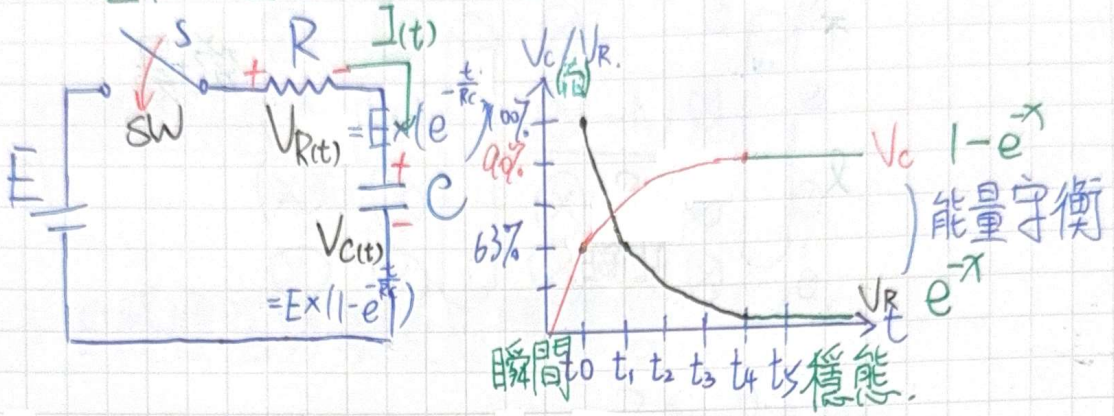
CH7. 直流暫態.

7-1. 電阻、電容(RC)暫態.



$\therefore T = 5t$

$\therefore$ 穩態.

$$I_{(t)} = C\frac{dV_{C(t)}}{dt}$$

$$V_{C(t)} = E \times (1 - e^{-\frac{t}{RC}}) \qquad RC = \tau \text{ 時間常數.}$$

$E = V_R + V_C$. $V_C = E - V_R$ $V_R = E - V_C$.

$$I = \frac{E}{R}.$$

$$I_{(t)} = \frac{E}{R} \times e^{-\frac{t}{RC}}. \qquad V_{R(t)} = Ee^{-\frac{t}{RC}}$$

開路: 電流無限大. 短路: 電流為 0.

RC 充電瞬間.

C = 短路. I = MAX.

RC 充電穩態.

C = 開路 $I \fallingdotseq 0$

$\tau = RC$

$\therefore$ RC 愈大 $\therefore$ 充電時間愈長.

$t = 0 < \tau < 5\tau$ 暫態.

$t \geq 5\tau$ 穩態

* $e^{-1} = 0.368$
* $e^{-2} = 0.135$
* $e^{-3} = 0.05$
* $e^{-4} = 0.02$
* $e^{-5} \fallingdotseq 0$.

t=0 ⇒ 開關閉合－瞬間. (SW)

$V_C = 0$ 短路　$V_R = E$ 最大值　$I = \frac{E}{R}$.

$t \geq 5\tau$

$V_C = E$ 開路.　$V_R = 0$　$I = 0$.

$\tau < t < 5\tau$

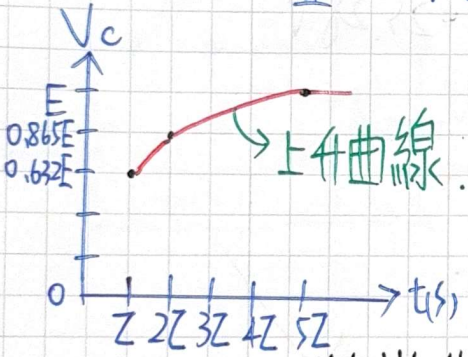
$V_{C(t)} = E(1 - e^{-\frac{t}{RC}})$

$V_{R(t)} = Ee^{-\frac{t}{\tau}}$

$I_{(t)} = \frac{E}{R}e^{-\frac{t}{\tau}}$

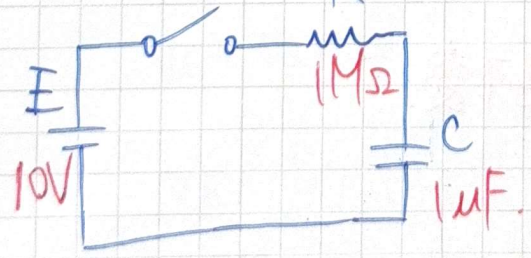
∴ 三用電表跟迴路串聯 ⇒ 形成迴路.

∵ 量的到電流



特性曲線.

ex 1: SW　R



(1) 時間常數 $= 1M \times 1\mu = 1s$

(2) $V_C = 0V_c$　$I = 0A$.

(3) $V_{C(2t)} = 10 \times (1 - e^{-2}) = 8.65V$.

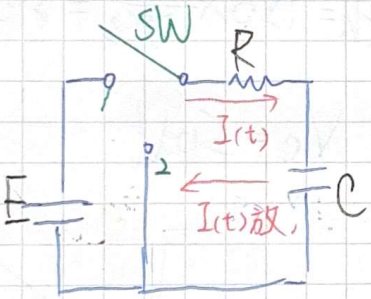
$V_{R(t)} = E - V_C = 1.35V$.

$I_{(t)} = \frac{E}{R}e^{-2} = 1.35\mu A$.

(4) t穩　$V_C = E = 10V$.

$V_R = 0V$. $I = 0A$.

	RC 充電	RC放電
$t=0$	$V_C=0$ $V_R=E$ $I=\frac{E}{R}$	$V_C=E$ $V_R=-V_C=-E$ $I=-\frac{E}{R}$
$0<t<5\tau$	$V_C=E(1-e^{-\frac{t}{\tau}})$ $V_R=E\times e^{-\frac{t}{\tau}}$ $I=\frac{E}{R}\times e^{-\frac{t}{\tau}}$	$V_C=E\times e^{-\frac{t}{\tau}}$ $V_R=-E\times e^{-\frac{t}{\tau}}$ $I=-\frac{E}{R}\times e^{-\frac{t}{\tau}}$
$t\geq 5\tau$	$V_C=E$ $I=0$ $V_R=0$	$V_C=0$ $V_R=0$ $I=0$



C充：先短後開
(瞬) (穩)

① 充電 $\tau=RC$

瞬：
$V_{C(t)}=0$
$V_{R(t)}=E$
$I_{(t)}=\frac{E}{R}$

$0<\tau<5$：
$V_{C(t)}=E\times(1-e^{-\frac{t}{\tau}})$
$V_{R(t)}=E\times e^{-\frac{t}{\tau}}$
$I_{(t)}=\frac{E}{R}\times e^{-\frac{t}{\tau}}$

$\tau\geq 5\tau$：
$V_{C(t)}=E$
$V_{R(t)}=\emptyset$
$I_{(t)}=\emptyset$

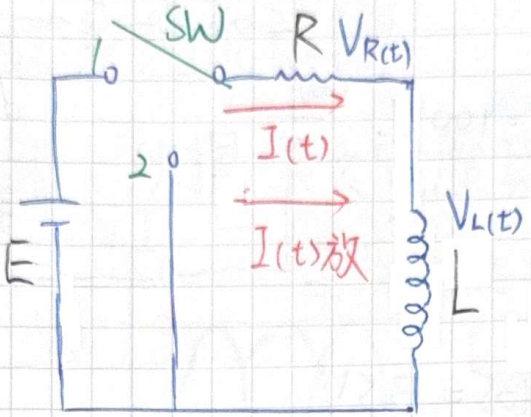
② 放電

瞬：
$V_{C(t)}=E$
$V_{R(t)}=-E$
$I_{(t)}=-\frac{E}{R}$

$0<\tau<5$：
$V_{C(t)}=E\times e^{-\frac{t}{\tau}}$
$V_{R(t)}=-V_C$
$I_{(t)}=-\frac{E}{R}\times e^{-\frac{t}{\tau}}$

$\tau\geq 5\tau$：
$V_{C(t)}=\emptyset$
$V_{R(t)}=\emptyset$
$I_{(t)}=\emptyset$

7-2. RL暫態



L會以磁場形式儲存能量

L充:先開後短

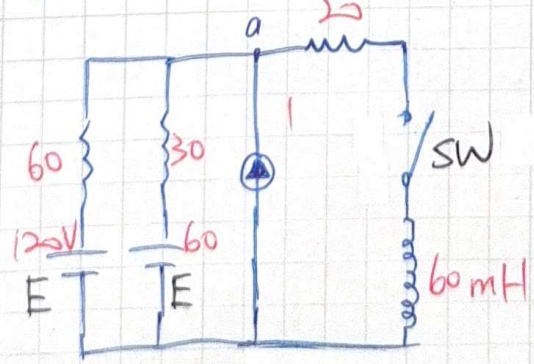
(瞬) (穩)

$\tau = \frac{L}{R}$

充電
- 瞬: $V_{L(t)} = E$, $V_{R(t)} = \emptyset$, $I_{(t)} = \emptyset$
- $0 < t < 5\tau$: $V_{L(t)} = E \times e^{-\frac{t}{\tau}}$, $V_{R(t)} = E \times (1 - e^{-\frac{t}{\tau}})$, $I_{(t)} = \frac{E}{R}(1 - e^{-\frac{t}{\tau}})$
- $t \geq 5\tau$: $V_{L(t)} = \emptyset$, $V_{R(t)} = E$, $I_{(t)} = \frac{E}{R}$

放電
- 瞬: $V_{L(t)} = -E$, $V_{R(t)} = E$, $I_{(t)} = \frac{E}{R}$
- $0 < t < 5\tau$: $V_{L(t)} = -E \times e^{-\frac{t}{\tau}}$, $V_{R(t)} = E \times e^{-\frac{t}{\tau}}$, $I_{(t)} = \frac{E}{R} \times e^{-\frac{t}{\tau}}$
- $t \geq 5\tau$: $V_{L(t)} = \emptyset$, $V_{R(t)} = \emptyset$, $I_{(t)} = \emptyset$

ex1.



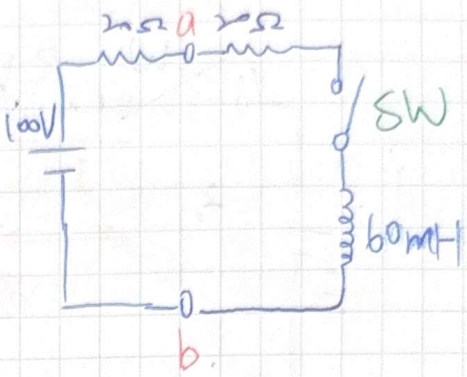
$\frac{V_{ab} - 120}{60} + \frac{V_{ab} - 60}{30} = 1$

$V_{ab} + 120 + 2V_{ab} - 120 = 60$

$3V_{ab} = 300 \quad V_{ab} = 100V.$

$R_{th} = 60 \parallel 30 = 20\Omega$

(1) $\tau = \frac{60 \times 10^{-3}}{2 \times 20} = 1.5\,ms$



(2). $t=0$. $I_L = 0A$ $V_L = 100V$.

(3) $t = 3ms$

$V_L = 100 \times e^{-2} = 100 \times 0.135 = 13.5V$.

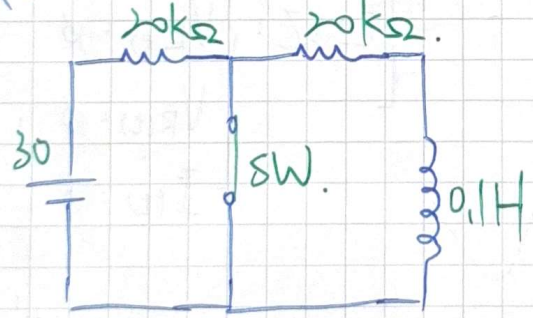
$I_L = \frac{86.5}{40} = 2.1625A$.

(4) $t = 7.5ms$

分壓.

$V_R = 100 \times \frac{\frac{1}{2}20}{\frac{1}{2}20 + 20} = 50V$ #.

ex2:



(1) $\tau = \frac{0.1}{2 \times 10^3} = 5\mu s$

未閉合穩.

(2) $I = \frac{30}{50k} = 0.6mA$.

閉合瞬.

$V_L = -V_R = -0.6 \times 10^{-3} \times 20 \times 10^{3}$

$= -12V$.