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

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

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

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

$\int \frac{1}{x}dx = log_e|x| \;\; \int e^x dx = e^x$

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

1.3 靜電力庫倫定律

基本電荷$e = 1.602 \times 10^{-19}C$

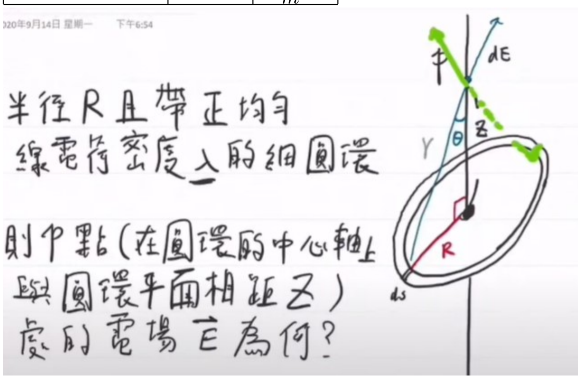
$k_e = 8.99 \times 10^9 \frac{N\cdot m^2}{c^2} = \frac{1}{4\pi\varepsilon_0}$

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

$\vec{F} = k_e\frac{q_1 q_2}{r^2}\hat{r}$ $\hat{r}$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	$\frac{C}{m^3}$



$dq = \lambda ds$

$dE = \frac{1}{4\pi\varrho_0}\frac{dq}{r^2} = \frac{1}{4\pi\varrho_0}\frac{\lambda ds}{r^2} = \frac{1}{4\pi\varrho_0}\frac{\lambda ds}{Z^2+R^2}$

1.4 基礎電路

$V_t = E - V_r$

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

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

串聯電路

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

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

克希荷夫電壓定律

$\sum V_{rise} = \sum V_{drop}$

$\sum V = \sum V_{rise} - \sum V_{drop} = 0$

並聯電路

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

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

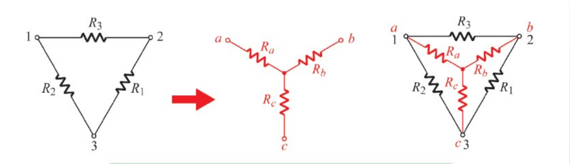
$G_T = G_1 + G_2 + ... + G_n$

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

克希荷夫電流定律

$\sum I_{in} = \sum I_{out}$

$\sum V = \sum I_{in} - \sum I_{out} = 0$

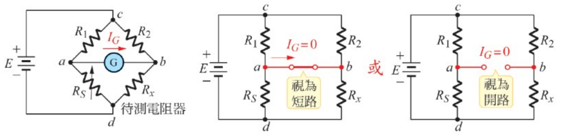


$R_a = \frac{R_2 R_3}{R_1+R_2+R_3} \;\; R_b = \frac{R_3 R_1}{R_1+R_2+R_3} \;\; R_c = \frac{R_1 R_2}{R_1+R_2+R_3}$

$R_1 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_a} \;\; R_2 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_b}$

$R_3 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_c}$

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$\phi(flux)$ $\phi = \vec{V}\cdot\vec{A} = V\cdot A\cos\vartheta$ V為流速A為面積向量

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

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

$\varrho\cdot\phi = q_{enc}$

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)

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

$r < R \;\; E = 0$

Case 2: 球體為非導體 (R 為球半徑 ρ 為體電荷密度)

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

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

2 翻譯

electric charge: 電荷
electric filed: 電場
likes repel: 同性相斥
opposites attract: 異性相吸
conductor: 導體
insulator: 非導體
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 V_t
voltage drop: 電壓降 E
terminal voltage: 端電壓 V_r
node: 節點
branch: 支路
loop: 迴路
mesh: 網目
series circuit: 串聯電路
parallel circuit: 並聯電路
multiplier: 倍增器
flux: 通量
electric flux: 電場通量

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