EECE 2150 - Circuits and Signals: Biomedical Applications Fall 2018
Quiz 2

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Consider the circuit shown in the figure.

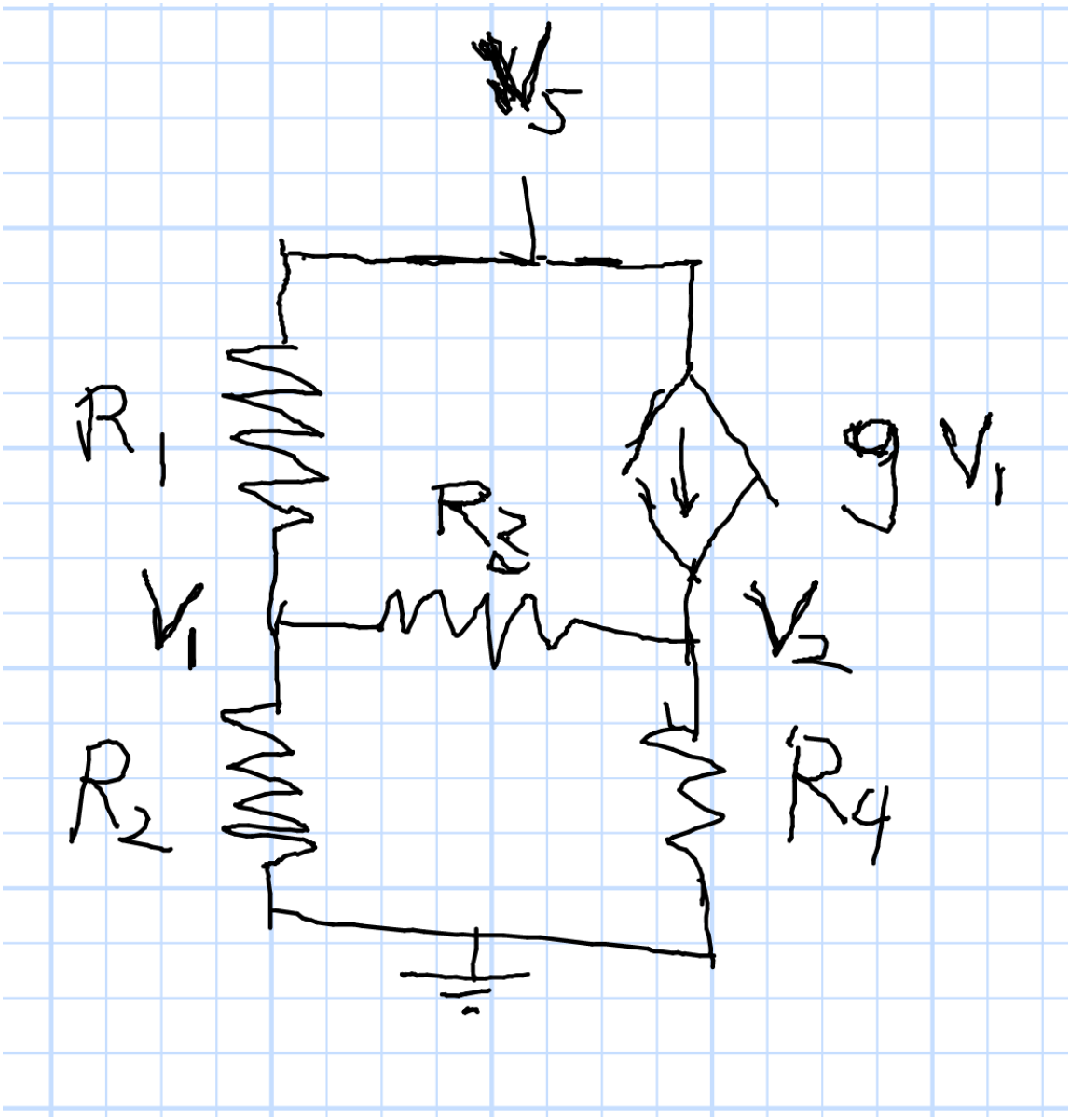
$$R_1 = 10\,\text{kOhms} \qquad R_2 = R_1$$
$$R_3 = 2\,\text{kOhms} \qquad R_4 = 5\,\text{kOhms}$$
$$g = 40\,\mu\text{A/V} \qquad V_s = 10\,\text{V}$$

1. Write two node equations for the unknown voltages V_1 and V_2.

2. Simplify the equations.

3. Convert the equations to matrix form, $\mathcal{M}\mathbf{x} = \mathbf{y}$

You do not need to solve the matrix equation for $\mathbf{x}$.


V_5
R_1
R_3
V_1
V_2
R_2
R_4

1.

$$-\frac{V_s - V_1|}{R_1} + \frac{V_1}{R_2} + \frac{V_1 - V_2}{R_3} = 0$$

$$-gV_1 + \frac{V_2}{R_4} + \frac{V_2 - V_1}{R_3} = 0.$$

2.

$$\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) V_1 + \left(\frac{-1}{R_3}\right) V_2 = \frac{V_s}{R_1}$$

$$\left(-g - \frac{1}{R_3}\right) V_1 + \left(\frac{1}{R_4} + \frac{1}{R_3}\right) V_2 = 0.$$

3.

$$\begin{pmatrix} \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) & \left(\frac{-1}{R_3}\right) \\ \left(-g - \frac{1}{R_3}\right) & \left(\frac{1}{R_4} + \frac{1}{R_3}\right) \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} \frac{V_s}{R_1} \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 0.7000 & -0.5000 \\ -0.5400 & 0.7000 \end{pmatrix} \times 10^{-3} \times \begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} 3.1818 \\ 2.4545 \end{pmatrix}$$

For your information, the solution is

$$\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} 3.1818 \\ 2.4545 \end{pmatrix}$$