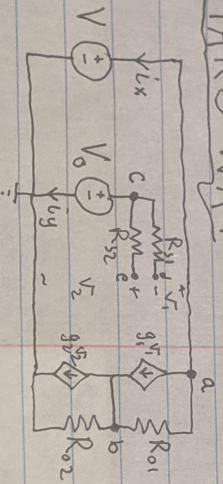


## HARD WAY



$$V_1 = V_a - V_f, \quad V_2 = V_e$$

$$a: i_x + g_1 V_1 + G_{o1} (V_a - V_b) = 0$$

$$\rightarrow i_x + g_1 (V_a - V_f) + G_{o1} (V_a - V_b) = 0$$

$$b: g_1 V_1 + G_{o1} (V_a - V_b) = g_2 V_2 + G_{o2} (V_b - 0)$$

$$\rightarrow g_1 (V_a - V_f) + G_{o1} (V_a - V_b) = g_2 V_e + G_{o2} V_b$$

$$c: i_y + G_{s2} (V_e - V_f) + G_{s2} (V_e - V_e) = 0$$

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$$d: G_{s1} (V_e - V_f) = 0$$

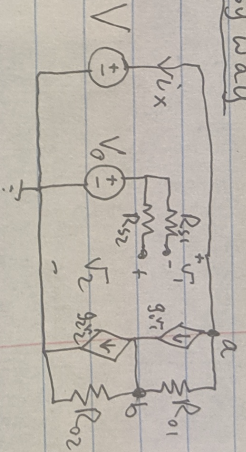
$$e: G_{s2} (V_e - V_e) = 0$$

$$t_1: V_a = V$$

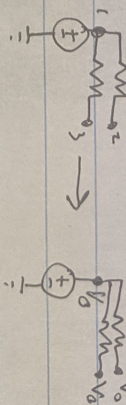
$$t_2: V_e = V_o$$

$$\begin{pmatrix} g_1 + G_{o1} & -G_{o1} & 0 & 0 & 0 & 1 & 0 \\ g_1 + G_{o1} & -G_{o1} - G_{o2} & 0 & -g_1 & -g_2 & 0 & 0 \\ 0 & 0 & G_{s1} + G_{s2} & -G_{s1} & -G_{s2} & 0 & 1 \\ 0 & 0 & 0 & G_{s1} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & G_{s2} & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} V_a \\ V_b \\ V_c \\ V_d \\ V_e \\ V_f \\ V_g \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

## Easy Way



No current ~~through~~ through  $R_{s1}$  or  $R_{s2}$ , so no voltage dropped across them, so



So all constant, no eqns needed.

$$V_1 = V_a - V_o, \quad V_2 = V_o$$

$$a: i_x + g_1 V_1 + (V_a - V_b) G_{o1} = 0$$

$$\rightarrow i_x + g_1 V_a + (V_a - V_b) G_{o1} = g_1 V_o$$

$$b: g_1 V_1 + (V_a - V_b) G_{o1} = g_2 V_2 + V_b G_{o2}$$

$$\rightarrow g_1 (V_a - V_o) + (V_a - V_b) G_{o1} = g_2 V_o + V_b G_{o2}$$

$$t: V = V_a$$

$$\begin{pmatrix} g_1 + G_{o1} & -G_{o1} & 1 & 0 \\ g_1 + G_{o1} & -G_{o1} - G_{o2} & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} V_a \\ V_b \\ V_c \\ V_d \end{pmatrix} = \begin{pmatrix} g_1 V_o \\ g_2 V_o + g_1 V_o \\ V \\ V \end{pmatrix}$$