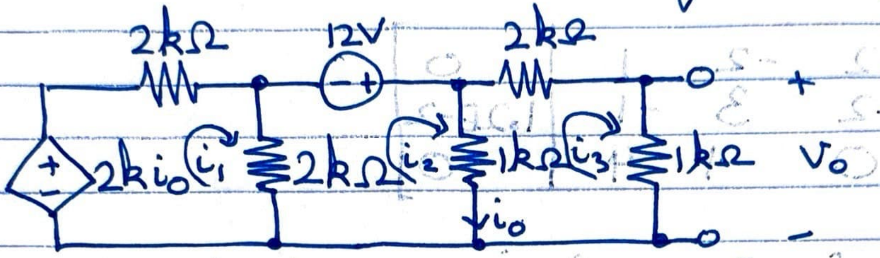
Summer 2020, Exam 1, Problem 2 (find v_o)

$2k = 2\times10^3$ SI units!



Use Mesh Current Analysis:

$i_o = (i_2 - i_3)$ —— ①

M1: $-2k\,i_o + 2k\,i_1 + 2k(i_1 - i_2) = 0$

subs ①: $-2E3(i_2 - i_3) + 2E3\,i_1 + 2E3(i_1 - i_2) = 0$

$\Rightarrow (2E3 + 2E3)i_1 - (2E3 + 2E3)i_2 + 2E3\,i_3 = 0$

$\Rightarrow 4E3\,i_1 - 4E3\,i_2 + 2E3\,i_3 = 0$

$\Rightarrow 2i_1 - 2i_2 + i_3 = 0$ —— ②

~~subs~~ M2: $2E3(i_2 - i_1) - 12 + 1E3(i_2 - i_3) = 0$

$\Rightarrow -2E3\,i_1 + 3E3\,i_2 - 1E3\,i_3 = 12$

$\Rightarrow -2i_1 + 3i_2 - 1i_3 = 12E{-3}$ —— ③

M3: $1E3(i_3 - i_2) + 2E3(i_3) + 1E3(i_3) = 0$

$\Rightarrow -1E3\,i_2 + (2E3 + 1E3 + 1E3)i_3 = 0$

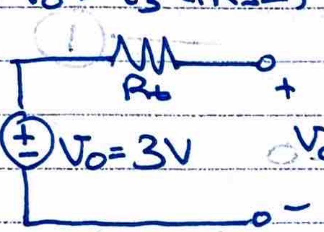
$\Rightarrow -i_2 + 4i_3 = 0$ —— ④

Put ②, ③, ④ in a matrix:

$$\left[\begin{array}{ccc|c} 2 & -2 & 1 & 0 \\ -2 & 3 & -1 & 1.2E{-2} \\ 0 & -1 & 4 & 0 \end{array}\right]$$

Solve: $i_1 = 0.0105\,A$, $i_2 = 0.012\,A$, $i_3 = 0.003\,A$

$\therefore V_o = i_3 (1k\Omega) = 3E{-3}\,A \times 1E3\,V = \boxed{3V}$



There is no need to calculate R_t here. The solution key treats $1k\Omega$ resistor as load and solves the rest using Thévenin's theorem.

If in doubt, ask the proctor regarding which circuit element should be taken as load, if any.

This is what solution did: