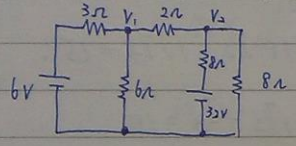
4A237021 晶片二甲 蕭聖翰

1. 大多數家庭所使用的實心銅電線直徑為 1.63mm，求出此種直徑的實心銅電線 50m 的電阻值。(銅的電阻率為 $1.723\times10^{-8}\ \Omega\cdot m$)

(A) 0.412Ω

$$R=\rho\times\frac{L}{\pi r^2}=1.723\times10^{-8}\times\frac{50}{\pi\left(\frac{1.63\times10^{-3}}{2}\right)^2}=0.4128\Omega$$

2. 如圖中所示電路節點 V_1 及 V_2 的電壓值，各為多少伏特？



V_1 的 KCL：$\frac{V_1-6}{3}+\frac{V_1}{6}+\frac{V_1-V_2}{2}=0$

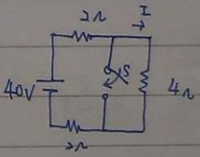
$\Rightarrow\left(\frac{1}{3}+\frac{1}{6}+\frac{1}{2}\right)V_1-\frac{1}{2}V_2-\frac{6}{3}=0$ —①

V_2 的 KCL：$\frac{V_2-V_1}{2}+\frac{V_2-32}{8}+\frac{V_2}{8}=0$

$\Rightarrow\left(\frac{1}{2}+\frac{1}{8}+\frac{1}{8}\right)V_2-\frac{1}{2}V_1-\frac{32}{8}=0$ —②

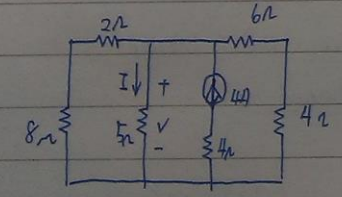
將①②聯立解得，$V_1=7V$，$V_2=10V$

3. 如圖所示，當開關 S 閉合，電流 I 為多少？



當開關開合時，4Ω 因被短路而兩端等電路，故無電流 0A。

4. 圖中 I 為？



$$I=\frac{\frac{1}{5}}{\frac{1}{2+8}+\frac{1}{5}+\frac{1}{6+4}}\times4=2A\downarrow$$

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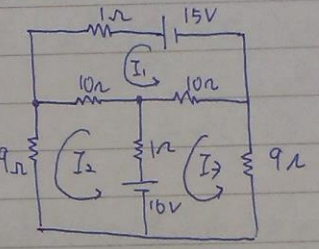
5. 圖中之電路，以迴路分析法所列出之方程式如下：

$a_{11}I_1 + a_{12}I_2 + a_{13}I_3 = 15$

$a_{21}I_1 + a_{22}I_2 + a_{23}I_3 = 10$

$a_{31}I_1 + a_{32}I_2 + a_{33}I_3 = -10$

則 $a_{11} + a_{22} + a_{33} = ?$



第一个迴路的KVL方程式：$(1+10+10)I_1 - 10I_2 - 10I_3 = 15$，

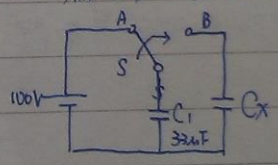
第二个迴路的KVL方程式：$-10I_1 + (1+10+9)I_2 - I_3 = 10$

第三个迴路的KVL方程式：$-10I_1 - I_2 + (9+10+1)I_3 = -10$

$a_{11} = 21$，$a_{22} = 20$，$a_{33} = 20$

因此，$a_{11} + a_{22} + a_{33} = 61$

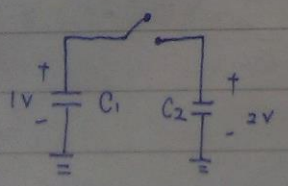
6. 如圖所示，C_1為33μF充滿电後，把開関S由A移至B，則C_1之电压降為75V後達到穩定。假設C_x之初始电压值為0，則C_x為？



$75 = \frac{100C_1}{C_1 + C_x} \Rightarrow 75C_x = 25C_1 \Rightarrow C_x = \frac{1}{3}C_1$

$= 11\mu F$ 丹

7. In the figure, $C_1 = 2pF$, $C_2 = 1pF$, derive the voltage on C_1 and C_2 after the switch is turned on?



$Q_T = C_1V_1 + C_2V_2 = (C_1 + C_2)V$

$\Rightarrow V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{2\times1 + 1\times2}{2+1} = \frac{4}{3}$ V

8. 如圖所示，開關打開一段很長時間，在 $t=0$ 時開關瞬間閉合，則 $t \geq 0$ 時，求 $V_c(t) = ?$

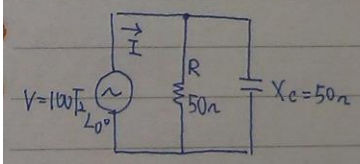
時間常數 $RC = [(15 \parallel 10) + 4] \times 10^3 \times 10^{-6} = 10^{-2}$ Sec，初值 $V_c = 0$

終值：電容器已開路，利用分壓律 $V_c(t \to \infty)$

$$= 40 \times \frac{10}{15+10} = 16\ V$$

$$\Rightarrow V_c(t) = (0-16)e^{-t/RC} + 16 = 16(1-e^{-100t})\ V$$

9. 如圖所示之 RC 並聯電路，其相量 I 為？



$$Z = R \parallel (-jX_C) = \frac{R \times (-jX_C)}{R - jX_C} = \frac{-j2500}{50-j50} = \frac{2500\angle -90^\circ}{50\sqrt{2}\angle -45^\circ}$$

$$= \frac{50\angle -45^\circ}{\sqrt{2}}$$

$$\Rightarrow I = \frac{V}{Z} = \frac{100\sqrt{2}\angle 0^\circ}{\frac{50\angle -45^\circ}{\sqrt{2}}} = \frac{100\sqrt{2}\angle 0^\circ}{50\sqrt{2}\angle -45^\circ} = 4\angle 45^\circ\ A$$

或

$$I = \frac{100\sqrt{2}\angle 0^\circ}{50} + \frac{100\sqrt{2}\angle 0^\circ}{-j50}$$

$$= 2\sqrt{2}\angle 0^\circ + 2\sqrt{2}\angle 90^\circ$$

$$= 4\angle 45^\circ\ A.$$

10. 图中 $C=1\mu F$，当 $t=0$ 时将開関接上。若电容初值 $=5V$，求

(a) 电容的电流与时間関係式

(b) $t=3\times10^{-5}$ 秒的端电压

Sol:

(a) 時間常数 $RC=30\times10^{-6}\,Sec=3\times10^{-5}\,Sec$，則

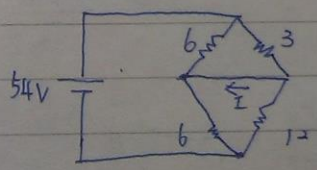
$$V_c(t)=V_{c0}\times e^{-t/RC}=5\times10^{-5\,t/3}\ V$$

$$\Rightarrow i(t)=-i_c(t)=-C\frac{dV_c(t)}{dt}=\frac{10^5}{3}\times10^{-6}\times5e^{-10^5t/3}$$

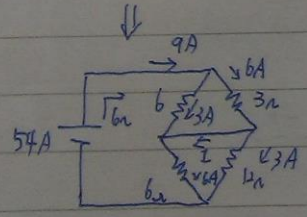
$$=\frac{1}{6}e^{-10^5t/3}$$

(b) $V_c(t=3\times10^{-5})=5\times e^{-10^5\times(3\times10^{-5})\,t/3}=5\times10^{-1}V$

11. 如图所示，$I=?$



$R=(6//3)+(6//12)=2+4=6\Omega$



$I=6-3=3A$.

12. What is the difference between drift current and diffusion current?

Sol: 漂移电流是因為电位不均而有电場存在所產生的

擴散电流則是因為載子濃度不均所產生的