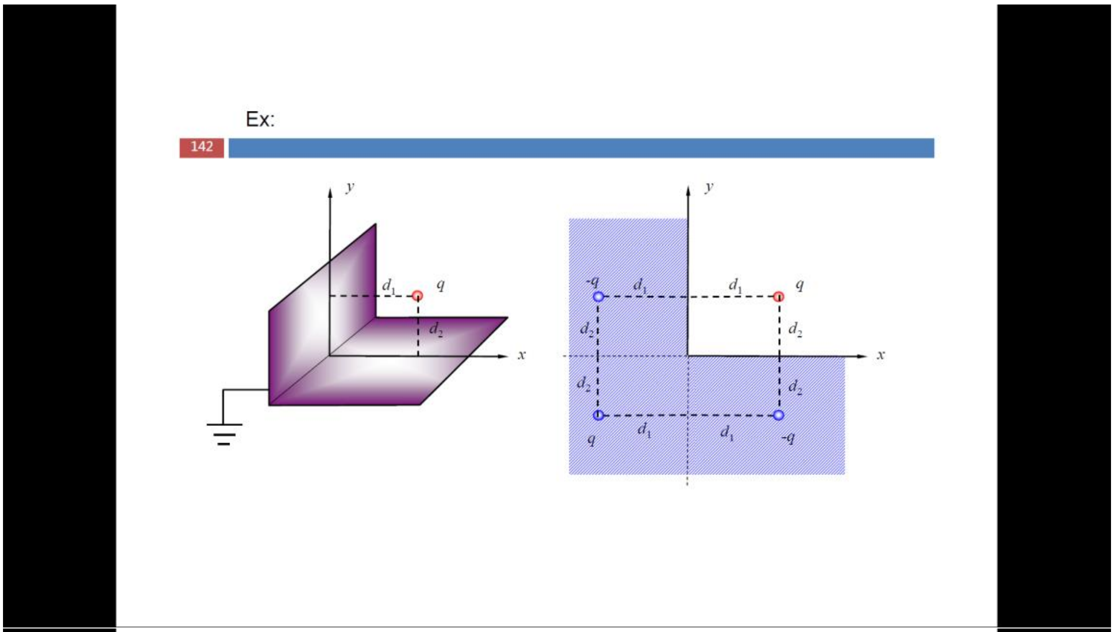
(*c*) Q_0 = ? (Initial charge)

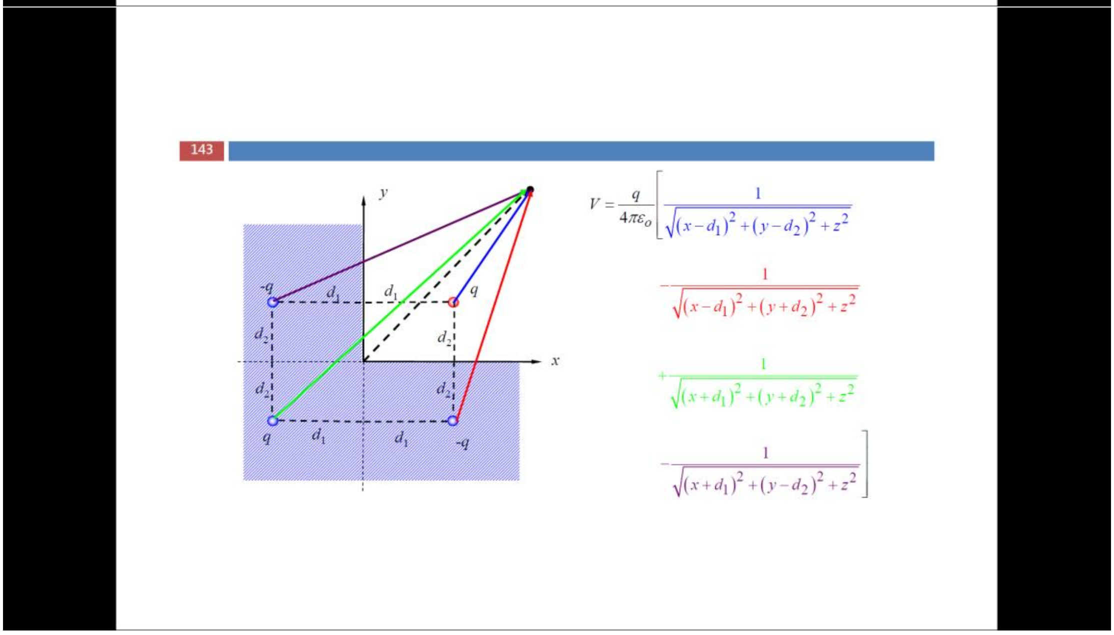


3.應用最後一行的公式



4.(20%)

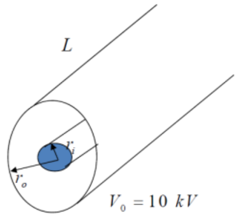

Ex:
142
y
x
d_1
d_2
q
-q


143
y
x
d_1
d_2
q
-q
$V=\frac{q}{4\pi\varepsilon_o}\left[\frac{1}{\sqrt{(x-d_1)^2+(y-d_2)^2+z^2}}-\frac{1}{\sqrt{(x-d_1)^2+(y+d_2)^2+z^2}}+\frac{1}{\sqrt{(x+d_1)^2+(y+d_2)^2+z^2}}-\frac{1}{\sqrt{(x+d_1)^2+(y-d_2)^2+z^2}}\right]$

5.(20%)

題目有改數字

EX.



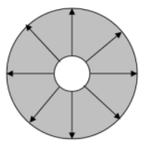
$$\begin{cases}\varepsilon_r = 2.6 \\ E_{ds} = 20\times 10^6\end{cases}$$

$$E_{\max} \le \frac{1}{4}E_{ds}$$

$r_i = 2\ mm$

$r_o = ?$

Sol:



$$\oiint \vec{D}\cdot d\vec{s} = \int \rho_\ell d\ell$$

$$\oiint \varepsilon\vec{E}\cdot d\vec{s} = \int \rho_\ell d\ell$$

$$E2\pi rL = \frac{\rho_\ell L}{\varepsilon_0\varepsilon_r}$$

$$\vec{E} = \frac{\rho_\ell}{2\pi r\varepsilon_0\varepsilon_r}\hat{r}$$

$$V_0 = V(r=r_i) - V(r=r_o) = -\int_{r=r_o}^{r_i}\vec{E}\cdot d\vec{\ell}$$

$$= -\int_{r=r_o}^{r_i}\frac{\rho_\ell}{2\pi\varepsilon_0\varepsilon_r}\frac{1}{r}dr$$

$$= \frac{\rho_\ell}{2\pi\varepsilon_0\varepsilon_r}\ln\frac{r_o}{r_i}$$

$$\begin{cases} \ln\dfrac{r_o}{r_i} = \dfrac{2\pi\varepsilon_0\varepsilon_r}{\rho_\ell}V_0 \\ E_{r,\ \max} = \dfrac{\rho_\ell}{2\pi\varepsilon_0\varepsilon_r r_i} = \dfrac{1}{4}E_{ds} \end{cases} \Rightarrow \frac{2\pi\varepsilon_0\varepsilon_r}{\rho_\ell} = \frac{4}{r_i}\frac{1}{E_{ds}}$$

$$\therefore \quad \ln\frac{r_o}{r_i} = \frac{4}{r_i}\frac{V_0}{E_{ds}}$$

$$r_0 = r_i e^{\frac{4}{r_i}\frac{V_0}{E_{ds}}}$$

$$= 2\times 10^{-3} e^{\frac{4}{2\times 10^{-3}}\frac{10\times 10^3}{20\times 10^6}}$$

$$= 2\times 10^{-3} e^{1} \ = 5.4\ mm$$