American University of Beirut
Department of Electrical and Computer Engineering
EECE 210 - Electric Circuits
Quiz 1
Closed Book - No Programmable Calculators - 90 minutes

March 6, 2015

Name: SOLUTION

ID:_____

Solve the following problems;
Provide your answers on the attached Scantron card;
This question sheet must be returned with the Scantron card;
There is No penalty;
Mark with a *pencil* your LAST NAME, your First name Initial (FI) and your Middle name Initial (MI);
Mark your AUB ID Number in the box titled "ID NUMBER";
Write the name of your course instructor on the Scantron card;
Use a pencil for marking your answers ;
When using an eraser, make sure that you have erased well.

This exam has 9 pages.

Course Instructors: L. Hamandi, S. Khaddaj, Y. Nasser, and R. Jabr.

1. In the circuit shown in Fig. 1, $V_S = 30$ V. Find the power supplied by the independent voltage source.

(a) 4.8 W
(b) 7.5 W
(c) 30 W
(d) 120 W
(e) None of the above

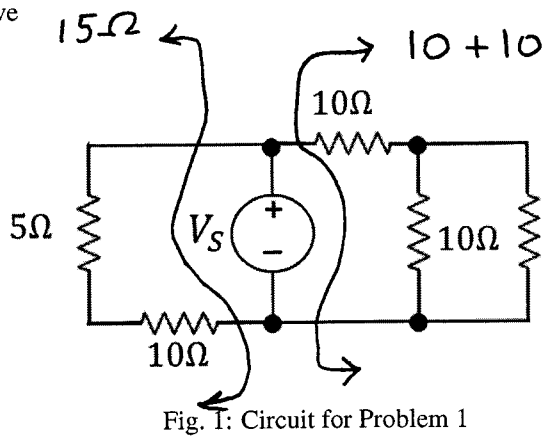


Fig. 1: Circuit for Problem 1

$10 + 10 // 10 = 15\Omega$

$R_{eq} = 15 // 15 = 7.5\Omega$

Power supplied by V_S = $P_{Req} = \frac{30^2}{7.5} = 120W$

2. In the circuit shown in Fig. 2, $R = 30\ \Omega$. Find the equivalent resistance R_{eq} seen across terminals ab.

(a) 15 Ω
(b) 18.75 Ω
(c) 20 Ω
(d) 21 Ω
(e) None of the above

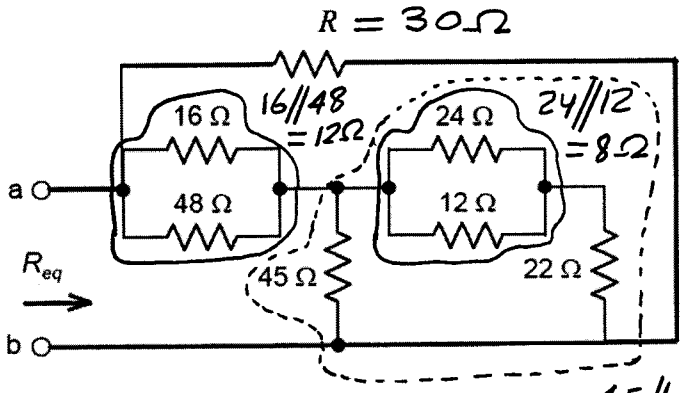


Fig. 2: Circuit for Problem 2

$45 // (8 + 22) = 18\Omega$

$R_{eq} = (12 + 18) // 30 = 15\Omega$

3. If $I_S = 3$ A in the circuit shown in Fig. 3, find the current I_O.

(a) 4.11 A
(b) 6.17 A
(c) 8.23 A
(d) 10.29 A
(e) None of the above

$I_o = \frac{3Vx}{2+3}$
$= \frac{3}{5}\left(\frac{24}{7} \times 3\right)$
$= 6.17\,A$

$6 // 8 = \frac{24}{7}\,\Omega$

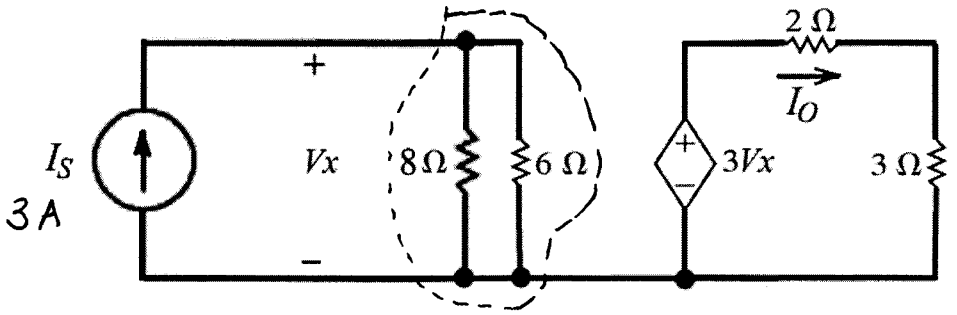


Fig. 3: Circuit of Problem 3

4. If $V_S = 180$ V in the circuit shown in Fig. 4, find the voltage V_0.

(a) 6 V
(b) 15 V
(c) 25 V
(d) 30 V
(e) None of the above

$20 // (10+10) = 10\Omega$
$20 // 20 = 10\Omega$
$10+10 = 20\Omega$

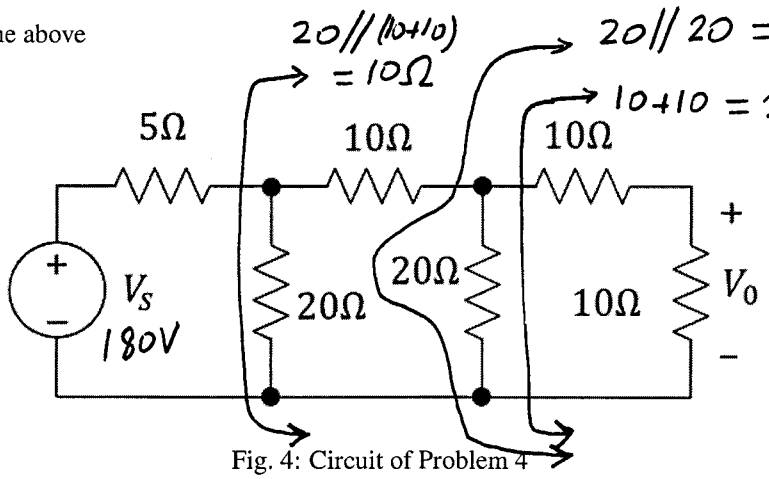


Fig. 4: Circuit of Problem 4

$V_0 = 180 \times \frac{10}{10+5} \times \frac{10}{10+10} \times \frac{10}{10+10}$

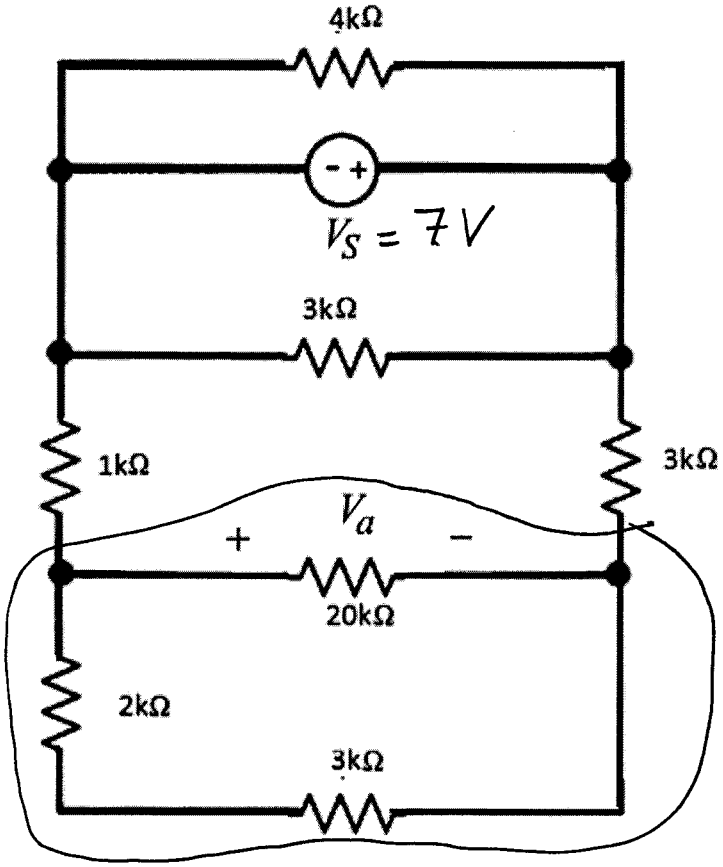
$= 30\,V$

5. If $V_S = 7$ V in the circuit shown in Fig. 5, find the voltage V_a.

(a) −2 V
(b) −2.5 V
(c) −3 V
(d) −3.5 V
(e) None of the above

$V_a = -7 \times \frac{4}{4+1+3}$

$= -3.5\,V$



$20 // (2+3) = 4k\Omega$

Fig. 5: Circuit of Problem 5

6. Each of the resistances in the circuit shown in Fig. 6 is equal to 100 Ω, and Is = 10 A. Find the current I_1.

(a) 7.33 A
(b) 8.07 A
(c) 8.80 A
(d) 9.53 A
(e) None of the above

$I_1 = 10 \times \frac{275}{100+275}$

$= 7.33\,A$

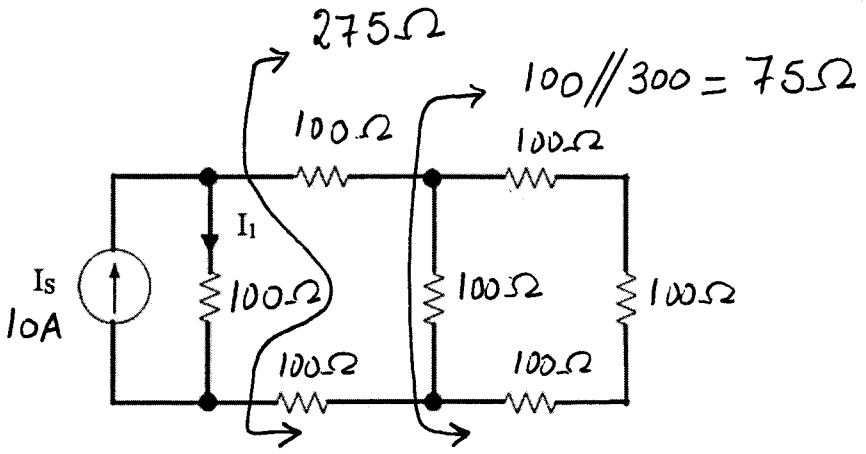


Fig. 6: Circuit of Problem 6

7. In the circuit shown in Fig. 7, $I_S = 5$ A. Find the power absorbed by the 5 Ω resistor.

(a) 0.8 W
(b) 1.8 W
(c) 3.2 W
(d) 5 W
(e) None of the above

$$I_{5\Omega} = \frac{2}{2+3+5}\,5 = 1\,A$$

$$\Rightarrow P_{5\Omega} = 5\,(1)^2 = 5\,W$$

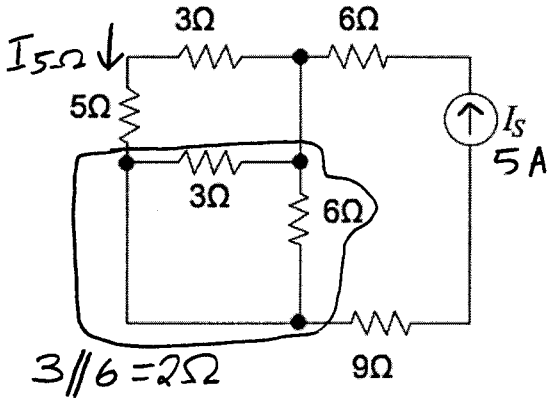


Fig. 7: Circuit of Problem 7

8. Find the voltage V_S in the circuit shown in Fig. 8 if $I_O = 11$ A.

(a) 83 V
(b) 166 V
(c) 332 V
(d) 498 V
(e) None of the above

$$I_o = \frac{22}{22+12}\,I_s$$

$$\Rightarrow I_s = \frac{34}{22} \times 11 = 17\,A$$

$$V_s = 12 \times I_o + 2 \times I_s$$
$$= 12 \times 11 + 2 \times 17$$
$$= 166\,V$$

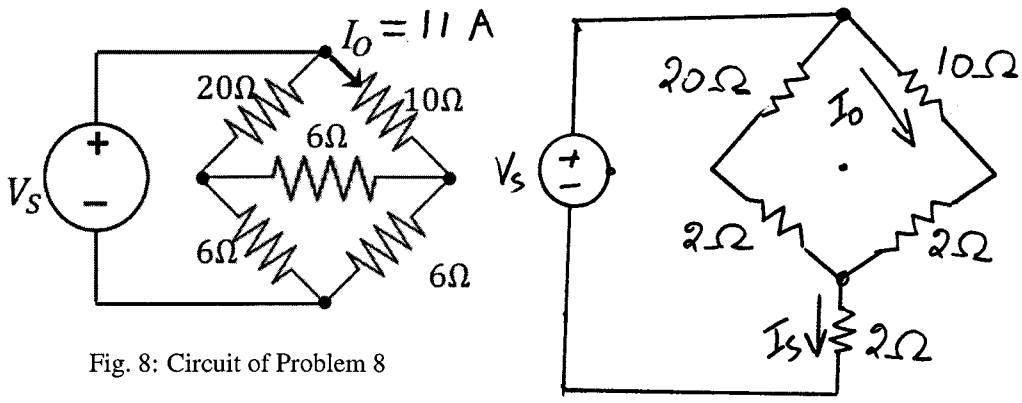


Fig. 8: Circuit of Problem 8

9. Each of the resistances in the circuit shown in Fig. 9 is equal to 50 Ω. Find the equivalent resistance seen across terminals ab.

(a) 155.56 Ω
(b) 171.11 Ω
(c) 186.67 Ω
(d) 202.22 Ω
(e) None of the above

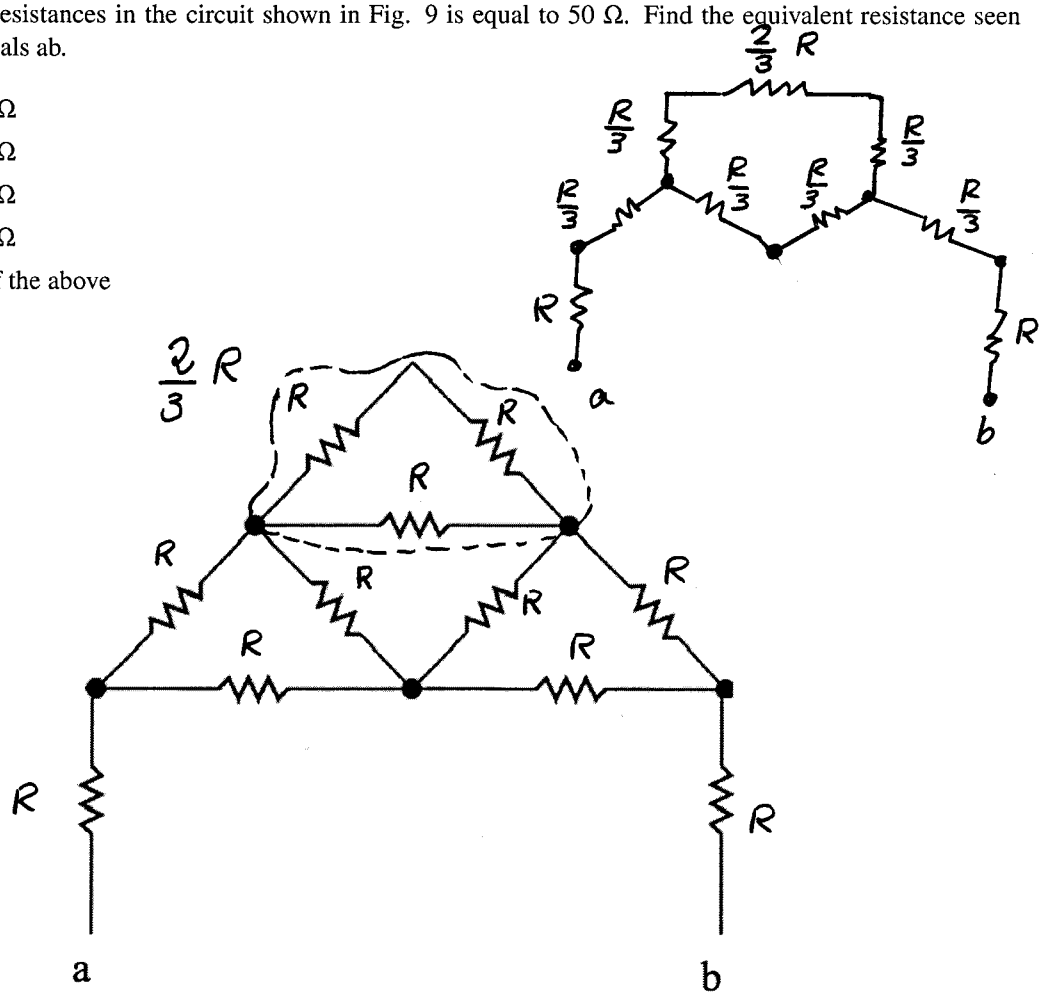


Fig. 9: Circuit of Problem 9

$$R_{ab} = \underbrace{\left(\frac{2}{3}R + \frac{R}{3} + \frac{R}{3}\right) \parallel \left(\frac{R}{3} + \frac{R}{3}\right)}_{\frac{4}{9}R} + \frac{R}{3} + R + \frac{R}{3} + R = \frac{28}{9}R$$

$$\Rightarrow R_{ab} = \frac{28}{9}(50) = 155.56\,\Omega$$

10. In the circuit shown in Fig. 10, $I_S = 3$ A. The node-voltage equation at node a can be equivalently written as:

(a) $3V_b - 7V_a = 8$
(b) $3V_b - 7V_a = 2$
(c) $7V_a - 3V_b = 4$
(d) $7V_a - 3V_b = 10$
(e) None of the above

$$\frac{V_a+12}{3} + \frac{V_a-5}{3} - 3 + \frac{V_a-V_b}{2} = 0$$

$$2V_a + 24 + 2V_a - 10 - 18 + 3V_a - 3V_b = 0$$

$$7V_a - 3V_b = 4$$

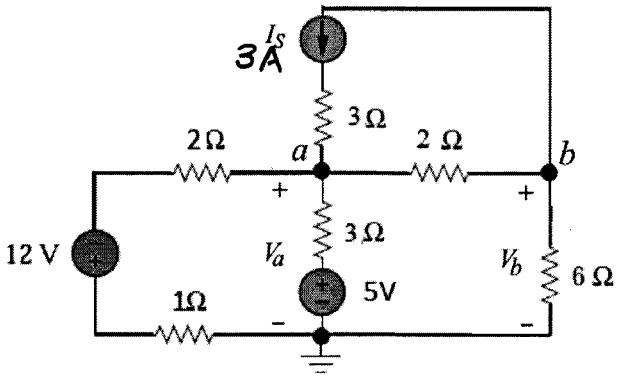


Fig. 10: Circuit of Problem 10

11. Find the voltage V_a in the circuit shown in Fig. 11 if $V_S = 12$ V. *hint: use the node-voltage method.*

(a) 11 V
(b) 9 V
(c) 8 V
(d) 7 V
(e) None of the above

$$\frac{V_a}{4} + 5 + \frac{V_a-24}{4} + \frac{(V_a+12)-24}{4} - 2 = 0$$

$$\frac{3}{4}V_a = 6 \Rightarrow V_a = 8V$$

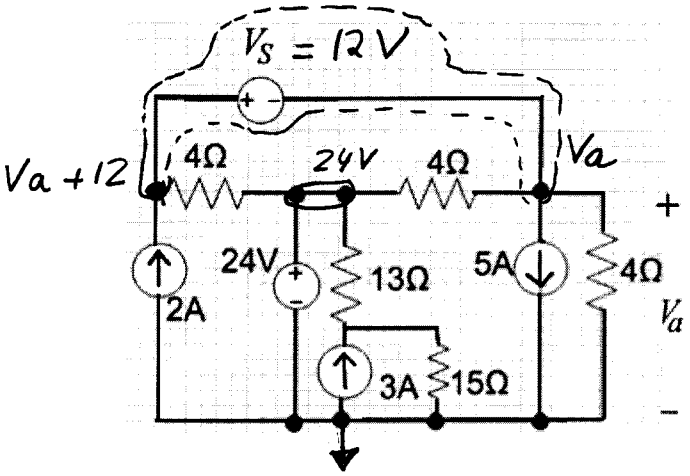


Fig. 11: Circuit of Problem 11

12. Find the current I_x in the circuit shown in Fig. 12 if $V_S = 12$ V and $V_T = 20$ V.

(a) −3.2 A
(b) −2.8 A
(c) −2.2 A
(d) −3.8 A
(e) None of the above

$$@\ V_x: \quad \frac{V_x-12}{10} + \frac{V_x-32}{10} + \frac{V_x+6}{5} = 0$$

$$V_x = 8\,V$$

$$I_x = \frac{-14}{5} = -2.8\,A$$

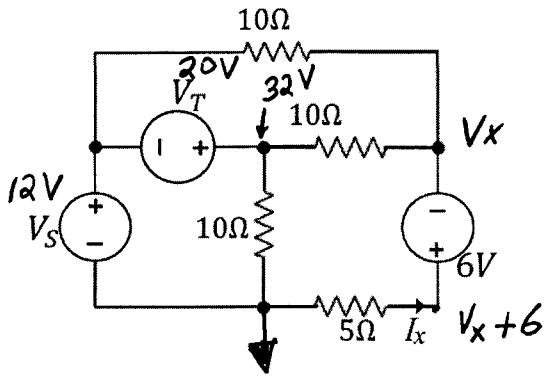


Fig. 12: Circuit of Problem 12

13. Find the current I_x in the circuit shown in Fig. 13 if $R = 5\ \Omega$. *hint: use the mesh-current method.*

(a) 1 A
(b) 1.3 A
(c) 2 A
(d) 2.66 A
(e) None of the above

$$9I_x - 1.I_y - 5\times 3 = 2$$

$$9I_x - I_y = 17$$

$$2I_y - 1.I_x - 1.3 = -3$$

$$-I_x + 2I_y = 0$$

$$\Rightarrow I_x = 2A$$

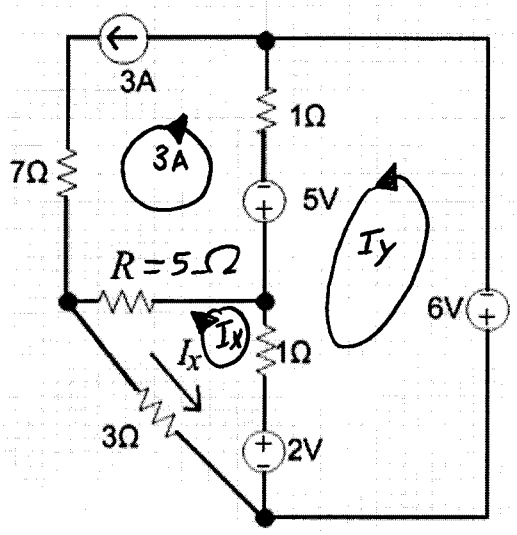


Fig. 13: Circuit of Problem 13

14. Each of the resistances in the circuit shown in Fig. 14 is equal to 10 kΩ, and $\beta = 2$ mA/V. Find the mesh current I_2 if $I_{SRC} = 23$ mA.

(a) 1 mA
(b) 2 mA
(c) 3 mA
(d) 4 mA
(e) None of the above

I_2 : $10(I_2 - 23) + 10(I_2 + 20I_2) + 10I_2 = 0$

$I_2 = 1\,mA$

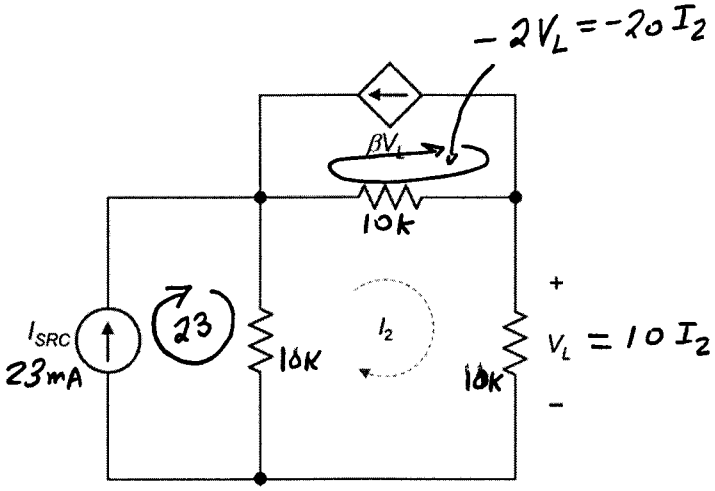


Fig. 14: Circuit of Problem 14

15. Find the current I_x in the circuit shown in Fig. 15 if $V_0 = 115$ V.

(a) 2 A
(b) 4 A
(c) 6 A
(d) 8 A
(e) None of the above

supermesh $\Rightarrow 40I_1 - 20I_x + 40(I_1 + 0.25I_x) - 30I_x = 0$

$80I_1 = 40I_x \Rightarrow I_1 = \frac{I_x}{2}$

$-115 + 90I_x - 20I_1 - 30(I_1 + 0.25I_x) = 0$

$90I_x - 20\frac{I_x}{2} - 30\left(\frac{I_x}{2} + 0.25I_x\right) = 115$

$\Rightarrow I_x = 2A$

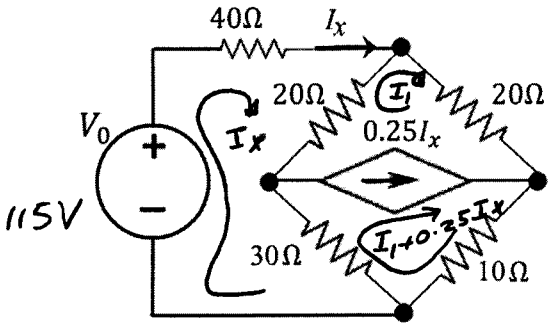


Fig. 15: Circuit of Problem 15