

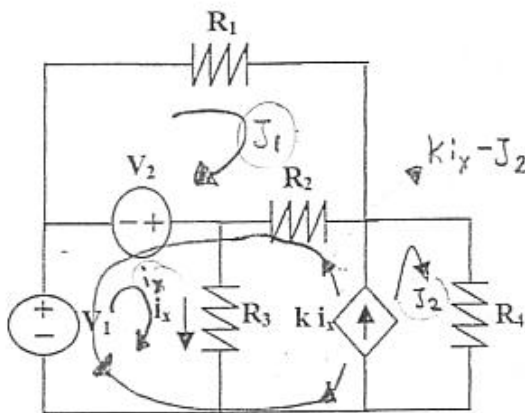
Problem 5: (21 pts)

- Is the following statement TRUE or FALSE ?

[..T.R.V.F..] A circuit with "m" meshes and "k" current sources can be completely analyzed by (m-k) mesh equations with (m-k) unknowns.

- Write down the mesh equations for the circuits given below. One of the mesh currents in each circuit is given. Determine the other current variables and express the solution of circuit in terms of mesh equations.

i) Write 3 mesh equations to find current i_x . Do not solve or simplify the equations. (5 pts)



Note: Selection of current variables significantly simplifies the problem. Make sure that you have fully understood the method.

Unknowns: $\{J_1, J_2, i_x\}$

Mesh J_1 :

$$V_2 + R_1 J_1 + R_2 (J_1 + k i_x - J_2) = 0$$

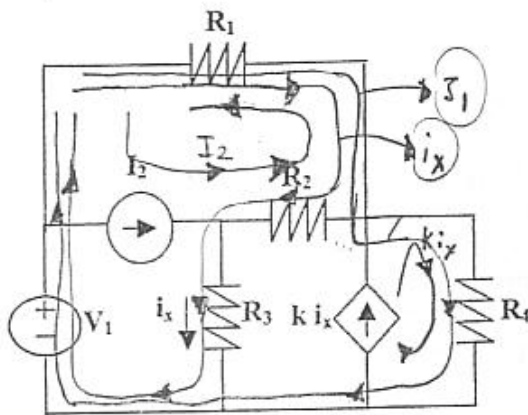
Mesh i_x :

$$-V_1 - V_2 + R_3 i_x = 0$$

Mesh $(k i_x - J_2)$ union J_2 :

$$R_2 (k i_x - J_2 + J_1) + V_2 + V_1 - R_4 J_2 = 0$$

ii) Write 2 mesh equations with 2 unknowns to find i_x . (7 pts)

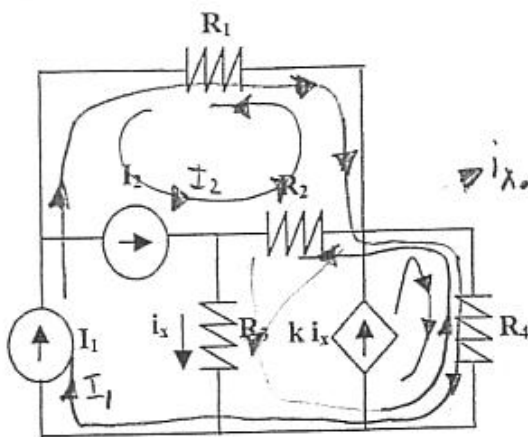


Unknowns: $\{ J_1, i_x \}$

Mesh J_1 : $R_1(J_1 + i_x - I_2) + R_4(ki_x + J_1) - V_1 = 0$

Mesh i_x : $R_1(J_1 + i_x - I_2) + R_2(i_x - I_2) + R_3 i_x - V_1 = 0$

iii) Write only one equation to find i_x . Solve for i_x . (8 pts)



Unknown: i_x

Mesh i_x : $R_3 i_x + R_4(i_x - ki_x - I_1) + R_2(i_x - I_2) = 0$

$$i_x = \frac{R_4 I_1 + R_2 I_2}{R_2 + R_3 + R_4(1-k)}$$