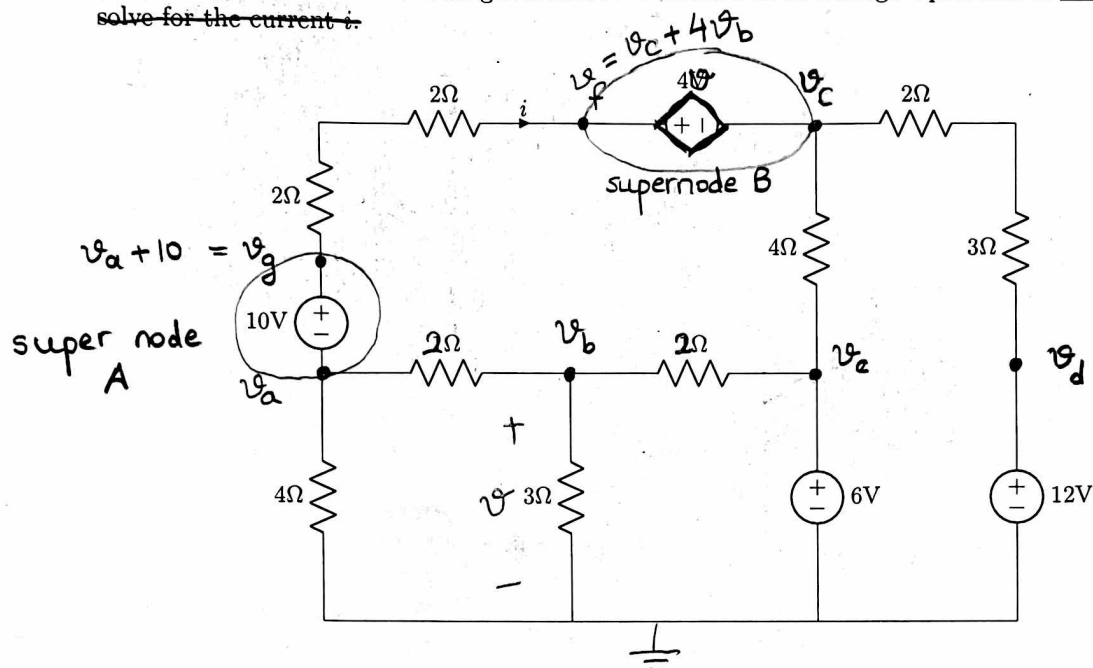1. (20 points) Consider the circuit given below. Write the node-voltage equations in **matrix form**, ~~and solve for the current i.~~

constraint eq.1 $\quad v_g = v_a + 10$

constraint eq.2 $\quad v_f = v_c + 4v_b$

$\quad\quad\quad\quad\quad v_d = 12 \text{ V}$

$\quad\quad\quad\quad\quad v_e = 6 \text{ V}$

KCL supernode A: $\quad \dfrac{v_a}{4} + \dfrac{v_a - v_b}{2} + \dfrac{v_a + 10 - (v_c + 4v_b)}{4} = 0$

KCL supernode B: $\quad \dfrac{v_c + 4v_b - (v_a + 10)}{4} + \dfrac{v_c - 6}{4} + \dfrac{v_c - 12}{5} = 0$

KCL node B: $\quad \dfrac{v_b - v_a}{2} + \dfrac{v_b}{3} + \dfrac{v_b - 6}{2} = 0$

$$
\begin{bmatrix}
\frac{1}{4}+\frac{1}{2}+\frac{1}{4} & -\frac{1}{2}-1 & -\frac{1}{4} \\[2mm]
-\frac{1}{4} & 1 & \frac{1}{4}+\frac{1}{4}+\frac{1}{5} \\[2mm]
-\frac{1}{2} & \frac{1}{2}+\frac{1}{3}+\frac{1}{2} & 0
\end{bmatrix}
\begin{bmatrix} v_a \\[3mm] v_b \\[3mm] v_c \end{bmatrix}
=
\begin{bmatrix} -\frac{5}{2} \\[2mm] \frac{5}{2}+\frac{3}{2}+\frac{12}{5} \\[2mm] 3 \end{bmatrix}
$$

$$
\begin{pmatrix}
1 & -3/2 & -1/4 \\
-1/4 & 1 & 7/10 \\
-1/2 & 4/3 & 0
\end{pmatrix}
\begin{pmatrix} v_a \\ v_b \\ v_c \end{pmatrix}
=
\begin{pmatrix} -5/2 \\ 32/5 \\ 3 \end{pmatrix}
$$