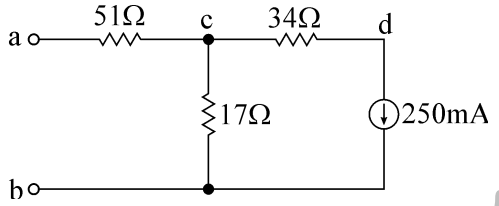
104 年原住民族特考

等 別：三等考試
類 科：電力工程
科 目：電路學

一、試求下圖由 a 與 b 兩端看入之戴維寧等效電路。



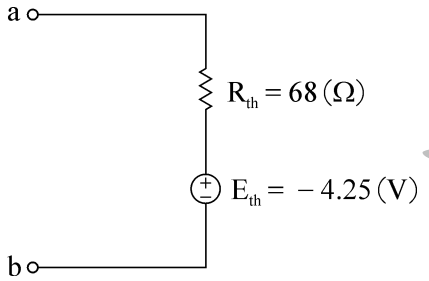
【擬答】：

將電流源開路，由 a、b 兩端求得等效電阻

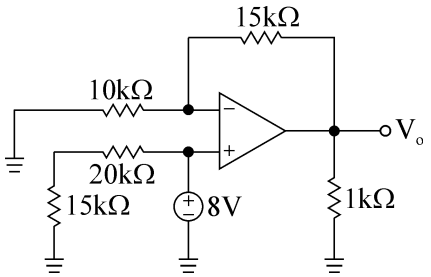
$R_{th} = R_{ab} = 51 + 17 = 68\ (\Omega)$

由 a、b 兩端所求得開路電壓 $E_{th} = V_{ab} = -17 \times 250 \times 10^{-3} = -4.25\ (V)$

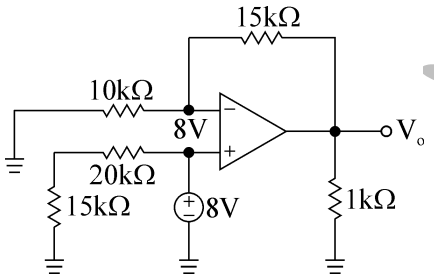
故戴維寧等效電路為：



二、試求下圖電路之 V_o。



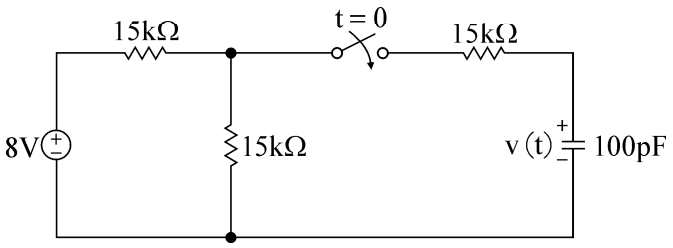
【擬答】：



$\because V_+ = 8\ (V)$，$V_- = V_+ = 8\ (V)$，故利用節點電壓法，則：

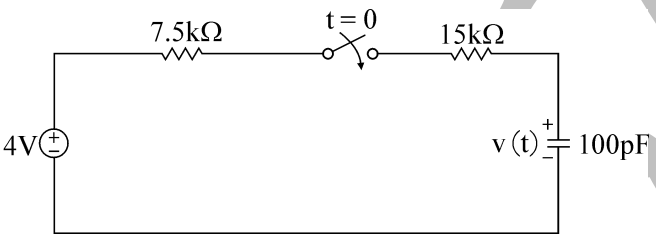
$$\frac{V_- - 0}{10k} + \frac{V_- - V_o}{15k} = 0 \Rightarrow \frac{8}{10k} + \frac{8 - V_o}{15k} = 0 \quad \therefore V_o = 20\ (V)$$

三、下圖開關在 t = 0 時會導通，試求 t ≥ 0 時之 v(t)。



【擬答】：

等效電阻 R_{th} = 15//15 = 7.5kΩ，等效電壓 $E_{th} = 8 \times \frac{15k}{15k+15k} = 4$（V），故等效電路如下所示：



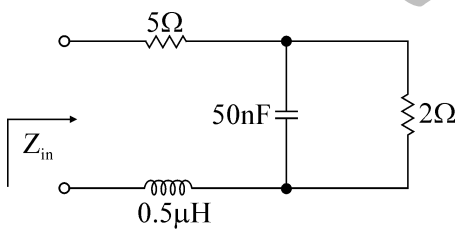
$\because V(0^+) = V(0^-) = 0$（V），$V(\infty) = 4$（V）

時間常數 $\tau = RC = (7.5 + 15) \times 10^3 \times 100 \times 10^{-12} = 2.25 \times 10^{-6}$（秒）

故 $v(t) = V(\infty) + [V(0) - V(\infty)]e^{-\frac{1}{\tau}t} = 4 + (0 - 4)e^{-\frac{1}{2.25\times10^{-6}}t}$

$= 4 - 4e^{-\frac{1}{2.25}\times10^6 t}$（V），$t \geq 0$

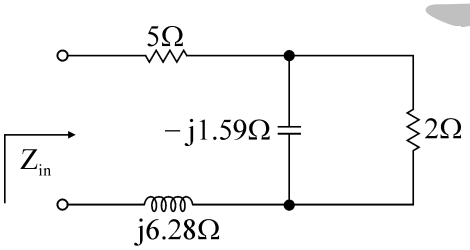
四、試求下圖電路在 2MHz 時的等效阻抗。



【擬答】：

當頻率 f = 2MHz 時，則電感抗 $X_L = j\omega L = j2\pi \times 2 \times 10^6 \times 0.5 \times 10^{-6} = j6.28$（Ω）

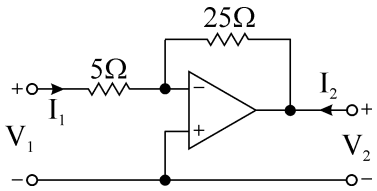
電容抗 $X_C = -j\frac{1}{\omega C} = -j\frac{1}{2\pi\times2\times10^6\times50\times10^{-9}} = -j1.59$（Ω）



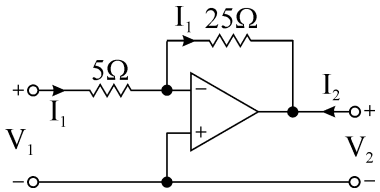
∴等效阻抗 $Z_{in} = [2 // (-j1.59)] + 5 + j6.28 = 0.7745 - j0.974 + 5 + j6.28$

$= 5.7745 + j5.306$（Ω）

五、試求下圖電路之 g 參數，g 參數定義為 $\begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix}\begin{bmatrix} V_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} I_1 \\ V_2 \end{bmatrix}$。



【擬答】：



$V_- = V_+ = 0$（V），$I_1 = \frac{V_1}{5} = g_{11}V_1 + g_{12}I_2$

故 $g_{11} = \frac{1}{5}$，$g_{12} = 0$

又 $V_1 = 5I_1 + 25I_1 + V_2$

$\Rightarrow V_2 = V_1 - 30I_1 = -5V_1 = g_{21}V_1 + g_{22}I_2$

故 $g_{21} = -5$，$g_{22} = 0$

$\therefore$ g 參數為 $\begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} = \begin{bmatrix} \frac{1}{5} & 0 \\ -5 & 0 \end{bmatrix}$