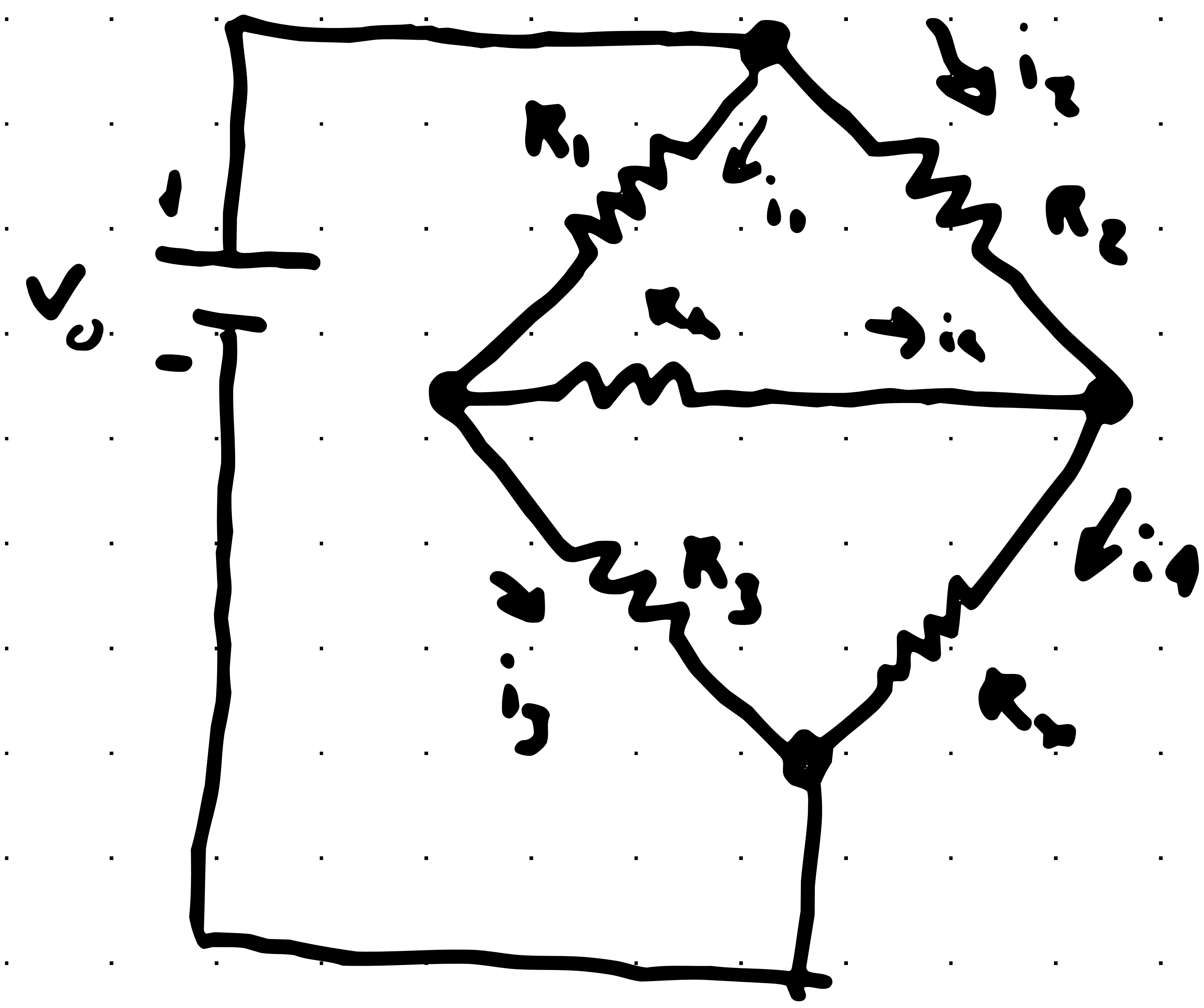
Tutorial 3 Solutions

ECED2000

a) If $R_1 = 1\Omega$ and $R_2 = 2\Omega$ and $R_x = 3\Omega$ what value should R_3 be adjusted so as to achieve a balanced condition?



a) Use Wheatstone Bridge equation

$$R_x R_1 = R_2 R_3$$

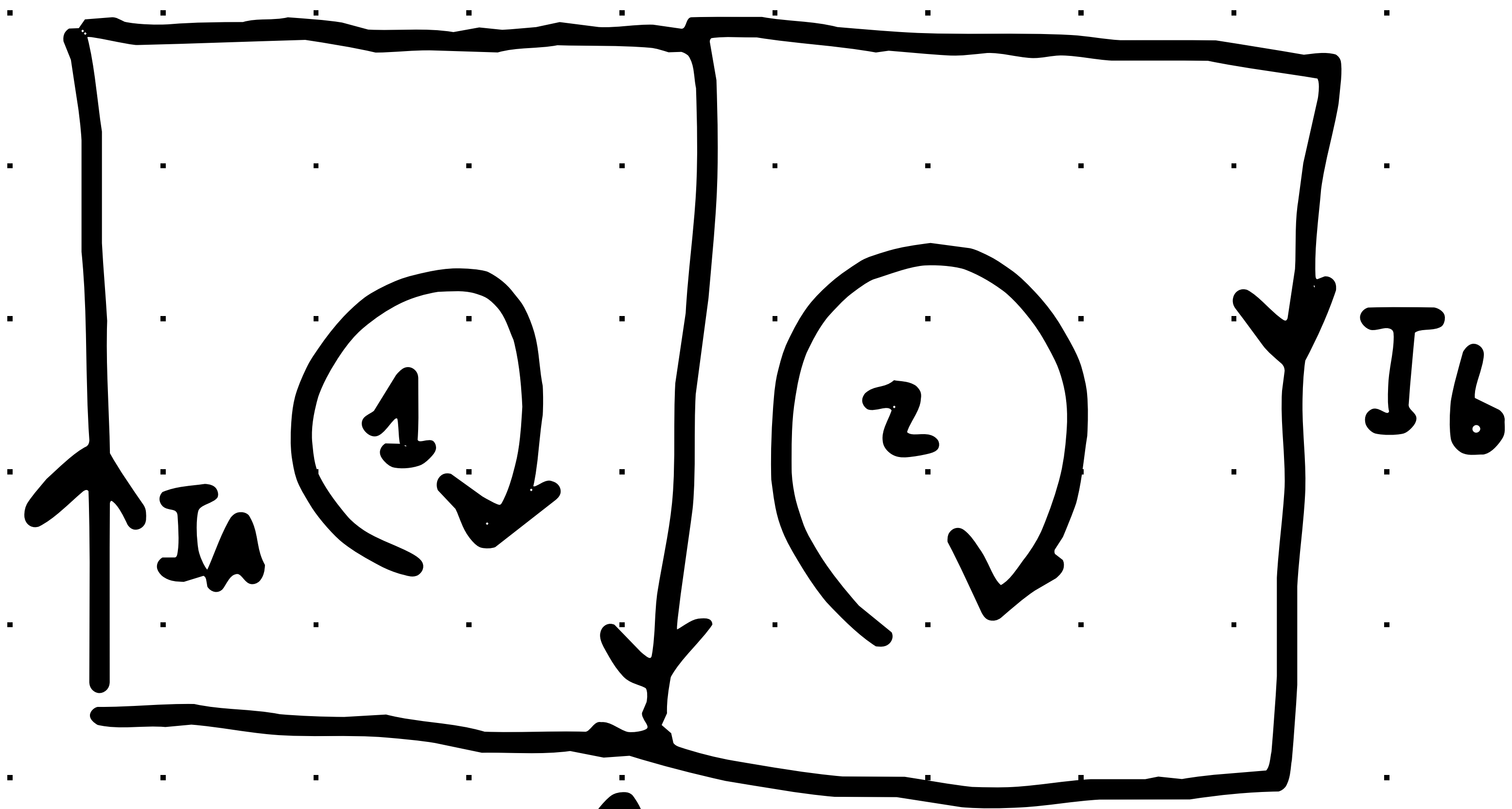
$$(3)(1) = (2) R_3$$

$$R_3 = \frac{3}{2} = 1.5\Omega$$

b) If $V_0 = 6V$, $R_a = 0.1\Omega$ and R_x deviated to be 3.01Ω, what would be reading on the Ammeter?

KVL and KCL will be here

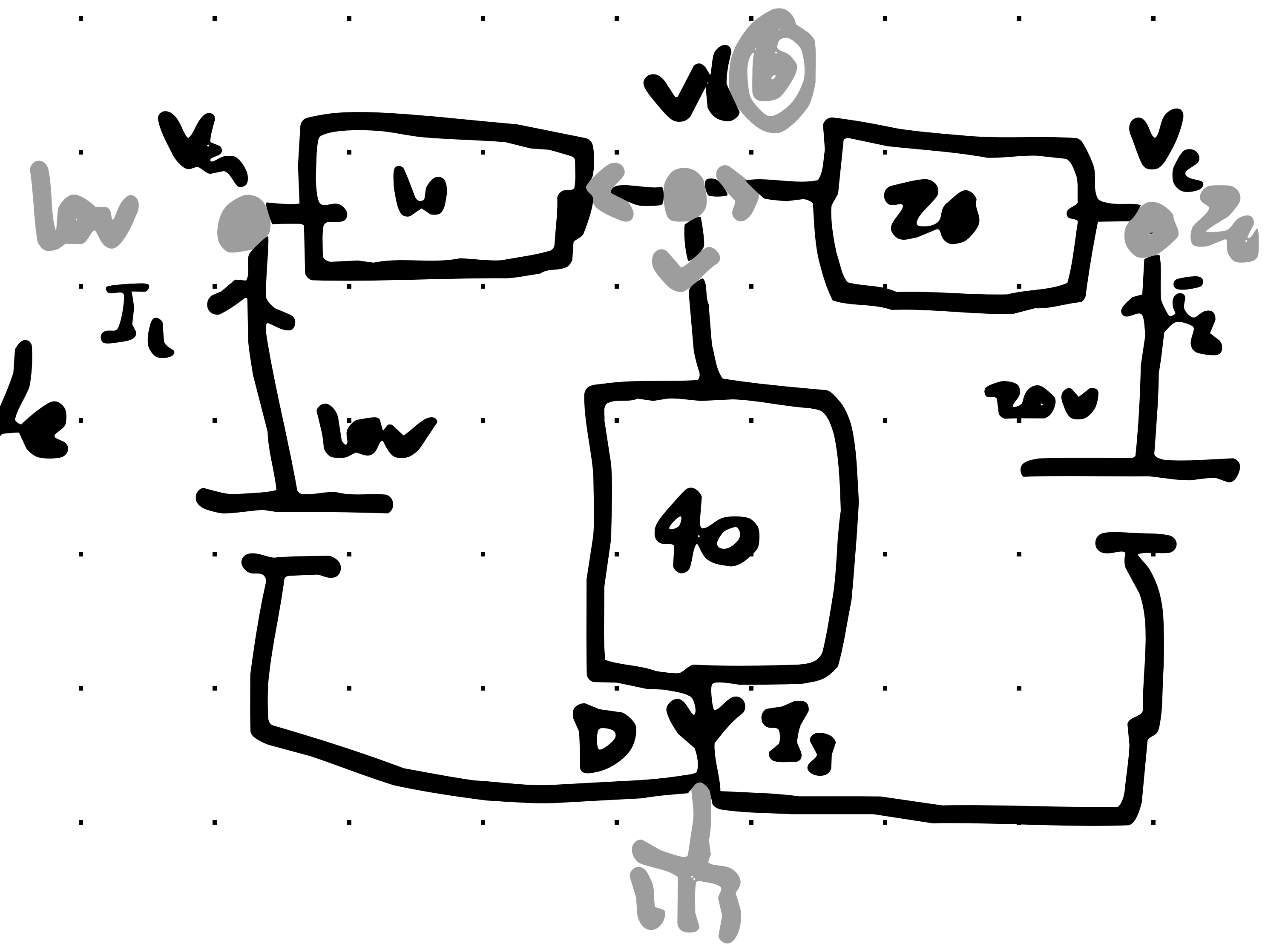
Mesh Analysis



This would be $I_a - I_b$!

- Both loops have to be going the same way!
- Fundamentally very similar to KCL and KVL.

Problem 2



Calculate I_1, I_2, I_3 and calculate the total power dissipated.

Node Analysis

$$\sum I = 0 \quad \text{(Node B)} \qquad \frac{V_b - 10}{10} + \frac{V_b - 20}{20} + \frac{V_b}{40} = 0$$

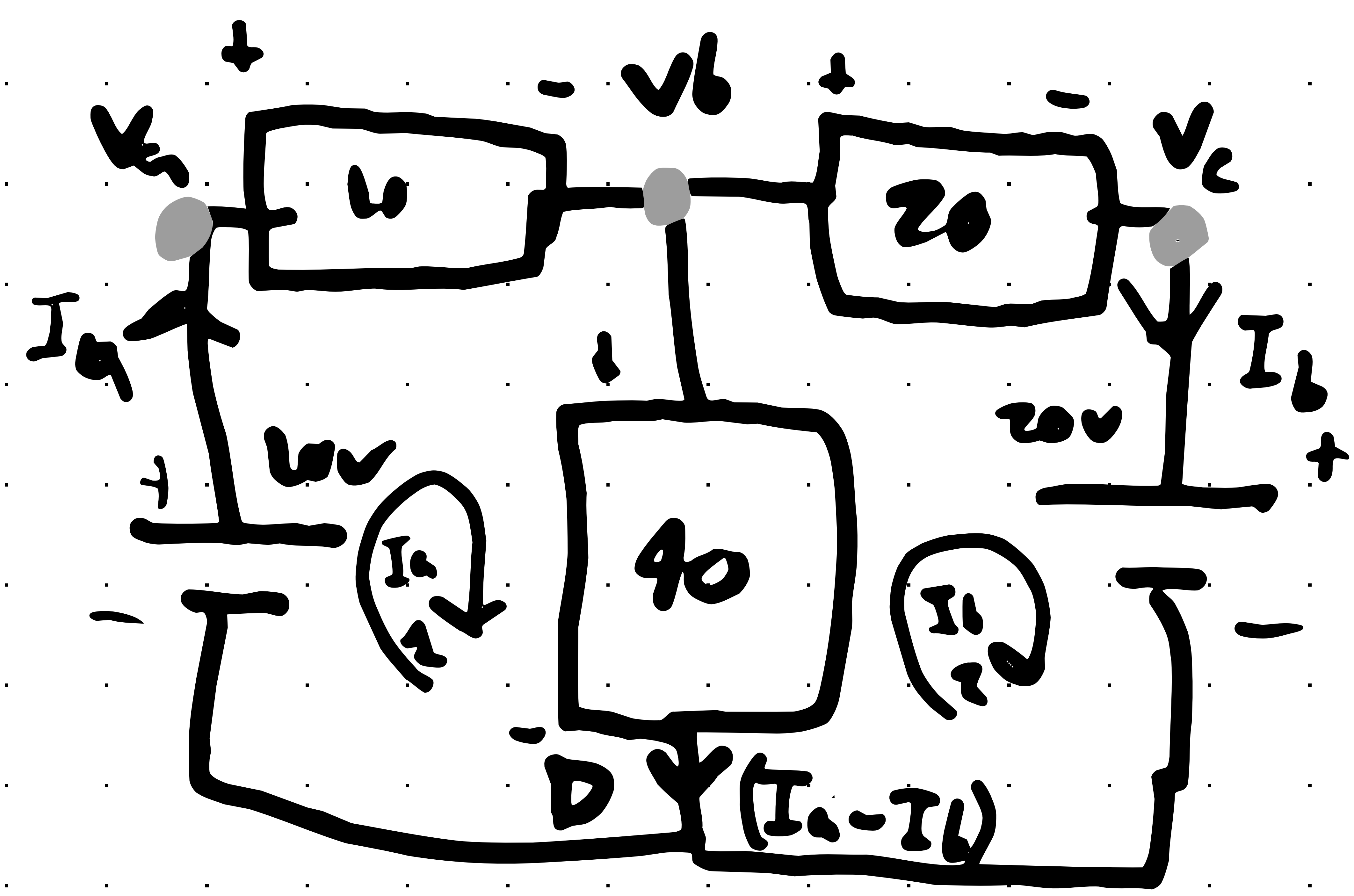
$$V_a = \frac{80}{7} V$$

$V = IR$

$$I_1 = \frac{10 - \frac{80}{7}}{10} = -0.14 A, \quad I_2 = \frac{20 - \frac{80}{7}}{20} = 0.43 A$$

$$I_3 = \frac{V_b}{40} = \frac{80/7}{40} = \frac{2}{7} A$$

Now, do it with <u>Mesh Analysis</u>

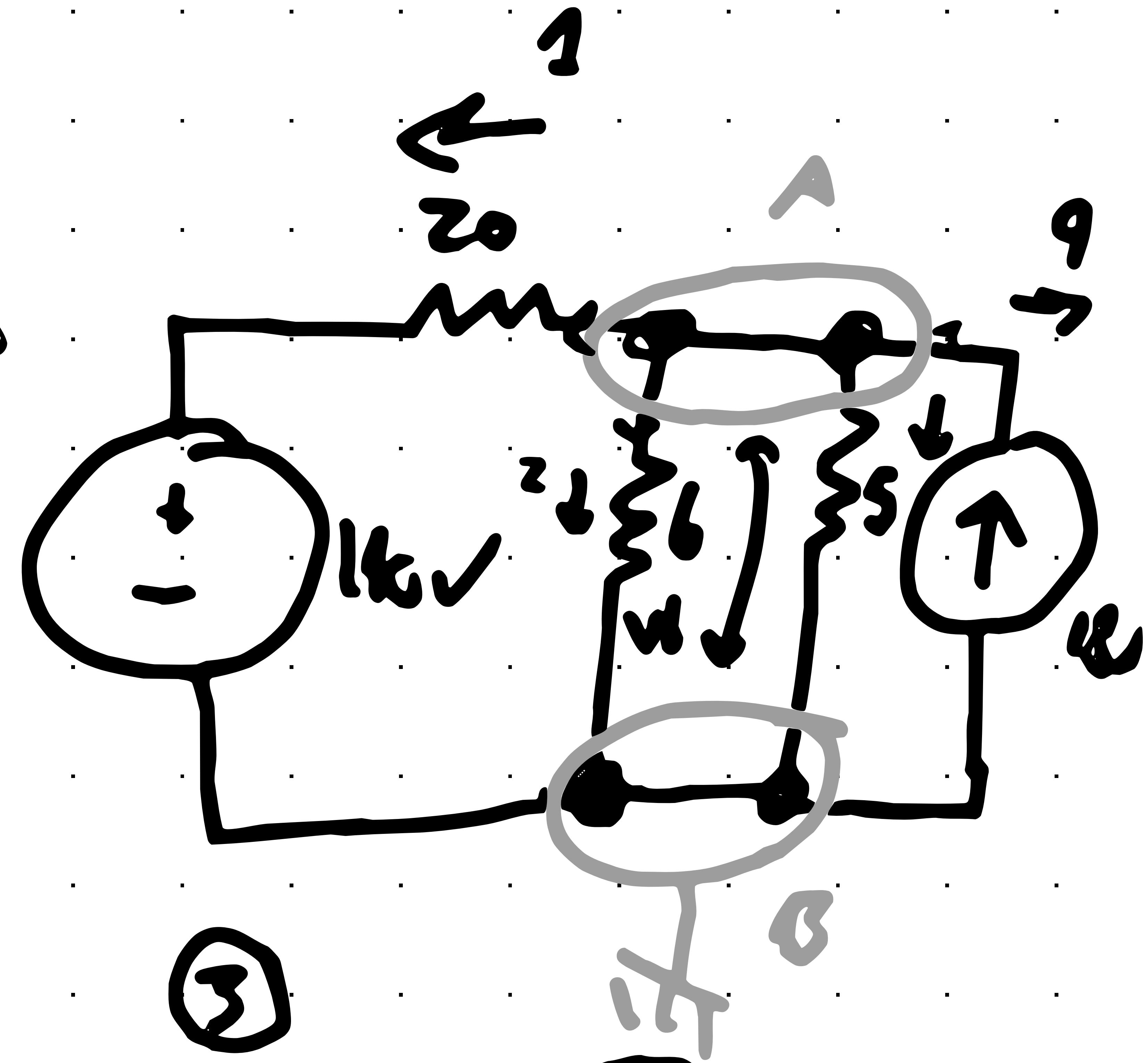


$\sum_{mesh 1} V = 0$ $\quad 10 - 10I_a - 40(I_a - I_b)$ (1)

$\sum_{mesh 2} V = 0$ $\quad 40(I_a - I_b) - 20I_b - 20 = 0$ (2)

Question 3

Use nodal analysis to calculate V_b and the current in 20Ω



$\sum I = 0$ Node A

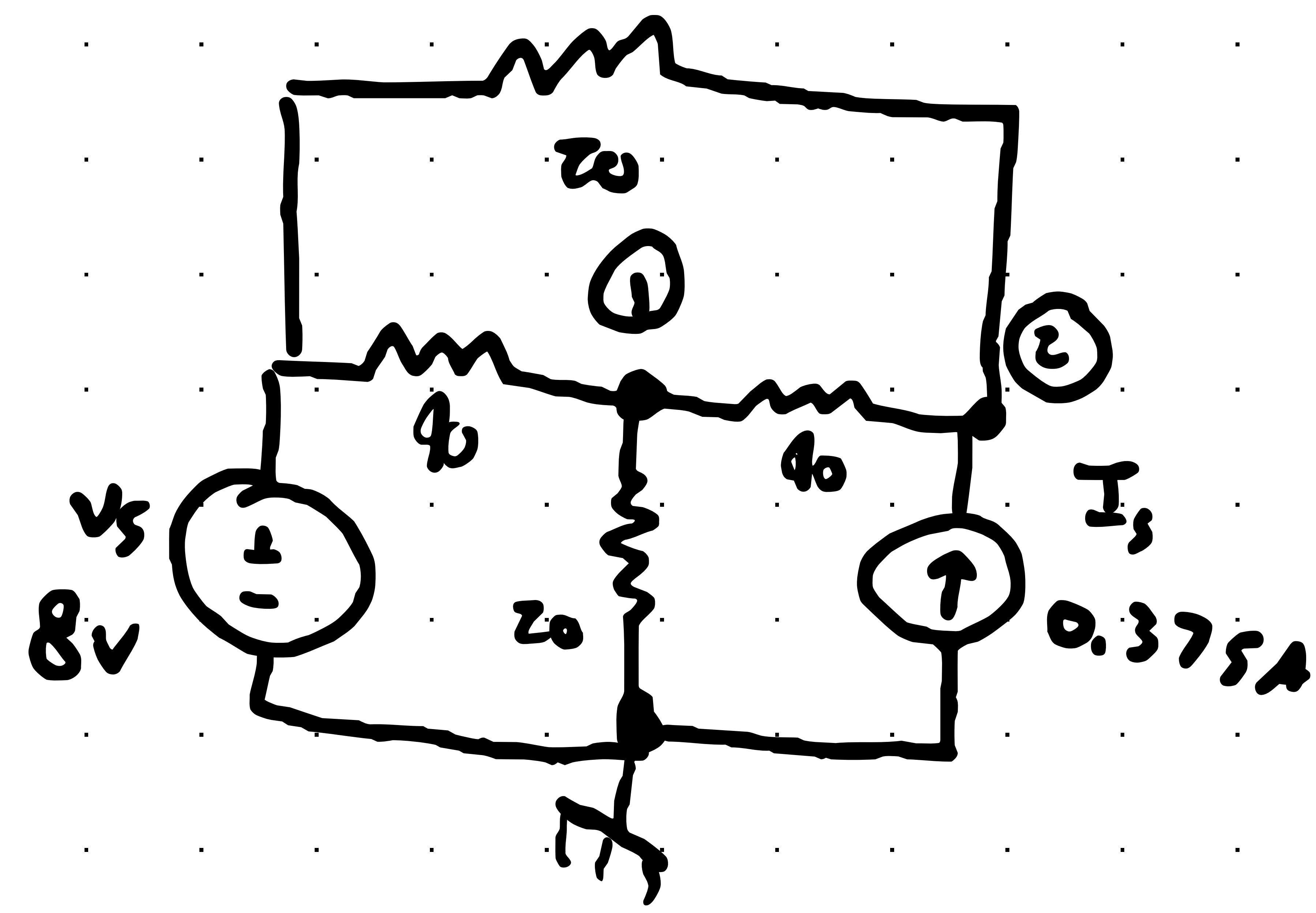
① ② ③ ④

$$\frac{V_b - 140}{20} + \frac{V_b}{6} + \frac{V_b}{5} + (-18) = 0$$

$V_b = 60V$

Question 4

Use the node voltage Method to Calculate the Current in R_1 and R_3



$\sum I = 0$ Node ① $\frac{V_1 - 8}{4} + \frac{V - 0}{20} + \frac{V_1 - V_2}{40}$

$\sum I = 0$ Node ② $\frac{V_2 - V_1}{40} + \frac{V_1 - 8}{20} + (-0.375) = 0$

$V_1 = 5v$ $V_2 = 12v$

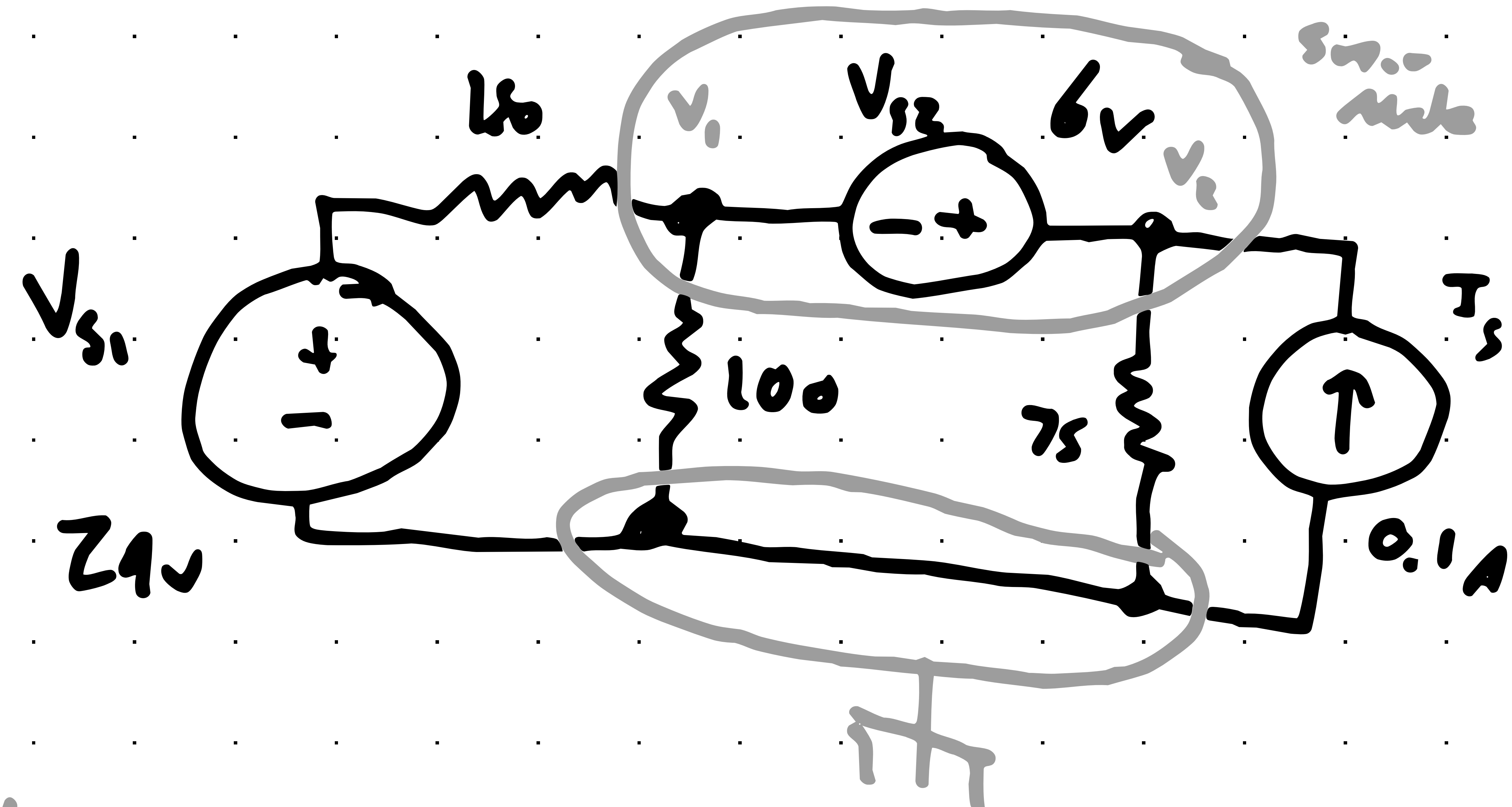
$I_1 = \frac{8-5}{40} = \frac{3}{40} A$

$I_2 = \frac{V_2 - V_1}{40} = \frac{12-5}{40} =$

0.175A

Q_5

Calculate the current in R_1 and R_2 using nodal analysis



$$\sum I = 0 \quad \frac{V_1 - 24}{150} + \frac{V_1}{100} + \frac{V_2}{75} + (0.1) = 0 \quad (1)$$

$$V_2 - V_1 = 6V, \quad V_2 = 6 + V_1 \quad (2)$$

Sub eqn 2 into eqn 1

$$\frac{V_1 - 24}{150} + \frac{V_1}{100} + \frac{6 + V_1}{75} - 0.1 = 0$$

$V_1 = 6V$ $\quad$ $V_2 = 6 + V_1 = 12V$

$$I_1 = \frac{24 - 6}{150} = \frac{18}{150} A$$

$$I_2 = \frac{V_2}{75} = \frac{12}{75} A$$