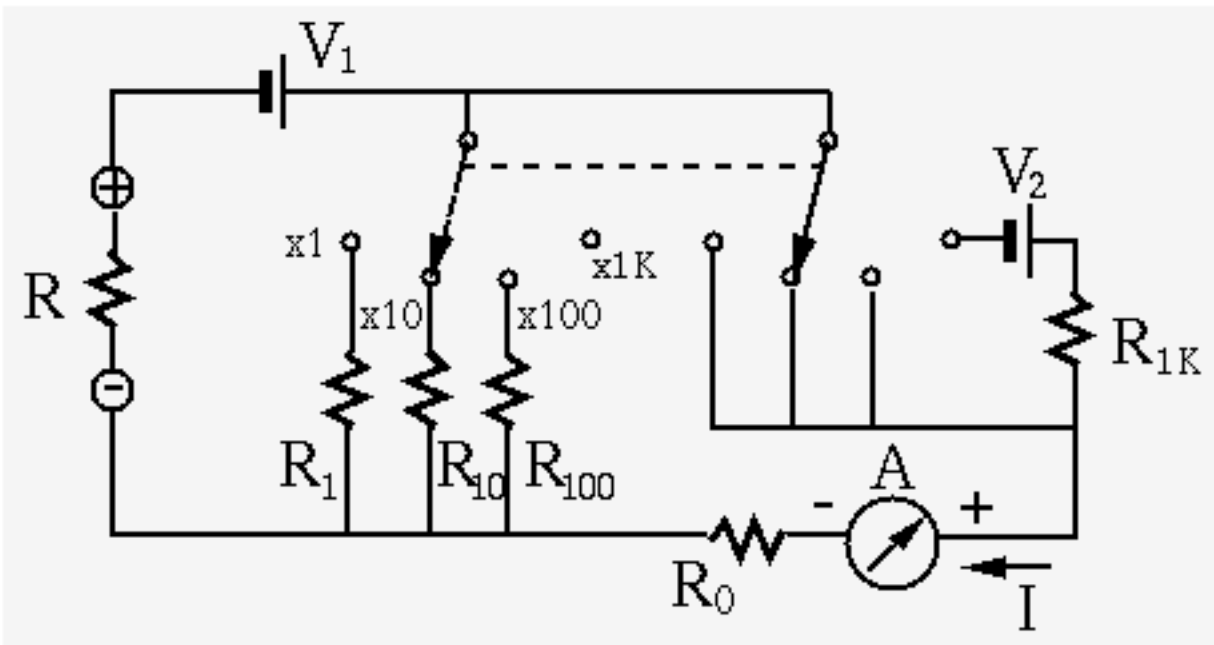
$$R_1 = 100/(50 - 0.1) = 2\ \Omega$$

- Resistance measurement: The circuit for resistance measurement is provided as shown below, where $V_1 = 1.5V$. Determine the values for the resistors labeled as R_0, R_1, R_{10}, R_{100} and R_{1000} and V_2 so that the needle display of the meter is full scale ($I = 100\ \mu A$) when the resistor $R = 0$ being measured (between the two leads labeled + and -) is zero, or half scale ($I = 50\ \mu A$) when the value of R and the position of he two synchronized rotary switches are given in each of the four case shown in the table:

positions	$\times 1$	$\times 10$	$\times 100$	$\times 1K$
R values	$20\,\Omega$	$200\,\Omega$	$2000\,\Omega$	$20\ K\Omega$



Solution:

- First determine R_0: when $R = 0$, we get $R_0 = 1.5V/0.1\ mA = 15\ K\Omega$.
- When $R = 20\ \Omega$, the current through meter A should be:

$$I = \frac{V_1}{R + R_1||R_0}\frac{R_1}{R_1 + R_0} = \frac{V_1}{R + \frac{R_1 R_0}{R_1 + R_0}}\frac{R_1}{R_1 + R_0} = V_1\frac{R_1}{RR_1 + RR_0 + R_1R_0}$$

$$= 5 \times 10^{-4}\ A$$

Given $V_1 = 1.5V$, $R_0 = 15K$ and $R = 20\Omega$, we can solve this equation to get

$$R_1 = \frac{R_0 RI}{V_1 - I(R + R_0)} = 20\Omega$$

- When $R = 200\ \Omega$, solving the above equaton we get $R_{10} = 202.7\Omega$.
- When $R = 2\ K\Omega$, solving the above equaton we get $R_{10} = 2307.7\Omega$.
- When $R = 20\ K\Omega$, we need to determine V_2 and R_{1k} so that $\underline{I = 510^{-5}A}$, and also when $R = 0$, $\underline{I = 10^{-4}A}$. R_{1k} and $V_1 + V_2$ can be found by solving these equations:

$$\begin{cases} (V_1 + V_2)/(R_{1k} + R_0) = 10^{-4}A \\ (V_1 + V_2)/(R + R_{1k} + R_0) = 5 \times 10^{-5}A \end{cases}$$

Solving we get $V_1 + V_2 = 2V$, $R_{1k} + R_0 = 20\ K\Omega$, i.e., $R_{1k} = 5K\Omega$, $V_2 = 0.5V$