生機系電工學第三次隨堂練習 2011/03/09

學號：＿＿＿＿＿＿＿＿　　姓名：＿＿＿＿＿＿＿＿

1. Sketching the location and connection of ammeters and voltmeters need to measure the current I_1 and voltage V_1.

2. Using a voltmeter with an ohm-per-volt rating of 1000, determine the indication of the meter when it is placed across the 4-kΩ resistor if the 50-V scale is used.

3. Using an ammeter with internal resistance of 200 Ω, determine the indication of the meter when it is inserted between the 4-kΩ resistor and 1-kΩ resistor.
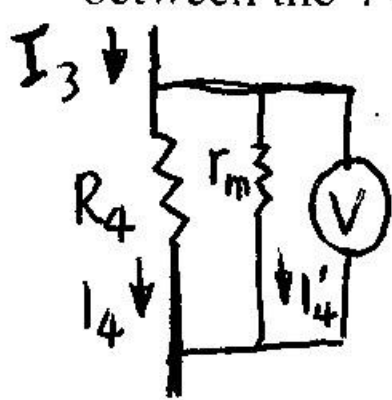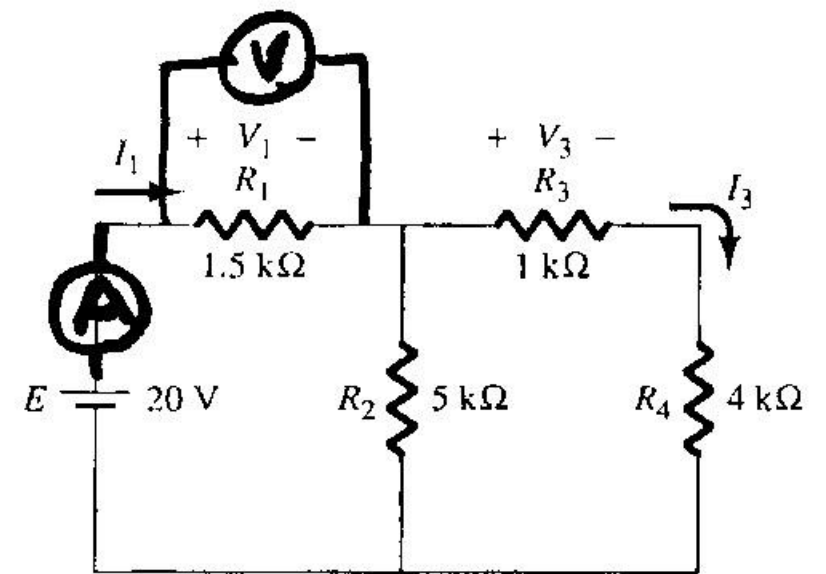
理想的 Voltmeter 內部電阻 r_m 越大越好，當 $r_m \to \infty$ ⓥ 測得 R_4 的理想值；當 r_m 非無限大，I_3 一部分流向 R_4，一部分流向 r_m，測得跨越 R_4 的電壓降，當然比 $r_m \to \infty$ 時，小了一些。

2. r_m ?　　$r_m = 50V \times 1000 \,\Omega/V = 50K\Omega$
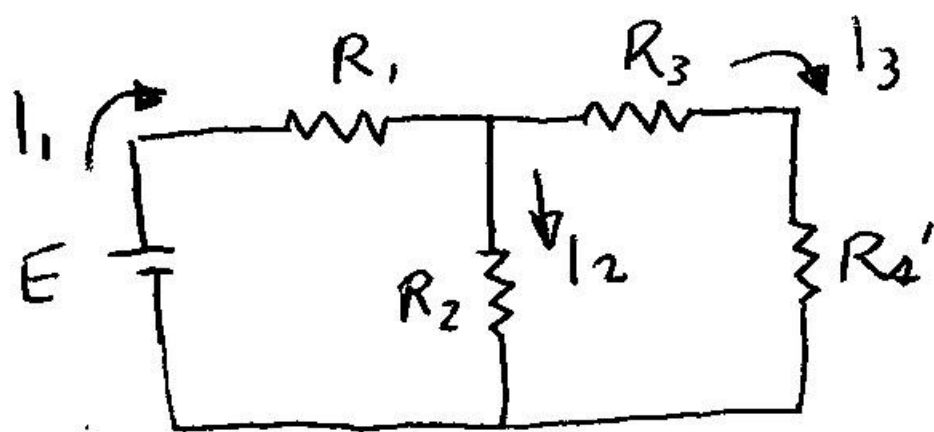
$R_4' = r_m // R_4 = \cdots = 3.704 K\Omega$

$$R_T = R_1 + (R_2 // (R_3 + R_4'))$$
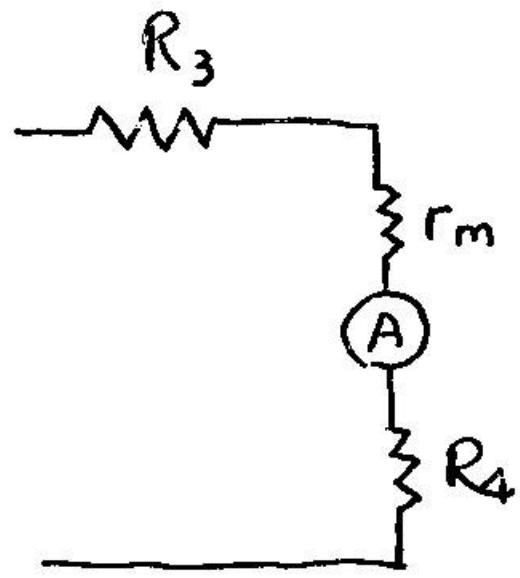$$= \cdots \text{（列出數字）}$$
$$= 3.924 K\Omega$$

由 E 流出的電流 $I_1 = \dfrac{E}{R_T} = \dfrac{20V}{3.924K\Omega} = 5.047 \, mA$

利用 Current-divider rule　$I_3 = I_1 \times \dfrac{R_2}{R_2 + R_3 + R_4'} = 2.626 \, mA$

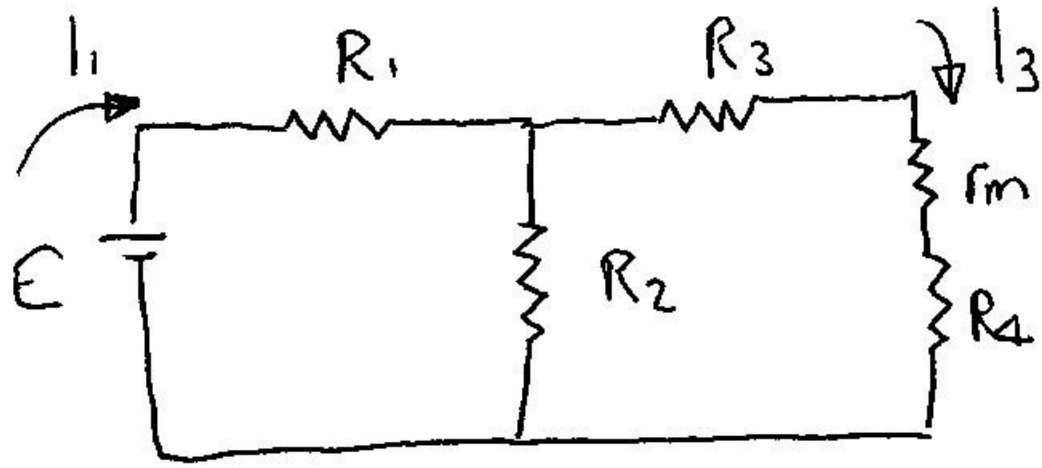利用 Current-divider rule　$I_4 = I_3 \times \dfrac{r_m}{R_4 + r_m} = 2.431 \, mA$

跨越 R_4 的電壓降 $V_4 = I_4 \times R_4 = 9.726 \, V$

3.

理想的 Ammeter 內部電阻

$r_m = 200\,\Omega$

$R_T = ((R_3 + r_m + R_4) \,/\!/\, R_2) + R_1$

$= \cdots$

$= 5.2\,k\Omega$

E 流出的電流　$I_1 = \dfrac{E}{R_T} = \dfrac{20V}{5.2\,k\Omega} = 4.939\,mA$

利用 Current-divider rule　$I_3 = I_1 \times \dfrac{R_2}{R_2 + R_3 + r_m + R_4}$

$= 2.421\,mA$

4. 理想 Ammeter, Voltmeter ?

$R_T = R_1 + (R_2 \,/\!/\, (R_3 + R_4)) = 4\,k\Omega$

E 流出的電流　$I_1 = \dfrac{E}{R_T} = \dfrac{20V}{4\,k\Omega} = 5\,mA$

利用 current-divider rule　$I_3 = I_1 \times \dfrac{R_2}{R_3 + R_4} = 2.5\,mA$

跨在 R_4 的電壓降　$V_4 = I_3 \times R_4 = 10\,V$