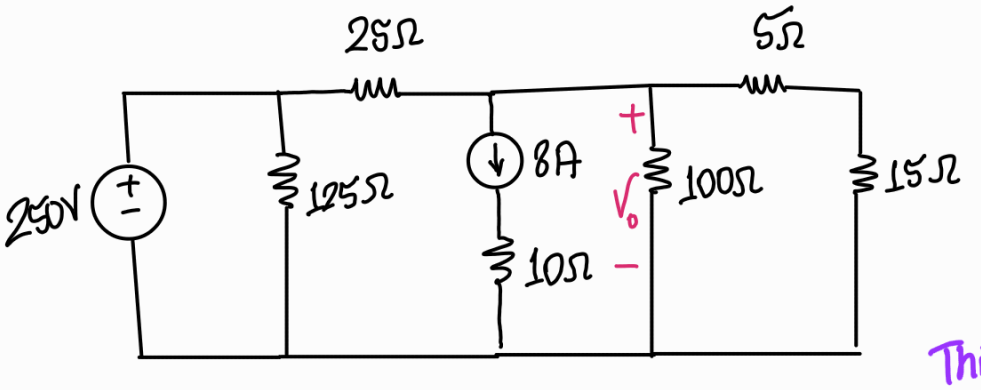
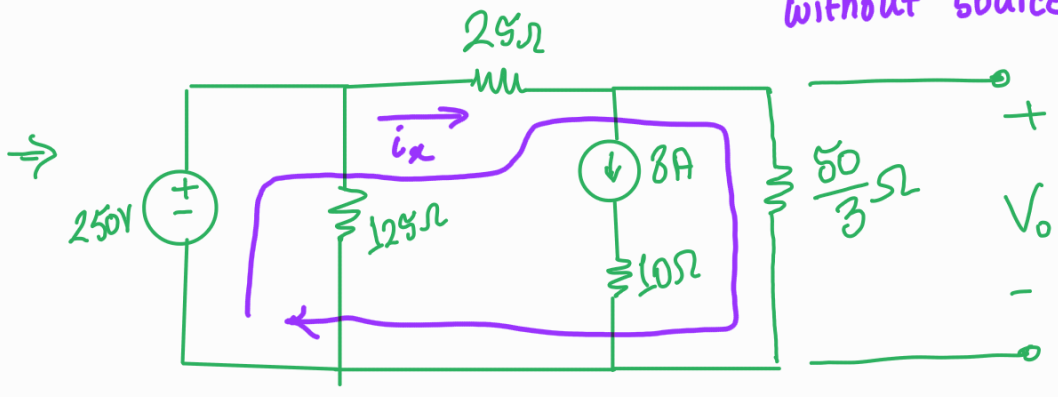
Problem 1



Find v_o and the power of the voltage source & the current source.

This problem is best solved without source transform



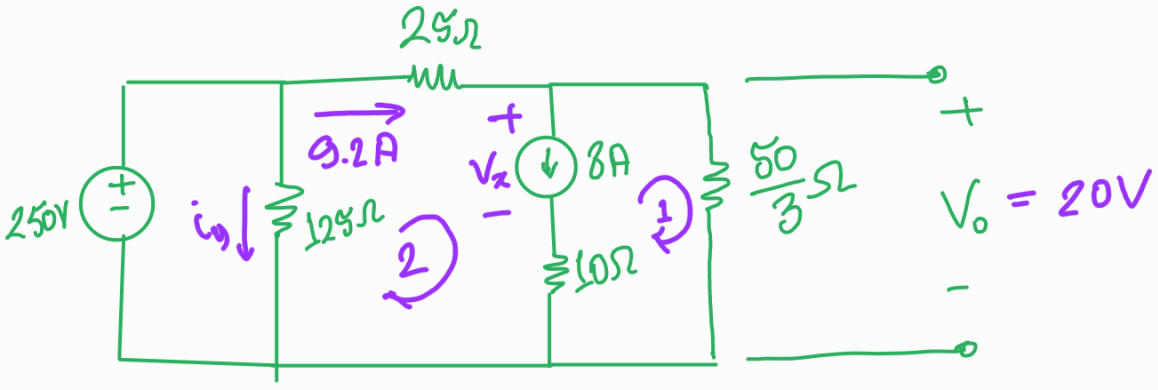
KVL → $-250 + 25i_x + \frac{50}{3}(i_x - 8) = 0$

$\Rightarrow \quad 75i_x + 50i_x - 400 = 750$

$\Rightarrow \quad 125\, i_x = 1150$

$\Rightarrow i_x = 9.2\ A$

$\therefore V_o = \frac{50}{3} \times (i_x - 8) = \frac{5 \times 12}{3} = 20\ V$



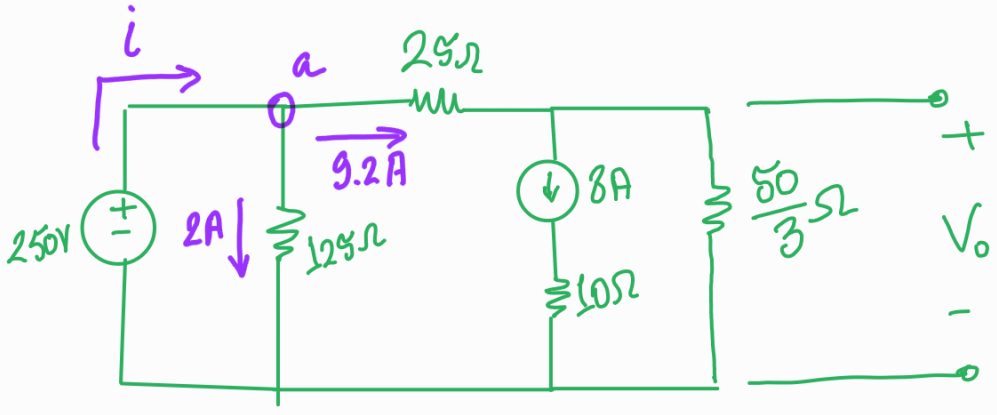
KVL @ 1 → $-V_x + 20 - 80 = 0$

$\Rightarrow V_x = -60V$

$\therefore P_{8A} = +V_x I = (-60) \times 8 = -480W$ [Mistake in slide]

KVL @ 2 — $-125\, i_y + 9.2 \times 25 + 20 = 0$

$\Rightarrow i_y = 2A$

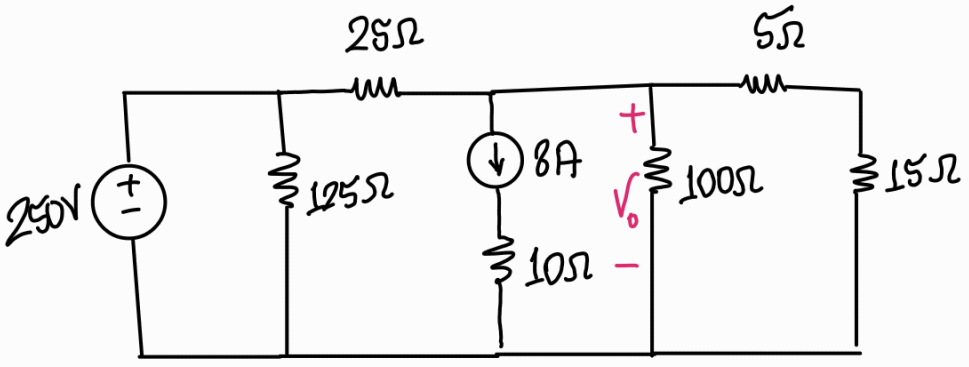


KCL @ a — $i = 2 + 9.2 = 11.2A$

$\therefore P_{250V} = -250 \times 11.2\ W = -2.8kW$

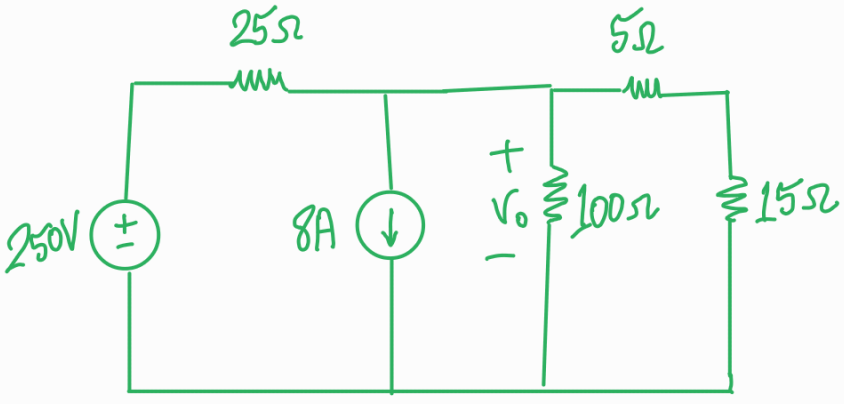
But what if you want to solve it using source transformation?

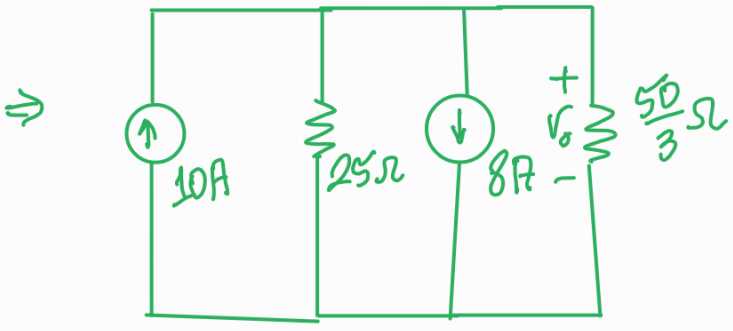
You can follow the slide based simplification. But note that you can only find V_o using the simplification. If you try finding the power in the truncated ckt, the power values will not match.

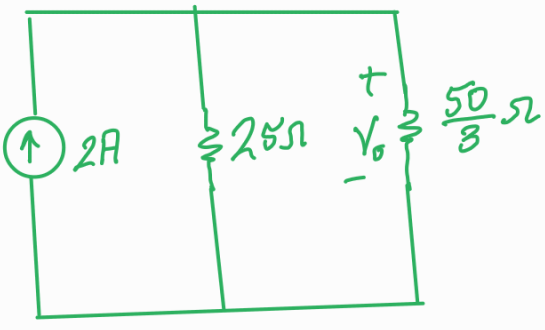


(truncation is a type of lossy compression)

truncating following the slide's principle



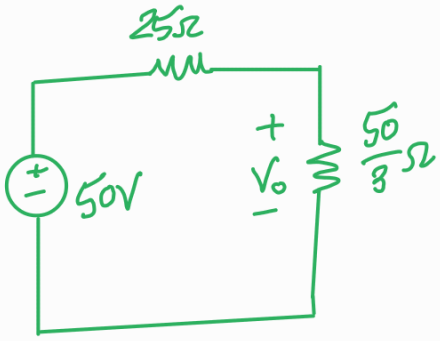




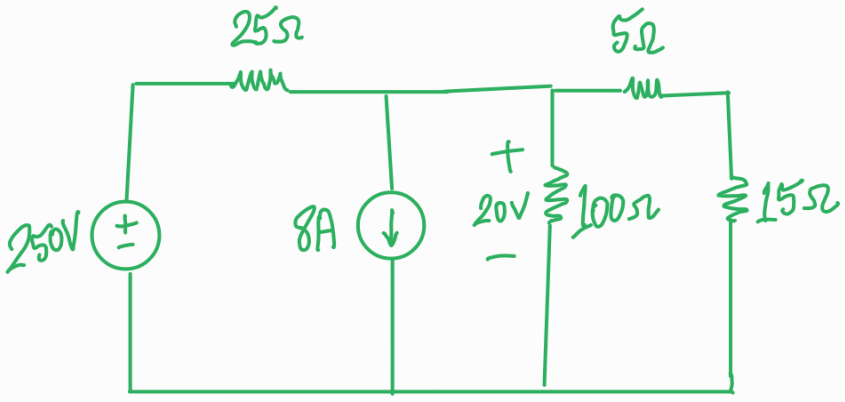
$$V_o = \frac{50/3}{25+50/3} \times 50 \text{ V}$$

$$= \frac{50 \times 50}{125} \text{ V}$$

$$= 20\text{V}$$ ← same as KVL-KCL method



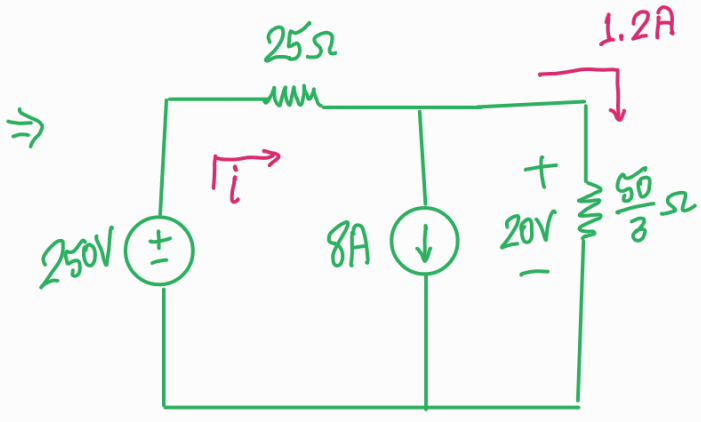
but now if you take the truncated ckt and try finding the power of the sources —



P_{8A} (truncated) $= +20 \times 8$ W

$= 160$ W

↳ doesn't match



$\Rightarrow i = 9.2$ A

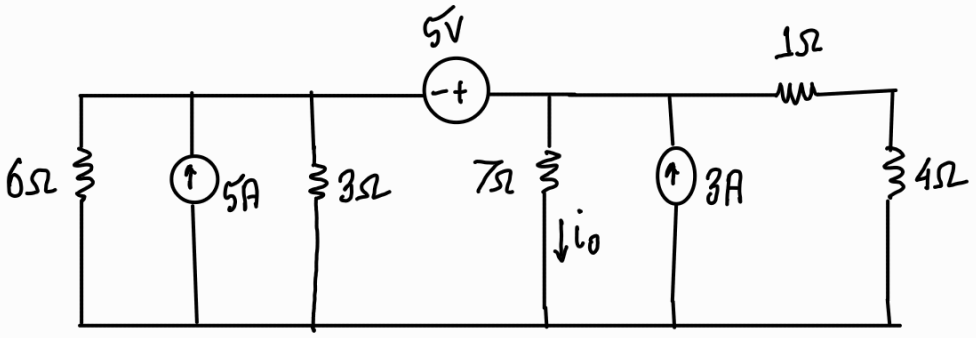
$\therefore P_{250V}$ (truncated) $= -250 \times 9.2$ W

$= -2.3$ kW

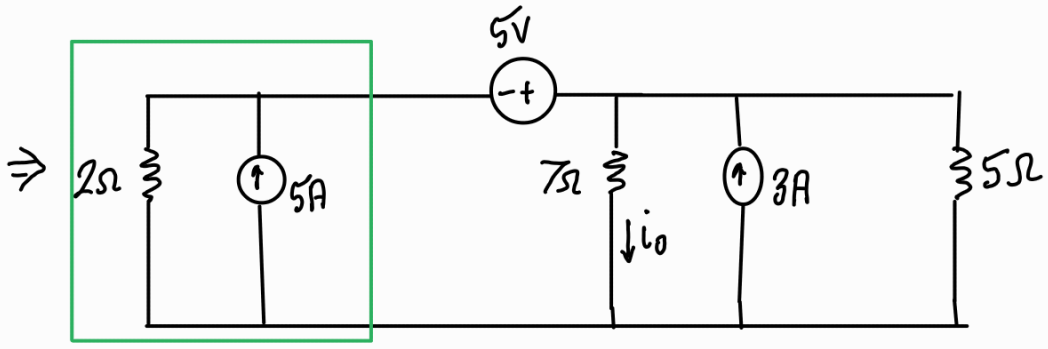
↳ doesn't match

Takeaway — the chances of such a question coming in the exams is very low. Even if such a question comes you probably won't be forced to apply source transformation.

Problem 2



Find i_o using source transformation.

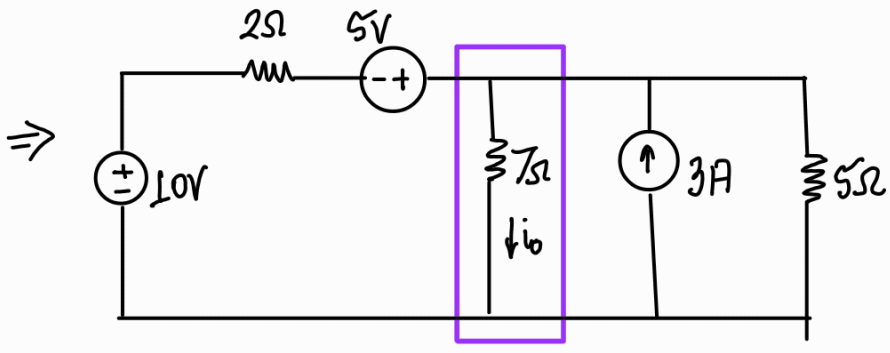


The goal of src transform is to bring the ckt in a form where you can combine resistors and sources.

So just follow these steps —

(i) simplify if possible

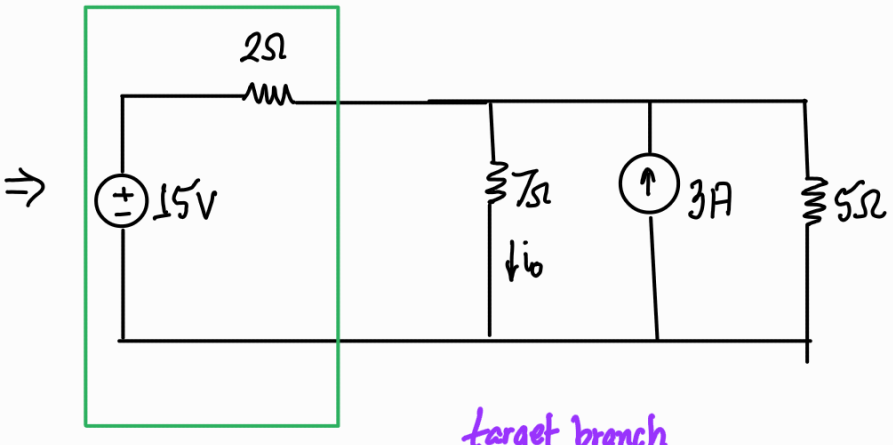
(ii) else apply src transform & try again



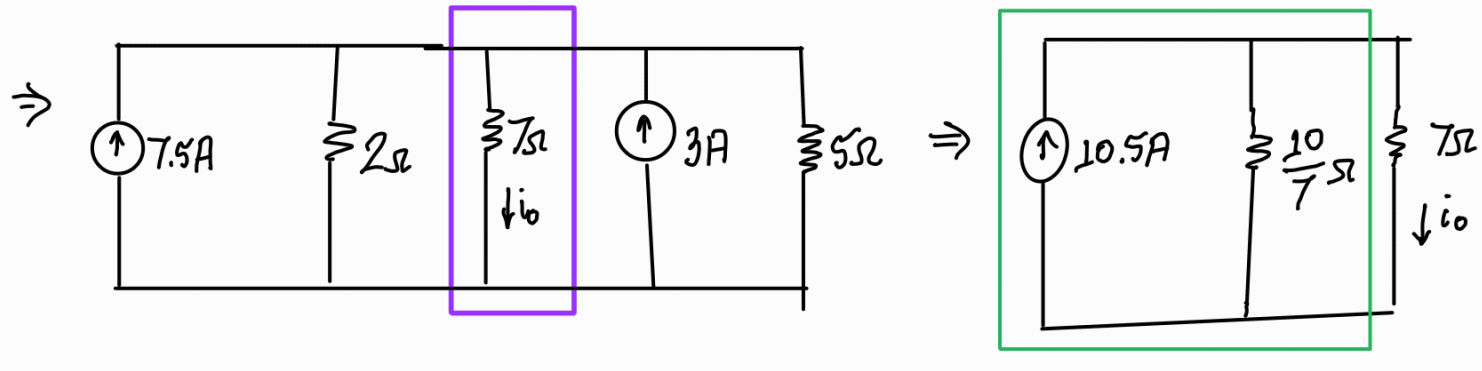
target branch
(DO NOT COMBINE)

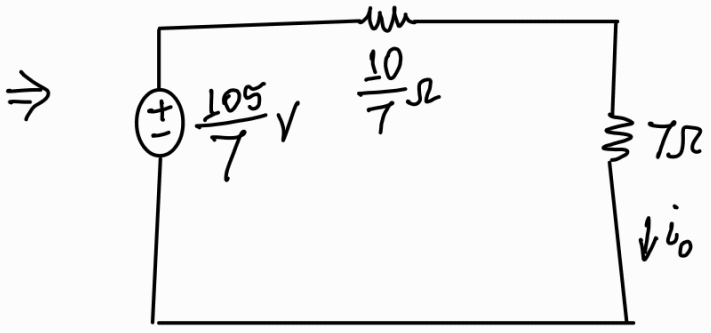
DO NOT COMBINE TARGET BRANCHES

(iii) Continue till there is a single loop left



target branch

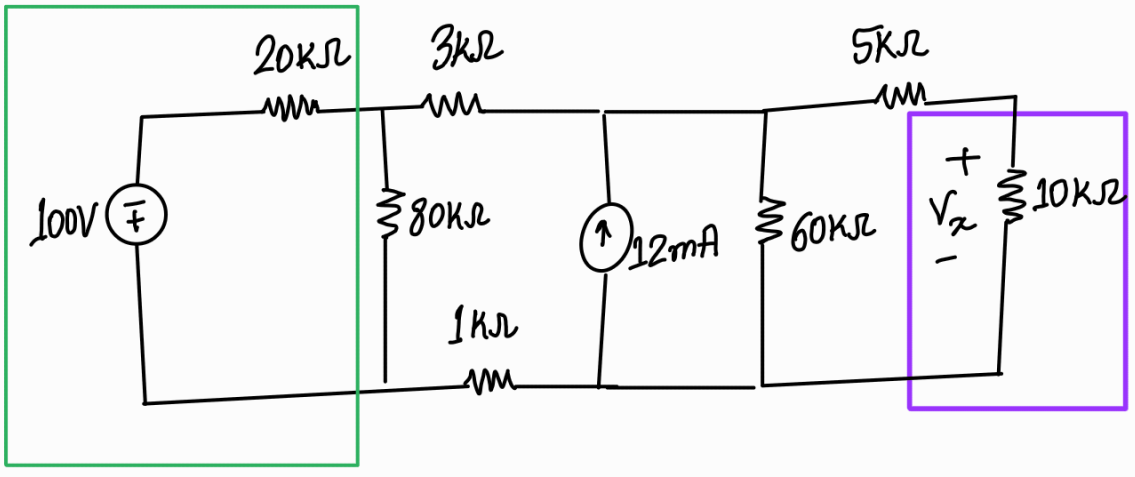




$$i_o = \frac{\frac{105}{7}}{7+\frac{10}{7}}$$

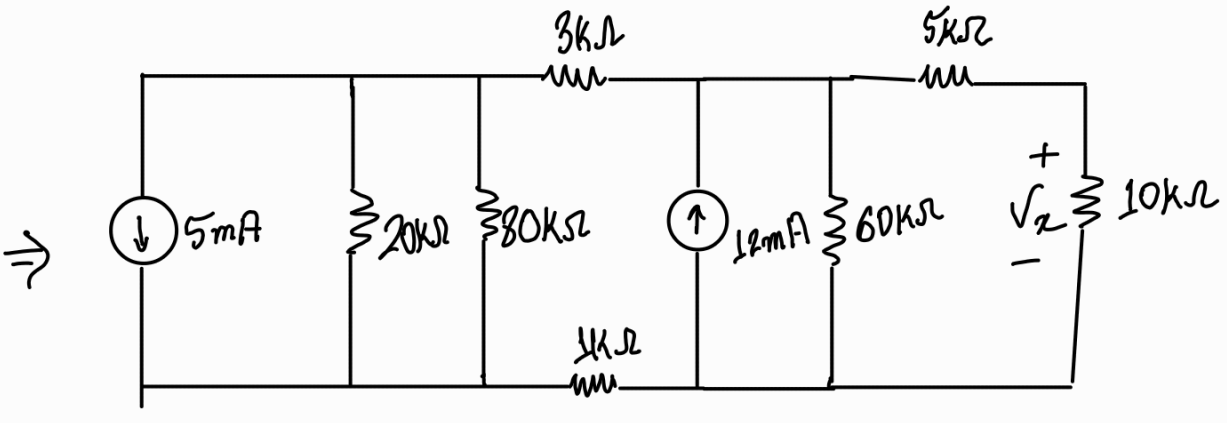
$$= \frac{105}{59}\ A = 1.78\ A$$

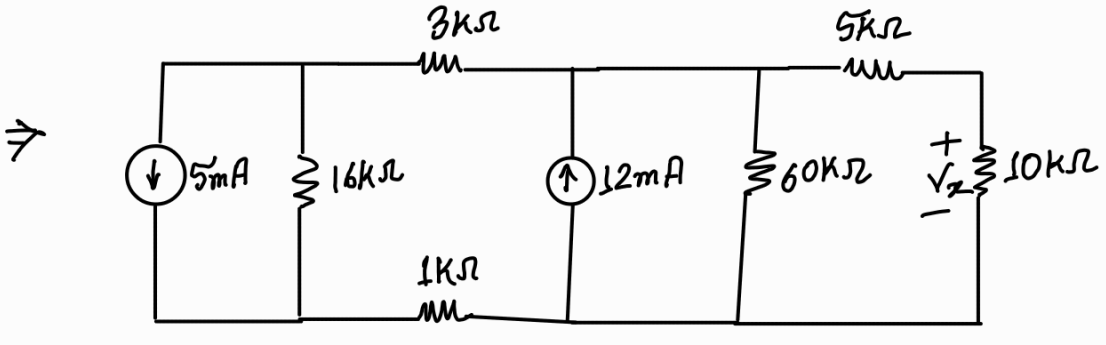
Problem 3

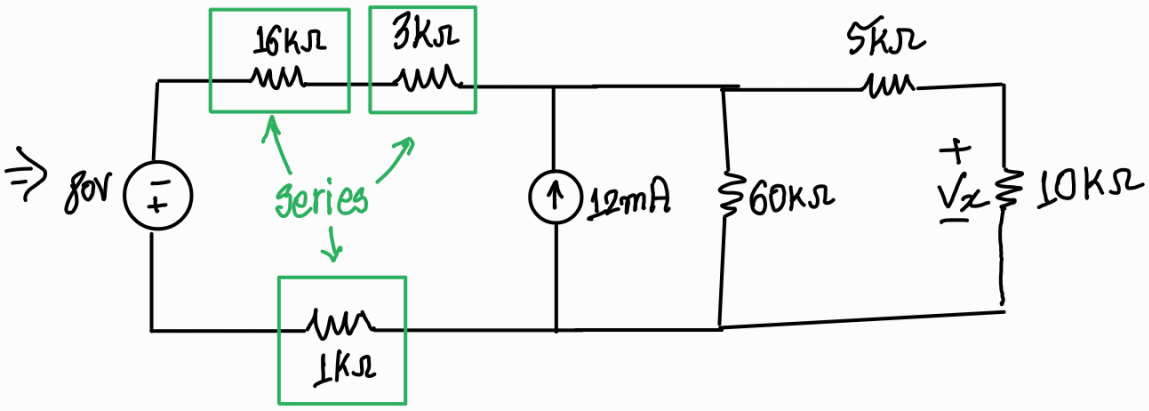


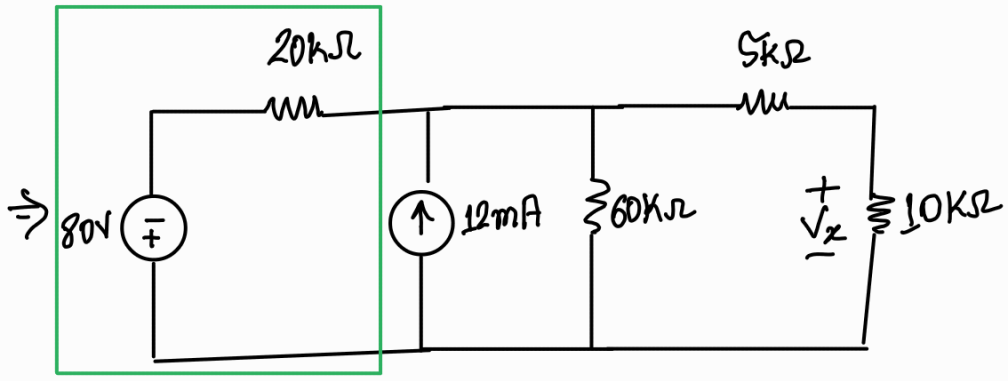
Find V_x

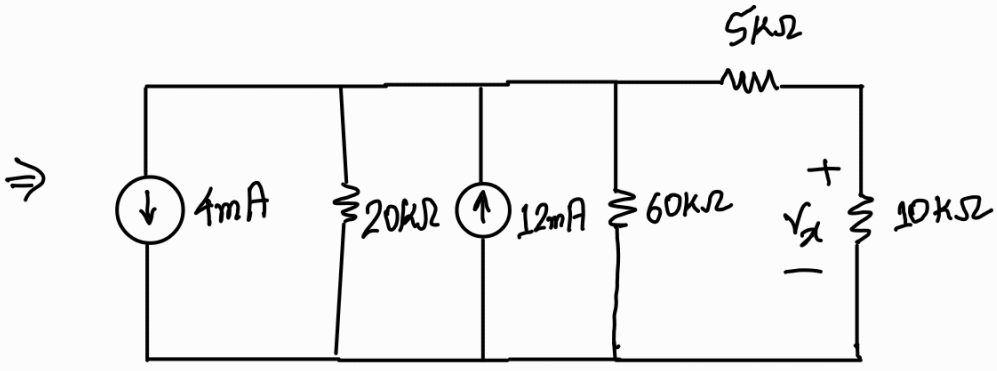
target branch

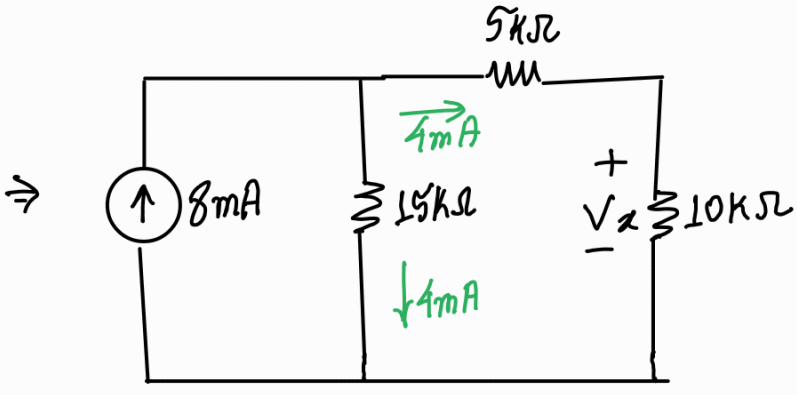






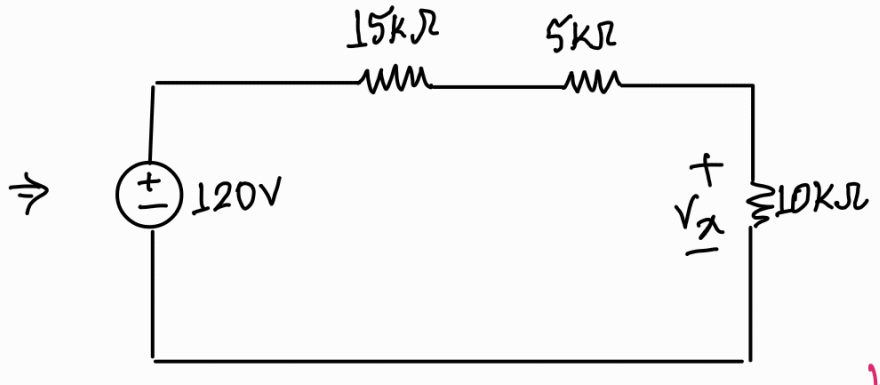






if the question doesn't ask you to bring the circuit to a single loop, you can just apply current divider here.

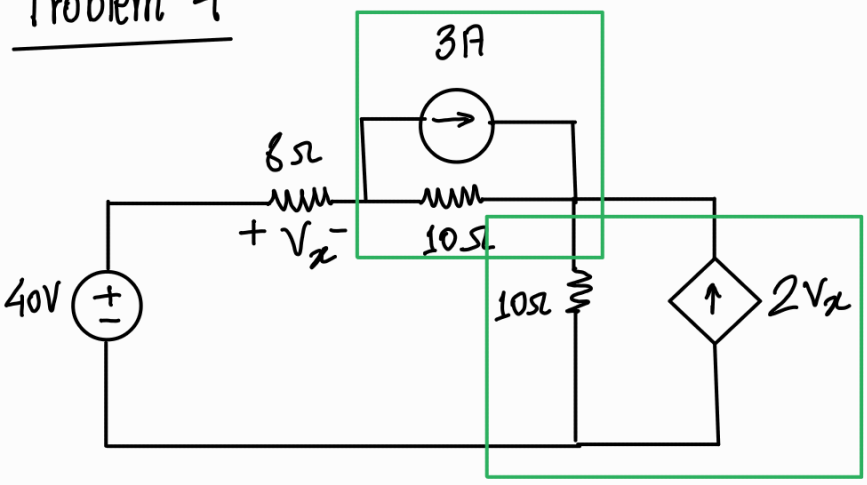
$\therefore V_x = 4 \times 10 \ V = 40V$



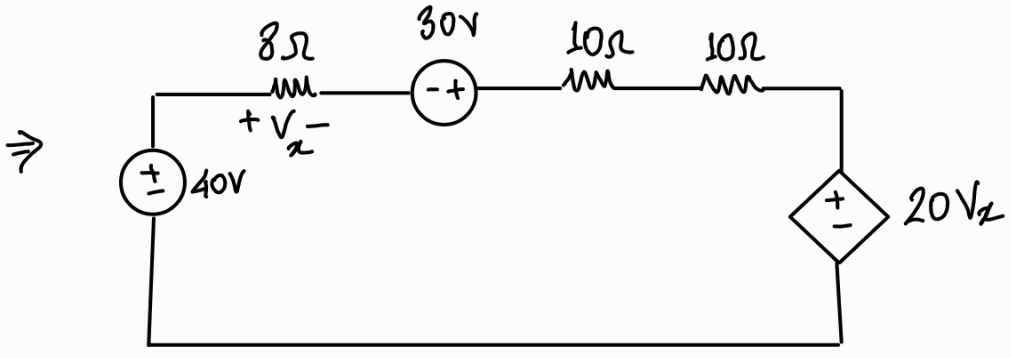
But if the question asks you to bring the ckt to a single loop, this is the form you want.

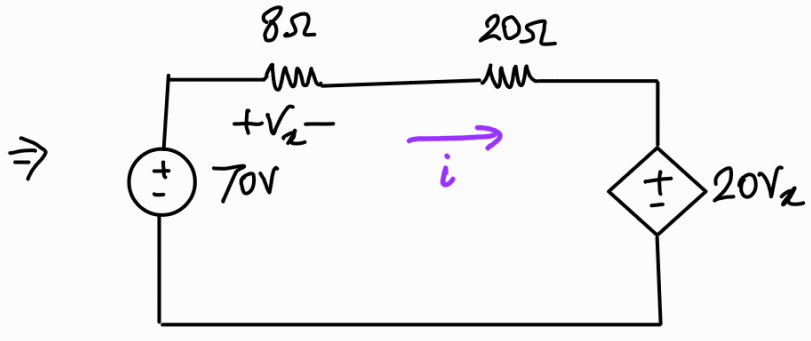
$V_x = \frac{10}{30} \times 120 \ V = 40V$

Problem 4



Find V_x





$$i = \frac{70 - 20V_x}{8 + 20}$$

but $i = \frac{V_x}{8}$

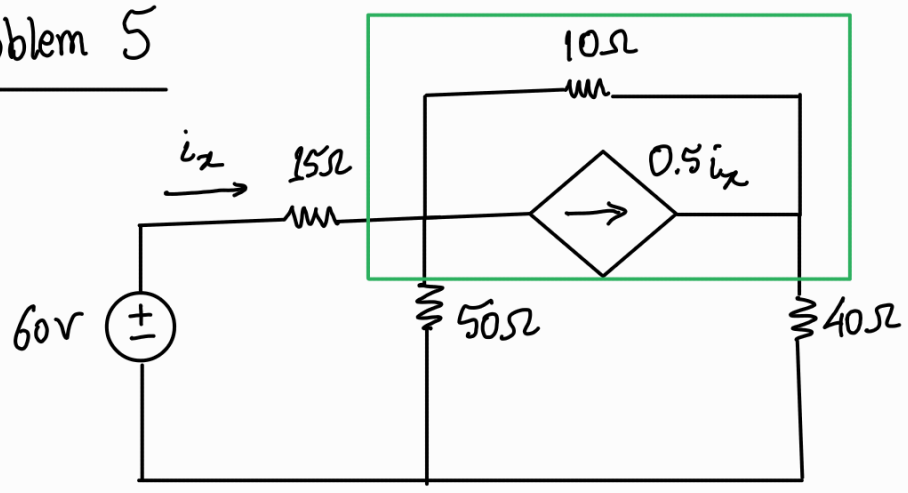
$$\therefore \frac{V_x}{8} = \frac{70 - 20V_x}{28}$$

$$\Rightarrow 28V_x = 560 - 160V_x$$

$$\Rightarrow 188V_x = 560$$

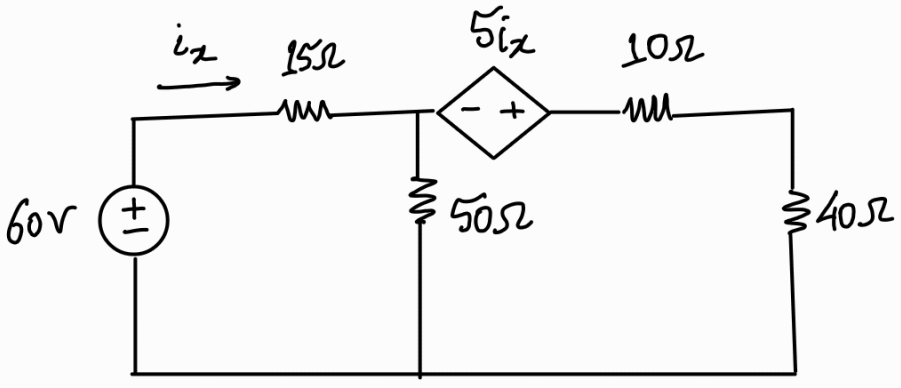
$$\Rightarrow V_x = 2.98V$$

Problem 5

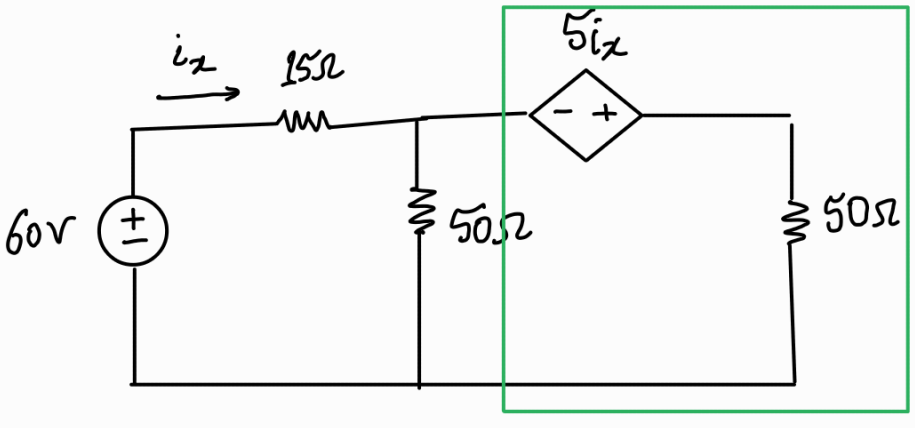


Find i_x

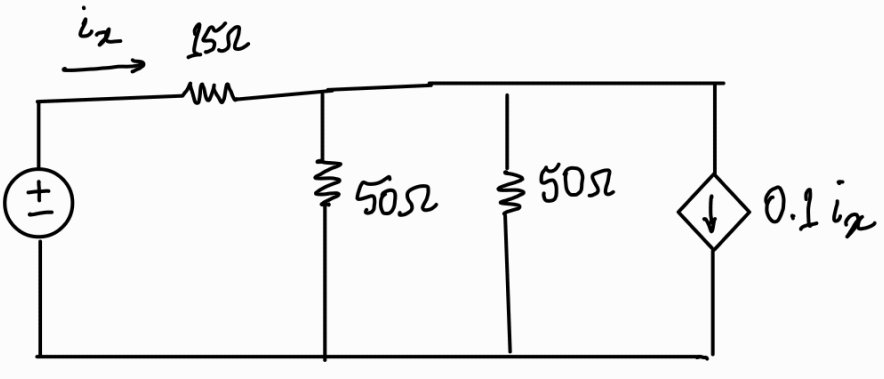
⇒

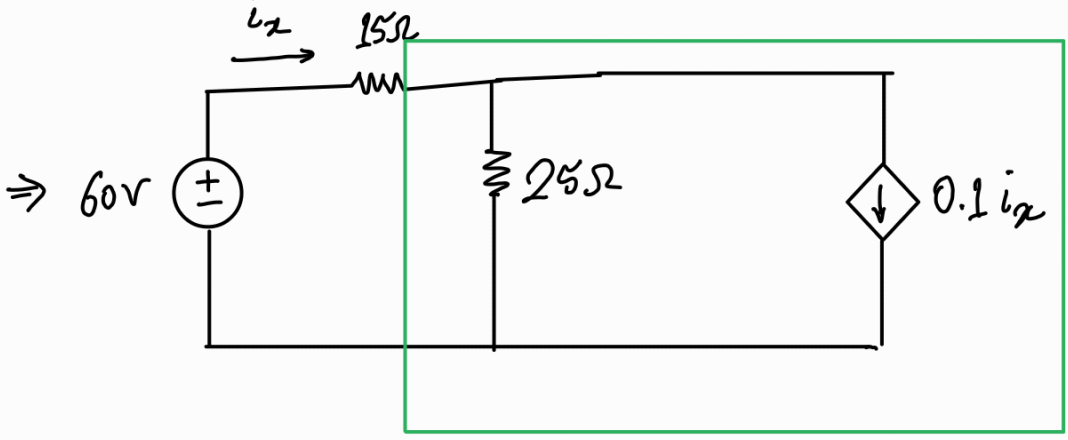


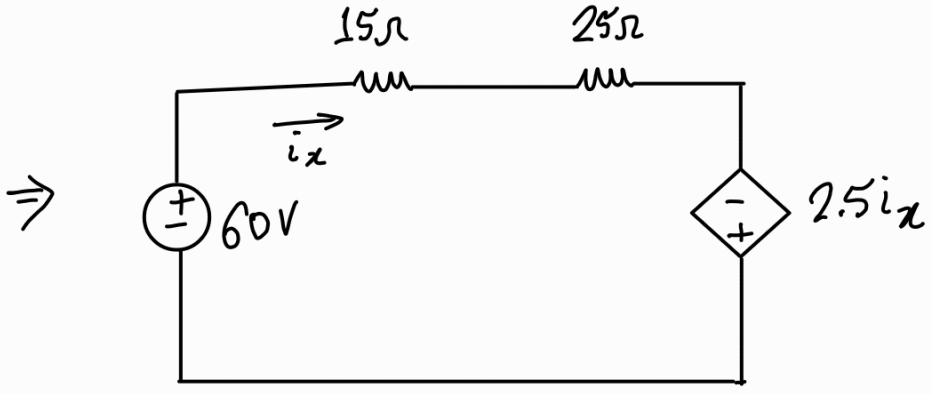
⇒



⇒







$$i_x = \frac{60 + 2.5 i_x}{40}$$

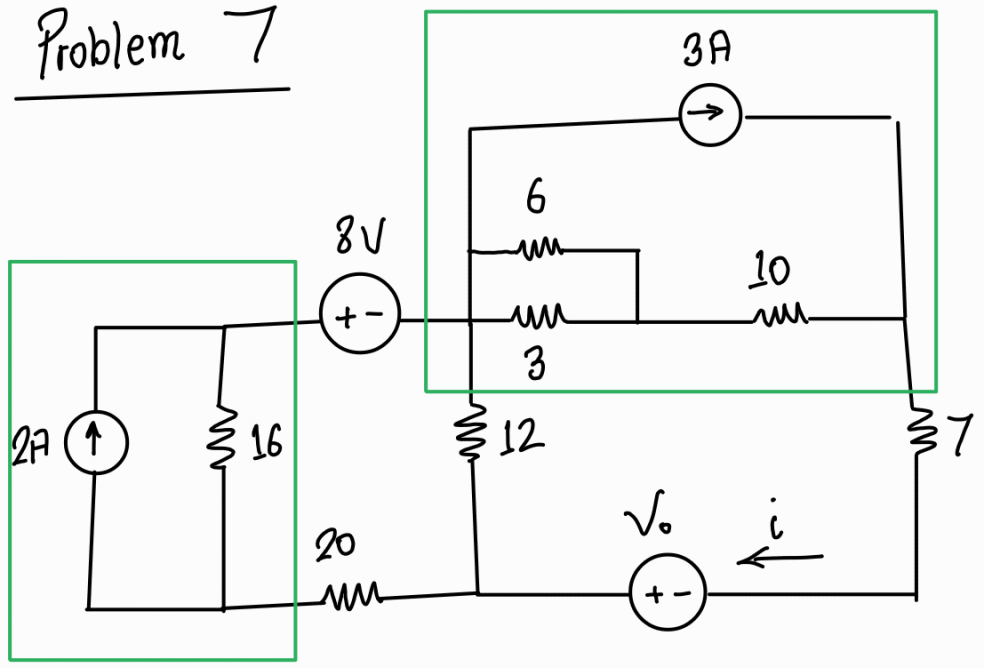
$$\Rightarrow 37.5 i_x = 60$$

$$\Rightarrow i_x = 1.6\,A$$

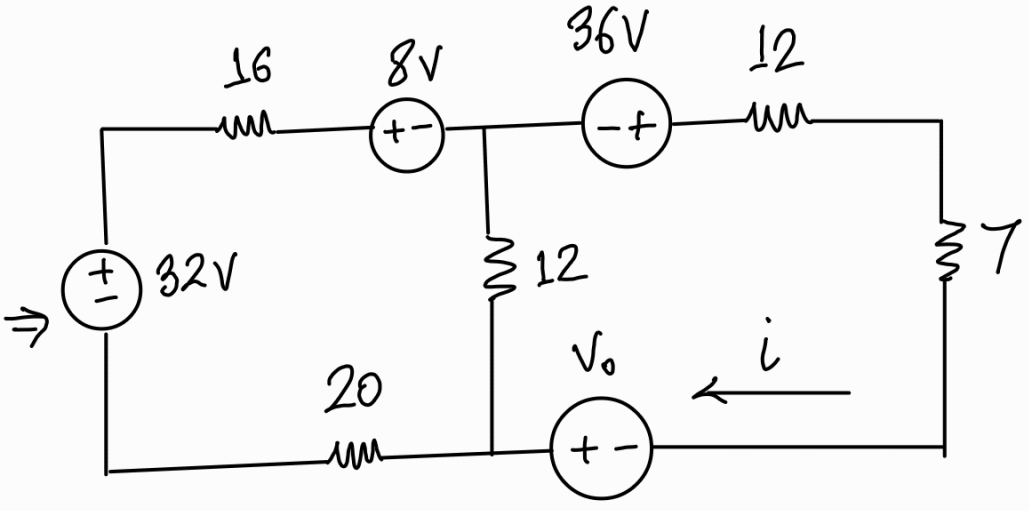
Problem 6

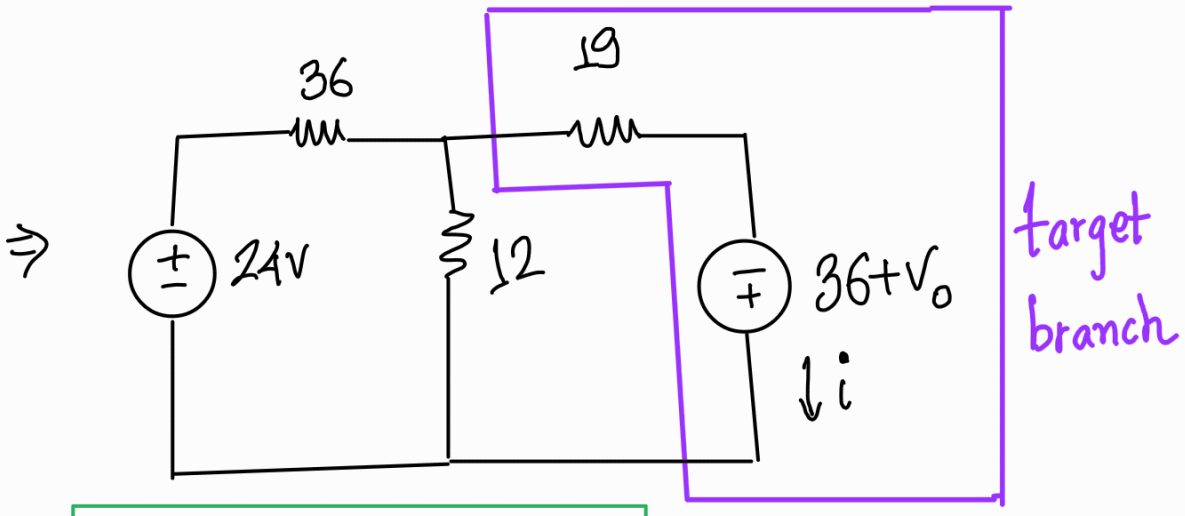
Literally the same as Problem 2.

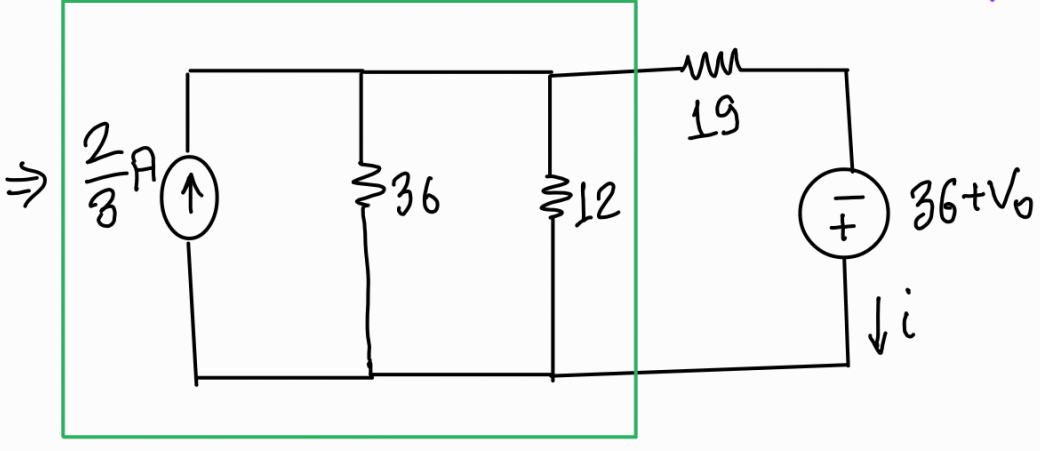
Problem 7

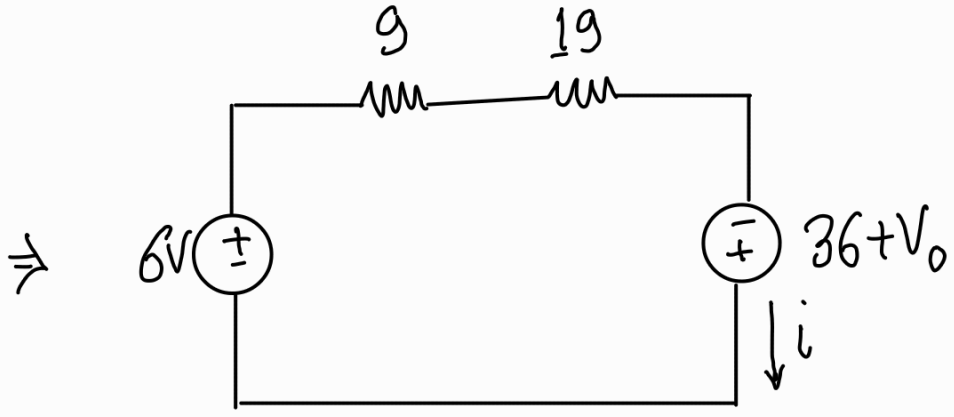


Reduce the ckt to a single loop. If $i = 2.5$A determine V_o







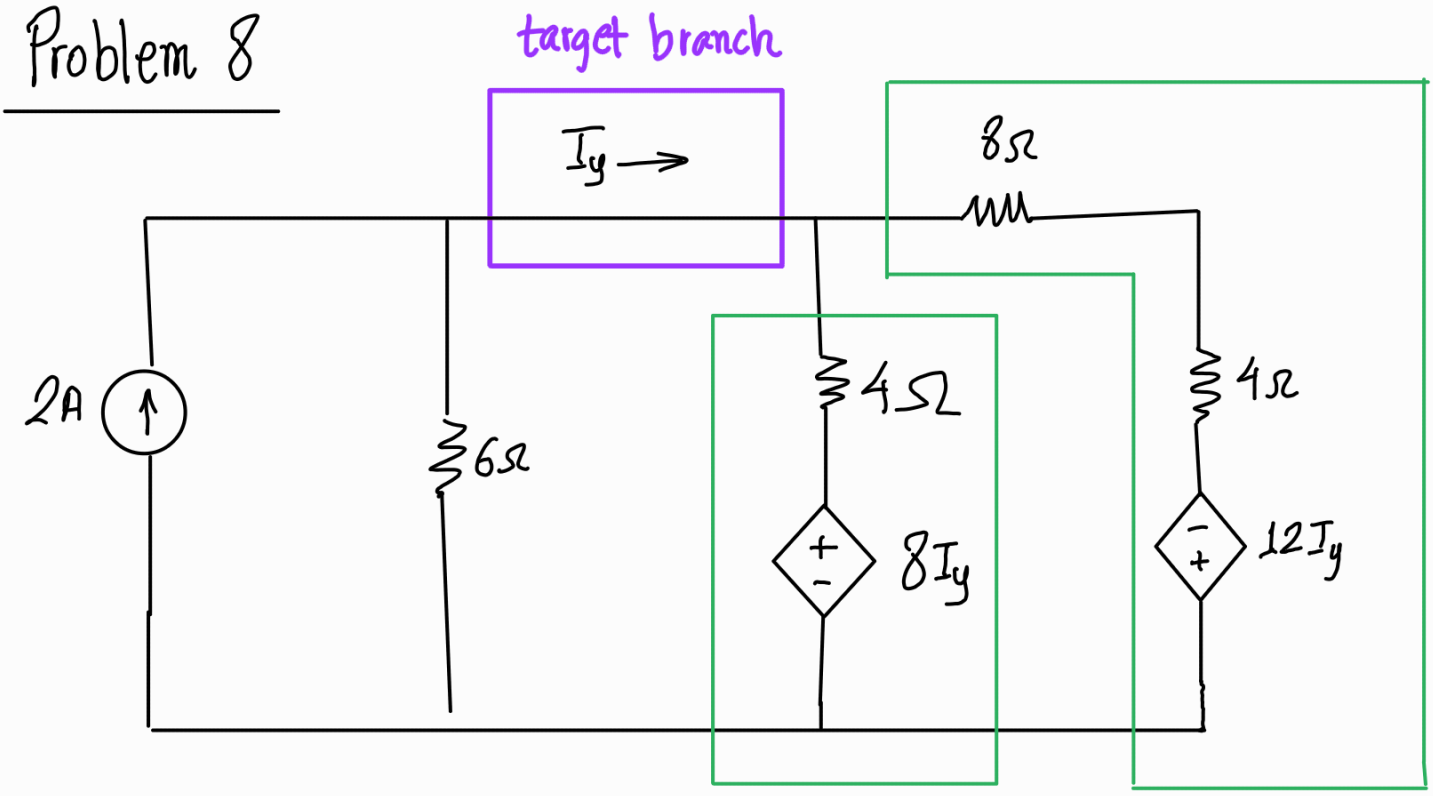


$$i = \frac{42+V_o}{9+19} \Rightarrow 2.5 = \frac{42+V_o}{28}$$

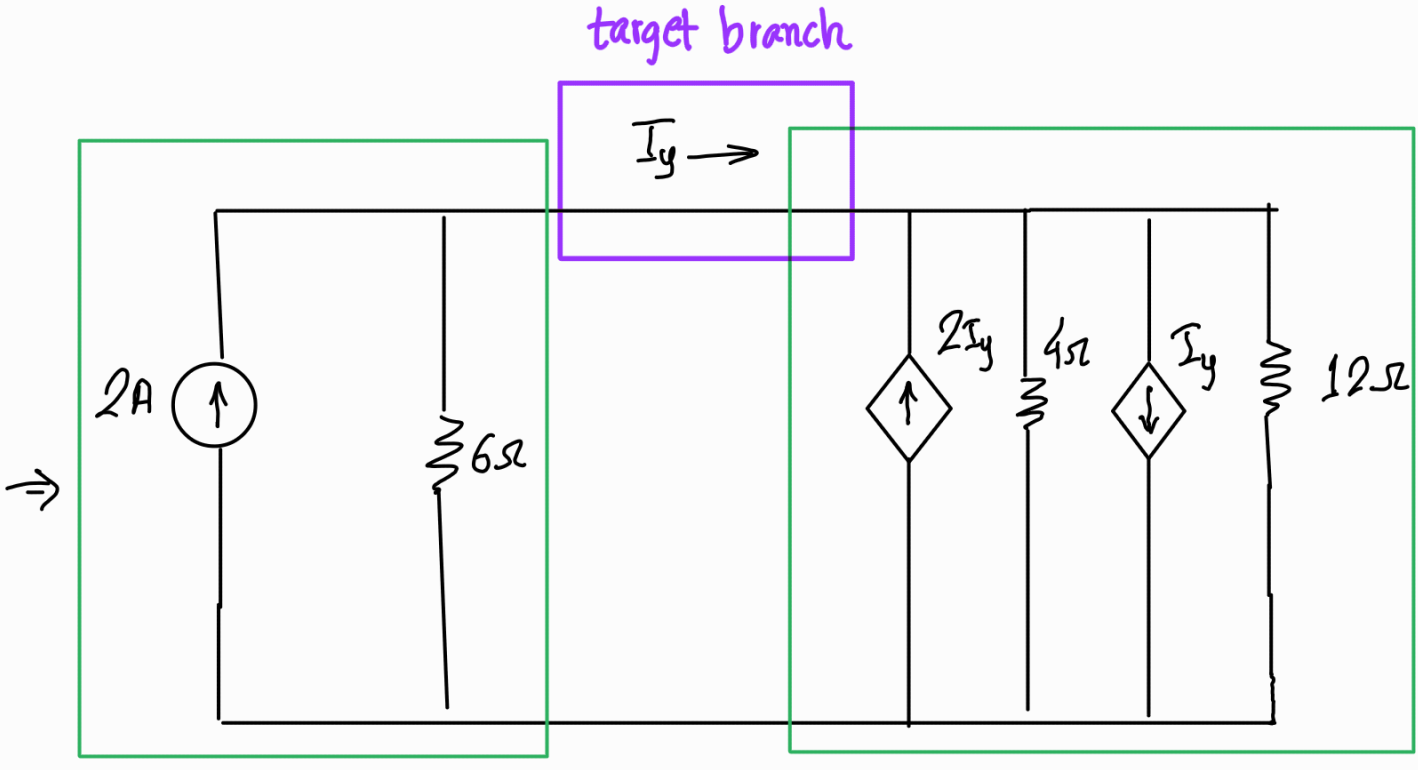
$$\Rightarrow V_o + 42 = 70$$

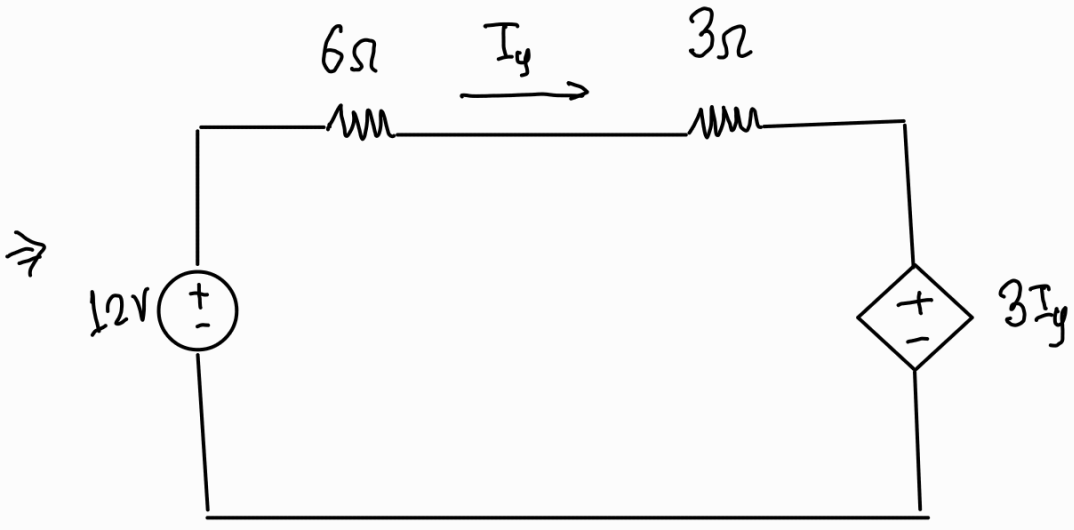
$$\Rightarrow V_o = 28\ V$$

Problem 8



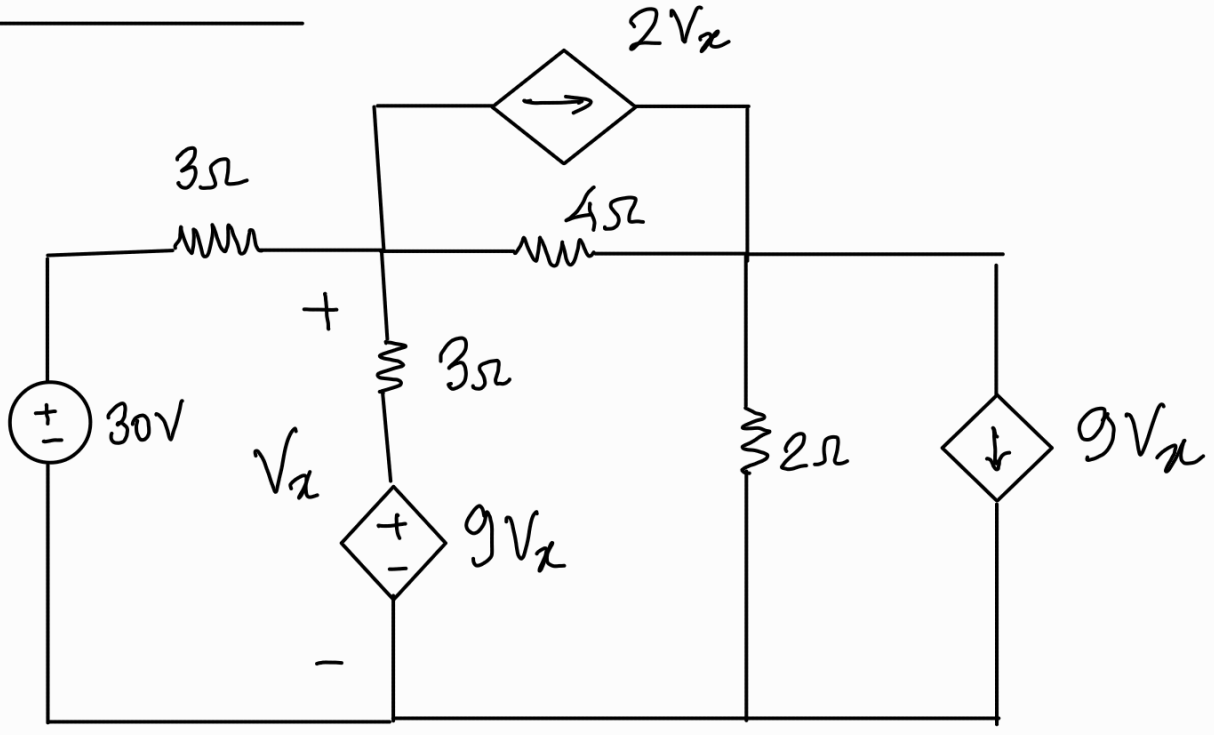
Reduce the ckt to a single loop and solve for I_y



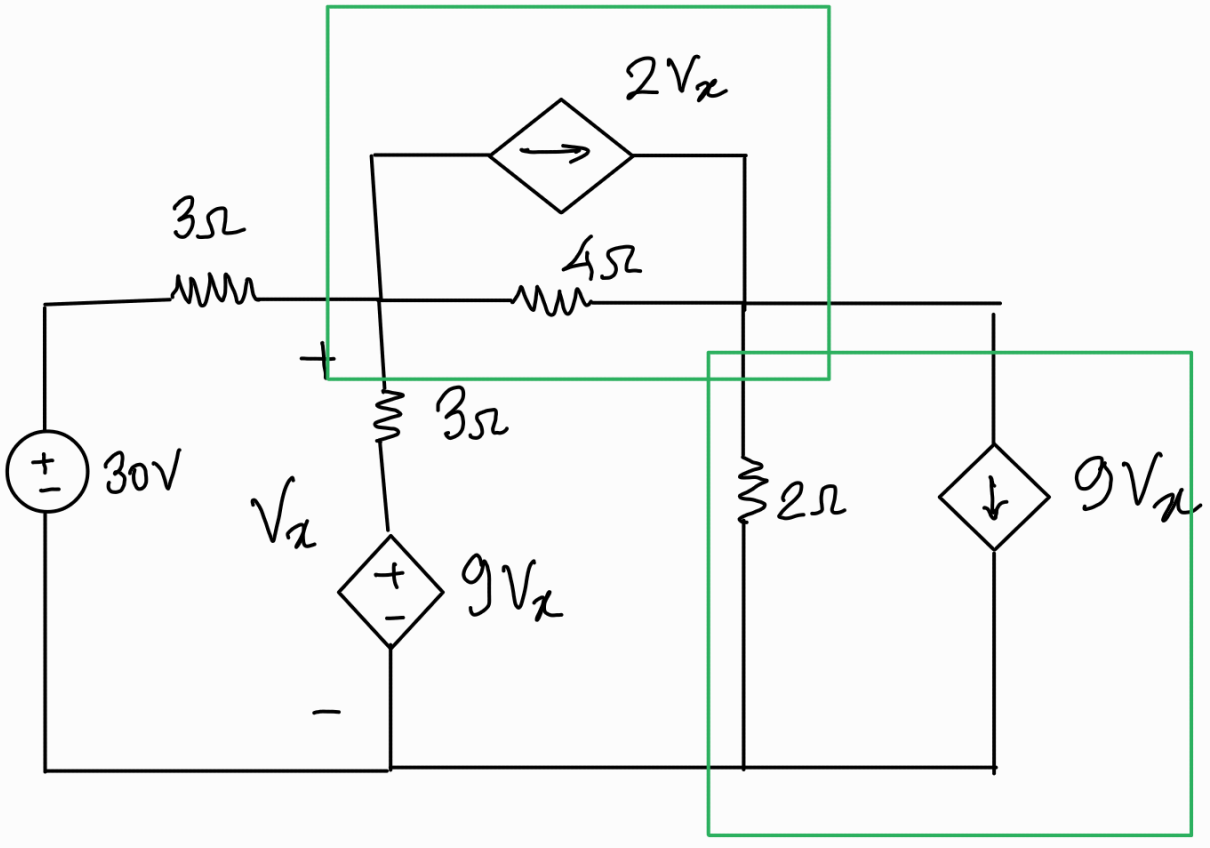


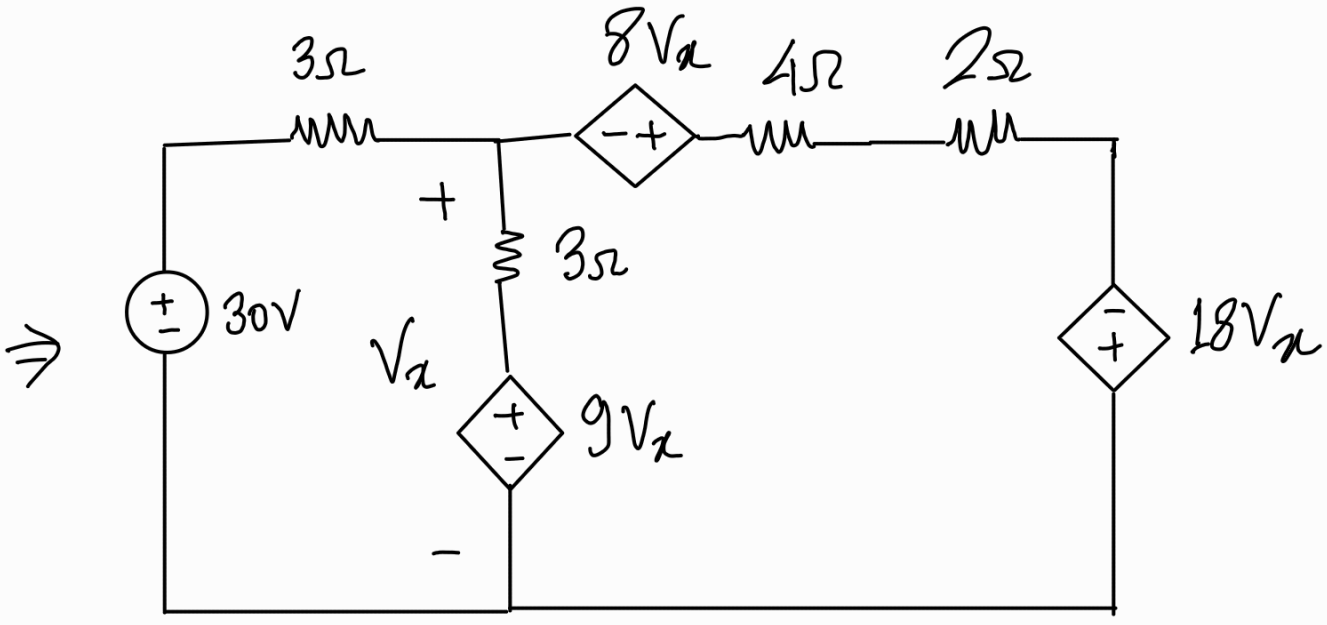
$$I_y = \frac{12 - 3I_y}{9} \Rightarrow I_y = 1A$$

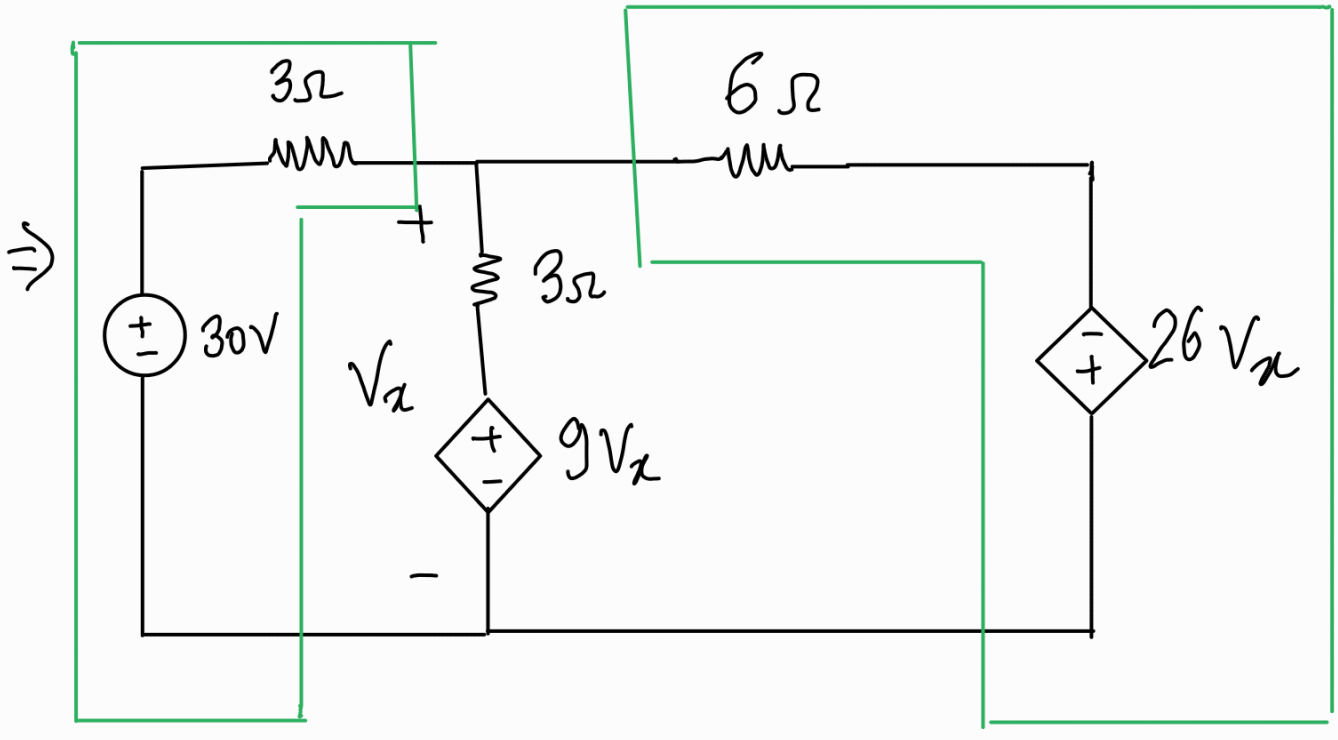
Problem 9

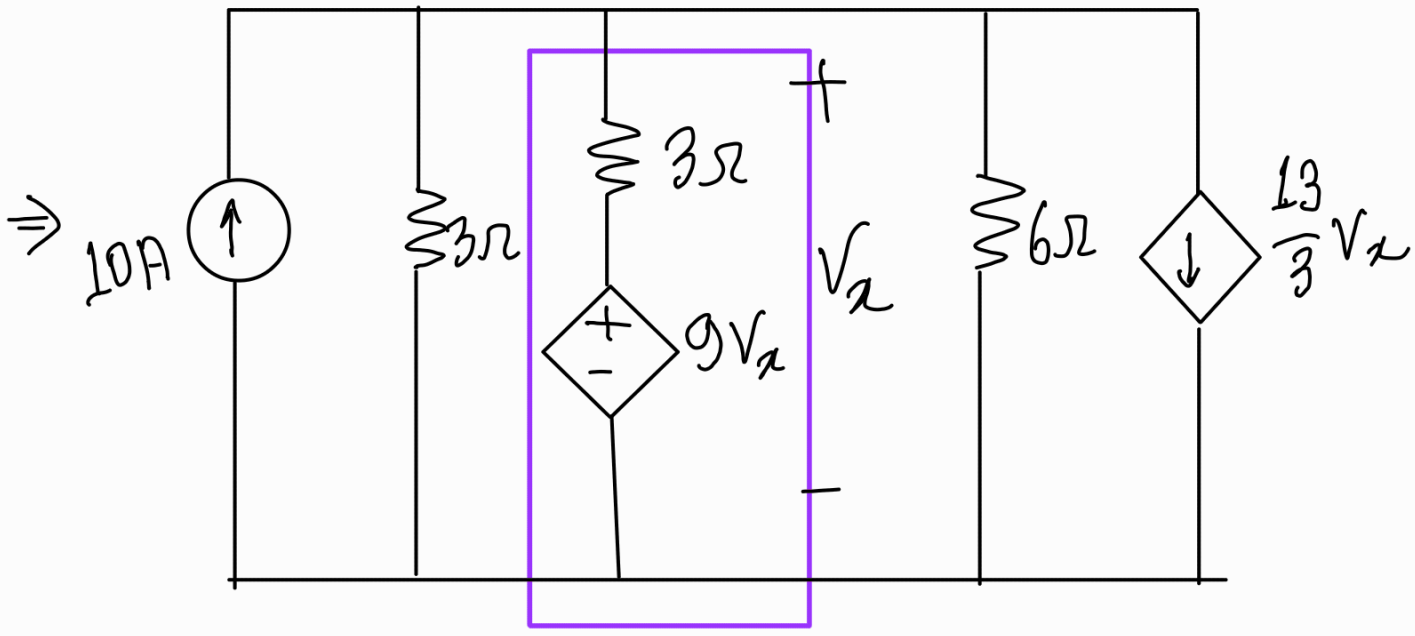


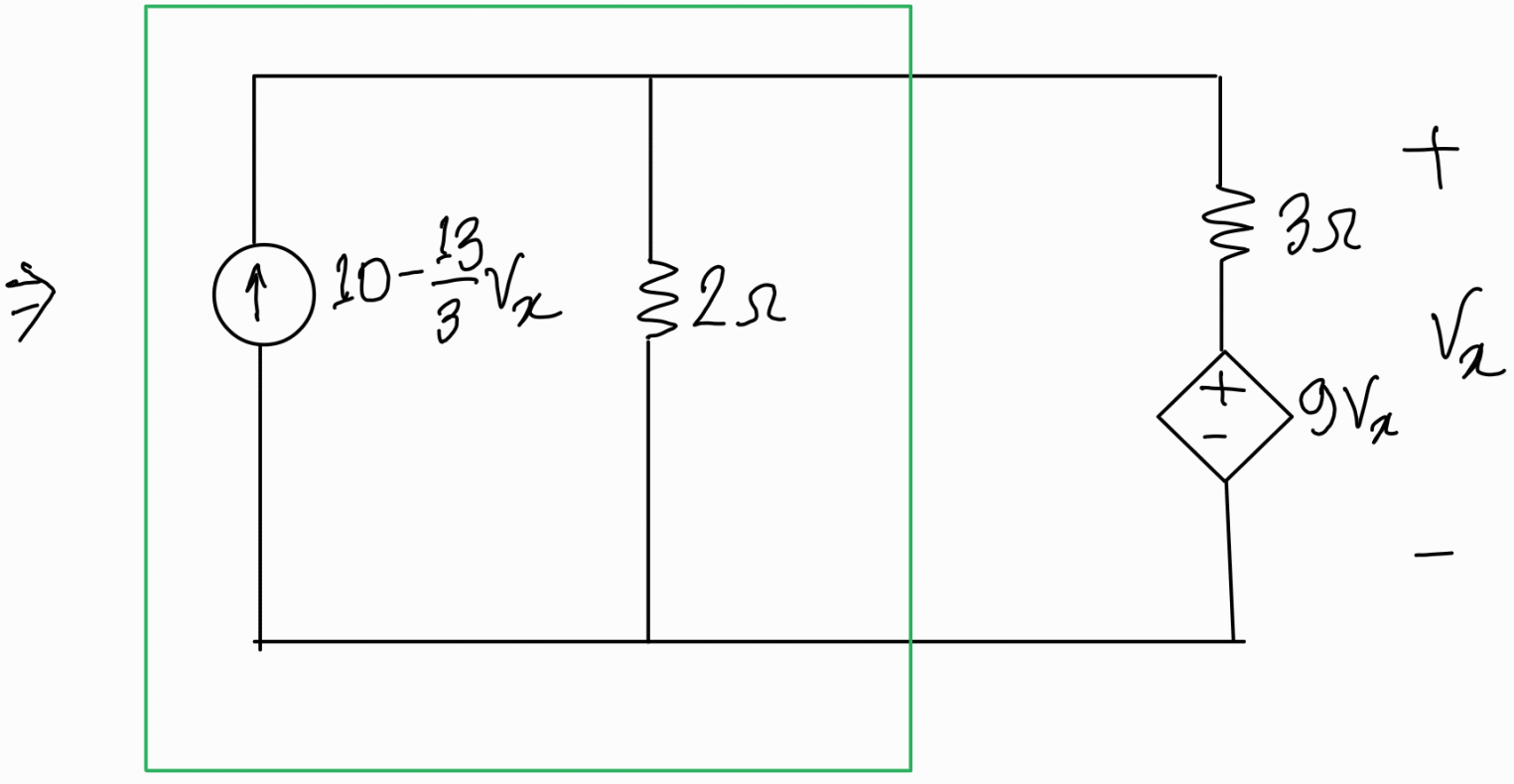
Reduce to a single loop and find V_x.

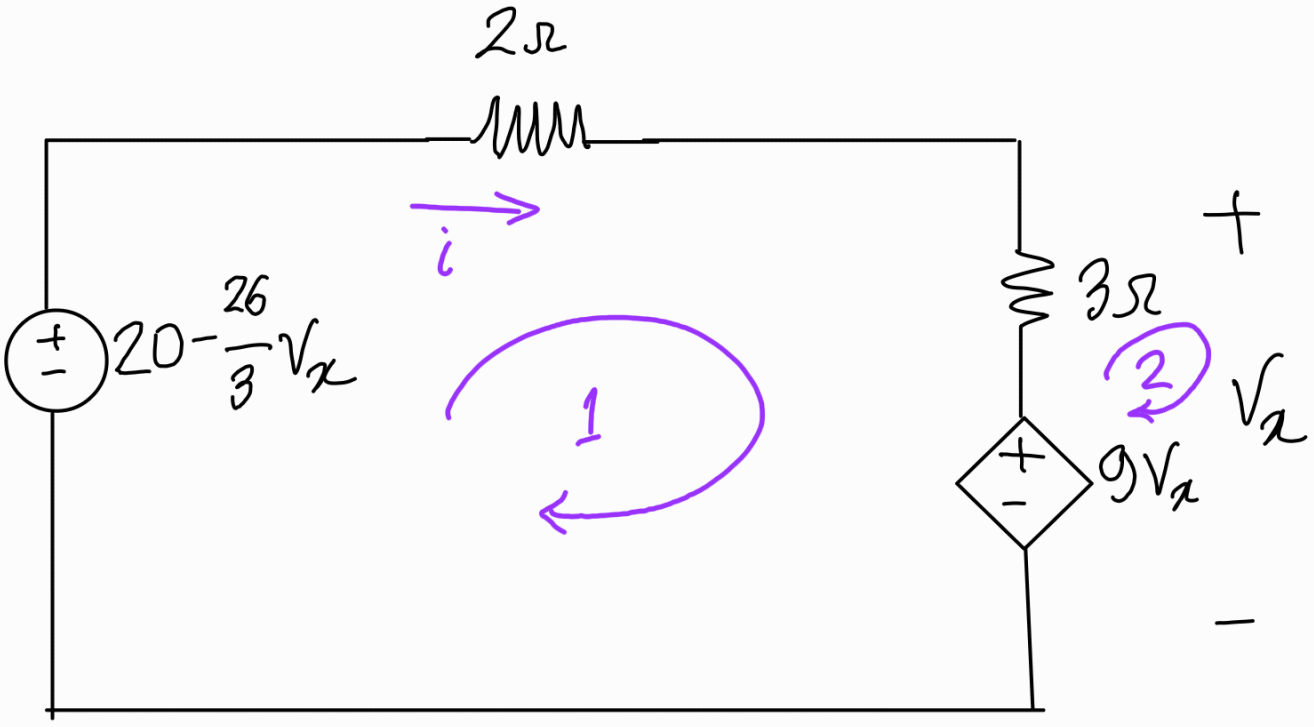



3Ω
8Vx
4Ω
2Ω
+
3Ω
30V
Vx
9Vx
18Vx
−


3Ω
6Ω
+
3Ω
30V
Vx
9Vx
26Vx
−


10A
3Ω
3Ω
+
V_x
−
9V_x
6Ω
$\frac{13}{3}V_x$
target branch


$10-\frac{13}{3}V_x$
2Ω
3Ω
+
V_x
−
9V_x



KVL @ 1 —

$$-20+\frac{26}{3}V_x+2i+V_x=0$$

$$\Rightarrow 26V_x+3V_x+6i=60$$

$$\Rightarrow 29V_x+6i=60 \quad \text{— (i)}$$

KVL @ 2 —

$$V_x-9V_x-3i=0 \Rightarrow 8V_x+3i=0 \quad \text{— (ii)}$$

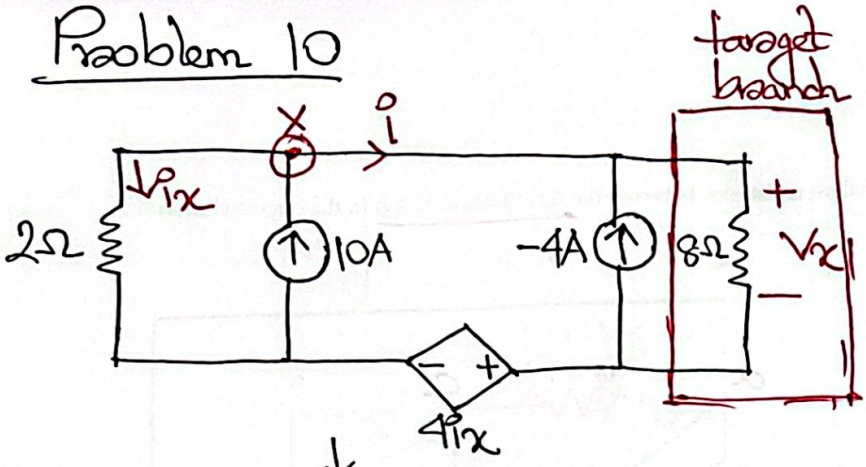
Solving (i) & (ii) ——

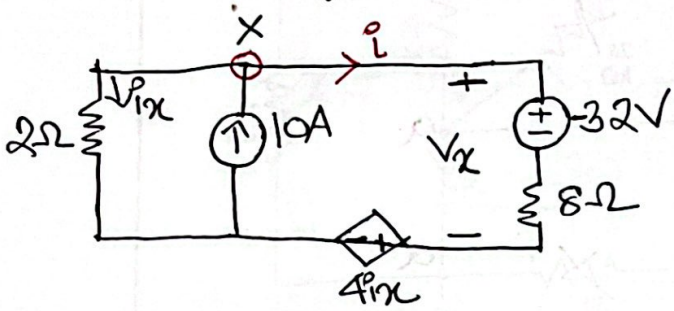
$$V_x = 4.615 \text{ V}$$

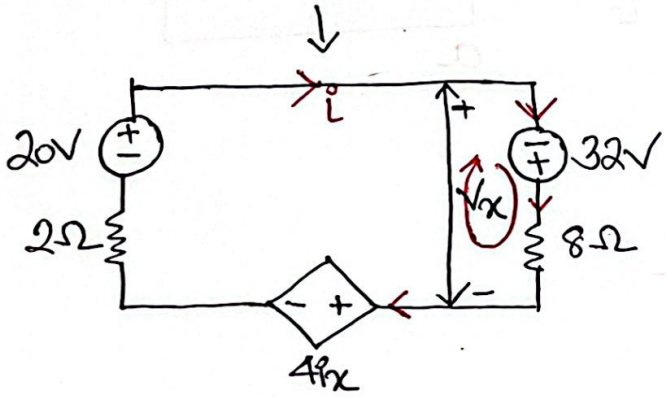
answer

$$i = -12.31 \text{ A}$$

Problem 10







Applying KCL at X,

$10 = i_x + i$ (We assume outgoing i)

$\Rightarrow i = 10 - i_x$ — (I)

Applying KVL in outer loop

$2i - 20 - 32 + 8i + 4i_x = 0$

$\Rightarrow 10i - 52 + 4i_x = 0$

$\Rightarrow i_x = \frac{52 - 10i}{4}$

$\Rightarrow i_x = 13 - \frac{5}{2}i$ — (II)

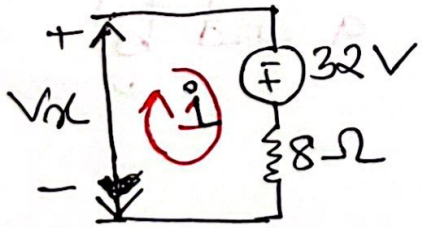
Substituting (I) in (II),

$i_x = 13 - \frac{5}{2}(10 - i_x)$

$\Rightarrow i_x = 13 - 25 + \frac{5}{2}i_x$

$\Rightarrow i_x = 8A$

$i = 10 - 8 = 2A$



Applying KVL in inner loop,

$-V_x - 32 + 8i = 0$

$\Rightarrow V_x = 8i - 32$

$\Rightarrow V_x = 16 - 32$

$\therefore V_x = -16V$