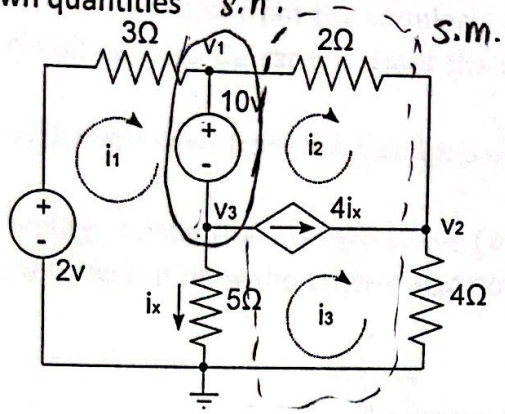
Question 1 (25 pts)

Consider the following circuit. Answer the following questions and show all your derivations. Do not solve the equations for the unknown quantities



a) Find the coefficients in the node equations for v_1, v_2 and v_3 in the form below.

25	v_1 +	−15	v_2 +	30	v_3 =	20
−2	v_1 +	3	v_2 +	−16/5	v_3 =	0
1	v_1 +	0	v_2 +	−1	v_3 =	10

KCL SN $\frac{v_1-2}{3} + \frac{v_3}{5} + 4i_x + \frac{v_1-v_2}{2} = 0 \Rightarrow 25v_1 - 15v_2 + 30v_3 = 20$

KCL v2 $\frac{v_2-v_1}{2} - 4i_x + \frac{v_2}{4} = 0 \Rightarrow -2v_1 + 3v_2 - \frac{16v_3}{5} = 0$

const $v_1 = v_3 + 10$, const: $i_x = \frac{v_3}{5}$

b) Find the coefficients in the mesh equations for i_1, i_2 and i_3 in the form below.

8	i_1 +	0	i_2 +	−5	i_3 =	−8
−5	i_1 +	2	i_2 +	9	i_3 =	10
4	i_1 +	−1	i_2 +	−5	i_3 =	0

KVL M1 $3i_1 + 10 + 5(i_1 - i_3) = 2 \Rightarrow 8i_1 - 5i_3 = -8$

KVL S.M $2i_2 + 4i_3 + 5(i_3 - i_1) - 10 = 0 \Rightarrow -5i_1 + 2i_2 + 9i_3 = 10$

const $i_3 - i_2 = 4i_x \Rightarrow i_3 - i_2 = 4i_1 - 4i_3 \Rightarrow 4i_1 + i_2 - 5i_3 = 0$

const $i_1 - i_3 = i_x$