

Two 20 kiloOhms resistors (R1 and R2) are connected in series across a 100 volt supply. Calculate:

- (a) The Voltage drop across the R1 resistor from nominal values:
 (b) The voltage across the R1 resistor if measured using a digital voltmeter (internal resistance of 1 milliOhms)
 (c) The voltage across the R1 resistor if measured using an analogue voltmeter (internal resistance of 20 kiloOhms)

Solution

$$\text{a) } U_1 = IR_1 = \frac{U}{R_1+R_1} R_1 = \frac{U}{2} = 50 \text{ V}$$

$$\text{b) } U = I * R + I_1 * R_1$$

$$I = \frac{U}{R_1 + \frac{R_1 r}{R_1 + r}} = \frac{100}{20000 + \frac{20000 * 0.001}{20000 + 0.001}} = 0,005 \text{ A}$$

$$\begin{cases} I_1 R_1 = I_2 r \\ I = I_1 + I_2 \end{cases} \gg I_1 = I * \frac{r}{R_1 + r} = 0,005 * \frac{0.001}{20000 + 0.001} = 2,5 * 10^{-10} \text{ A}$$

$$U_1 = I_1 R_1 = 2,5 * 10^{-10} * 20000 = 5 * 10^{-6} \text{ V}$$

$$\text{c) } I = \frac{U}{R_1 + \frac{R_1 r}{R_1 + r}} = \frac{100}{20000 + \frac{20000 * 20000}{20000 + 20000}} = 0,0033 \text{ A}$$

$$I_1 = I * \frac{r}{R_1 + r} = 0,005 * \frac{20000}{20000 + 20000} = 0,0025 \text{ A}$$

$$U_1 = I_1 R_1 = 0,0025 * 20000 = 50 \text{ V}$$