1 公式

1.1 向量

$|\vec{u}| = \sqrt{\vec{i}^2 + \vec{j}^2 + \vec{k}^2}$ $a_x = a\cos\theta$ $b_x = b\sin\theta$

$|\hat{u}| = \frac{u}{|\vec{u}|}$ $|\vec{a}\cdot\vec{b}| = |\vec{a}||\vec{b}|\cos\theta$

$\vec{a}\cdot\vec{b} = a_x b_x + a_j b_j + a_z b_z$ $\vec{a}\times\vec{b} = |\vec{a}||\vec{b}|\sin\theta$

$\vec{a}\times\vec{b} = \vec{i}\begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} - \vec{j}\begin{vmatrix} a_1 & a_3 \\ b_1 & b_3 \end{vmatrix} + \vec{k}\begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix}$

1.2 微積分

$\frac{d}{dx}x_t = v_t$ $\frac{d}{dx}v_t = a_t$ $\frac{d}{dx}log_e|x| = \frac{1}{x}$

$\frac{d}{dx}e^x = e^x$ $\frac{d}{dx}a^x = a^x log_e a$

$\int v_t = x_t$ $\int a_t = v_t$

$\int \frac{1}{x}dx = log_e|x|$ $\int a^x dx = \frac{a^x}{log_e} + c$

$\int e^x dx = e^x$

1.3 靜電力庫倫定律

基本電荷$e = 1.602\times 10^{-19}C$

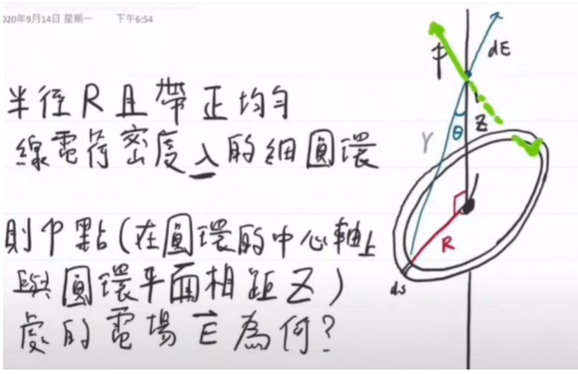
$k_e = 8.99\times 10^9 \frac{N\cdot m^2}{c^2} = \frac{1}{4\pi\varepsilon_0}$

$\varepsilon_0 = 8.85\times 10^{-12}\frac{C^2}{N\cdot m^2}$

$\vec{F} = k_e\frac{q_1 q_2}{r^2}\hat{r}$ $\hat{r}$表示兩粒子延伸軸單位向量

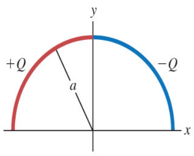
$\vec{E} = \frac{\vec{F}}{q} = k_e\frac{q_1}{r^2}\frac{N}{C}$

電荷	符號	單位
	q	c
線電荷密度	λ	$\frac{C}{m}$
面電荷密度	σ	$\frac{C}{m^2}$
體電荷密度	ϱ	$\frac{C}{m^3}$



$dq = \lambda ds$

$dE = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{\lambda ds}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{\lambda ds}{Z^2+R^2}$



$|E| = \frac{4kQ}{\pi a^2}$

1.4 基礎電路

$I = \frac{Q}{t} = \frac{n\cdot A\cdot Le}{\frac{L}{V_d}} = nA_eV_d$

e：載子的單位電量 n：每單位體積載子數

A：截面積 L：長度

$V_t = E - V_r$

$P = \frac{W}{t} = \frac{V\times Q}{t} = V\times I = \frac{V^2}{R} = I^2R$

$R = \rho\times\frac{l}{A}$

串聯電路

$E = V_1 + V_2 + ... + V_n$

$R_T = R_1 + R_2 + ... + R_n$

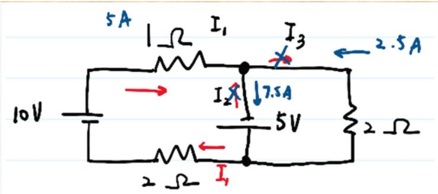
並聯電路

$E = V_1 = V_2 = ... = V_n$

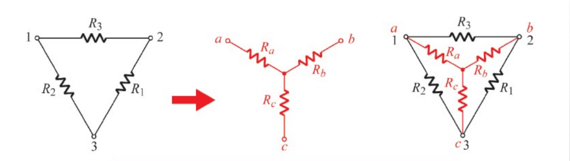
$I_n = \frac{E}{R_n} = G_n\times E$

$G_T = G_1 + G_2 + ... + G_n$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + ... + \frac{1}{R_n}$



$\begin{cases} \text{Junction} I_1 + I_2 = I_3 \\ \text{左迴路 } 10\text{-}I_1 1 + 5 - I_2\cdot 2 = 0 \\ \text{右迴路 } -2\cdot I_3 - 5 = 0 \end{cases}$



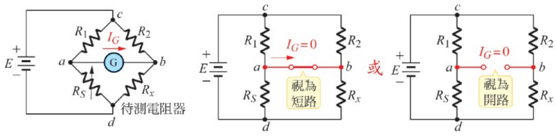
$R_{ab} = \frac{(R_1+R_2\times R_3)}{R_1+R_2+R_3}$ $R_{bc} = \frac{(R_2+R_3\times R_1)}{R_1+R_2+R_3}$ $R_{ca} = \frac{(R_3+R_1\times R_2)}{R_1+R_2+R_3}$

$R_a = \frac{R_2R_3}{R_1+R_2+R_3}$ $R_b = \frac{R_3R_1}{R_1+R_2+R_3}$ $R_c = \frac{R_1R_2}{R_1+R_2+R_3}$

$R_1 = \frac{R_aR_b+R_bR_c+R_cR_a}{R_a}$ $R_2 = \frac{R_aR_b+R_bR_c+R_cR_a}{R_b}$

$R_3 = \frac{R_aR_b+R_bR_c+R_cR_a}{R_c}$

惠斯同電橋



$R_2\times R_s = R_1\times R_x$

電壓表倍增器 (倍增率 m)(串聯) $R_m = R_v(m-1)$

電流表分流器 (倍增率 n)(並聯) $R_s = \frac{R_A}{n-1}$

1.5 高斯定律

通量$\phi(flux)$ $\phi = \vec{V}\cdot\vec{A} = V\cdot A\cos\theta$

V為流速 A為面積向量 θ為與$\vec{A}$夾角

電場通量ϕ $\phi = \sum\vec{E}\cdot\Delta\vec{A}(\frac{N\cdot m^2}{C})$

高斯定律通過高斯面之總電通量ϕ

與該曲面之靜電荷 q_{enc} 之間關係 $\phi = \frac{\sum q_{enc}}{\varepsilon_0}$

如果q_{enc}為正，淨通量向外 如果q_{enc}為負，淨通量向內

$\phi = \oint\vec{E}\cdot d\vec{A}$

$\phi\propto E\propto$ 通過每單位面積電場線數目

Case 1: 球體為導體 (R 為球半徑)(屏蔽效應)

$r\geq R$ $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

$r<R$ $E=0$

Case 2: 球體為非導體 (R 為球半徑 ρ 為體電荷密度)

$r>R$ $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} = \frac{\rho(\frac{4}{3}\pi R^3)}{4\pi\varepsilon_0}\frac{1}{r^2} = \frac{\rho R^3}{3r^2\varepsilon_0}$

$r<R$ $E = \frac{1}{4\pi\varepsilon_0}\frac{q'}{r^2} = \frac{\rho(\frac{4}{3}\pi R^3)\frac{r^3}{R^3}}{4\pi\varepsilon_0}\frac{1}{r^2} = \frac{\rho r}{3\varepsilon_0}$

高斯轉庫倫 $E = \frac{1}{4\pi\varepsilon_0}\frac{q_{enc}}{r^2}$ $F = \frac{1}{4\pi\varepsilon_0}\frac{q\cdot q_{enc}}{r^2}$

2 翻譯

electric charge	電荷	electric filed	電場
opposites attract		異性相吸	
likes repel		同性相斥	
semi conductor	半導體	linear charge	線電荷
surface charge	面電荷	volume charge	體電荷
electromotive force/emf		電動勢 ε	
voltage drop		電壓降	
terminal voltage		端電壓	
node	節點	branch	支路
loop	迴路	mesh	網目
multiplier	倍增器		
series circuit		串聯電路	
parallel circuit		並聯電路	
flux	通量	electric flux	電場通量

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