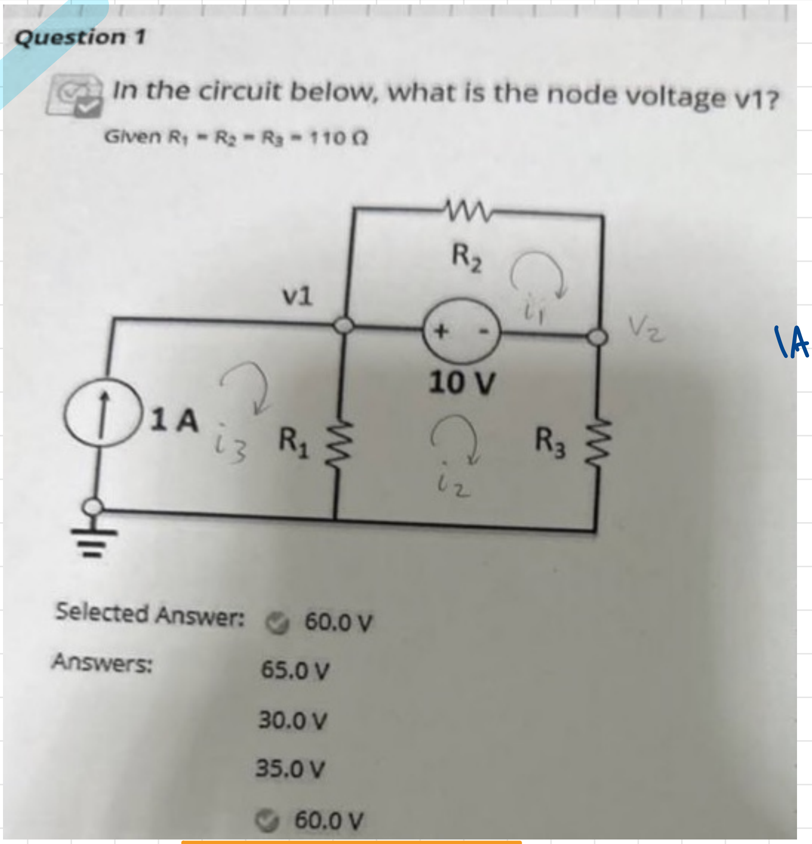
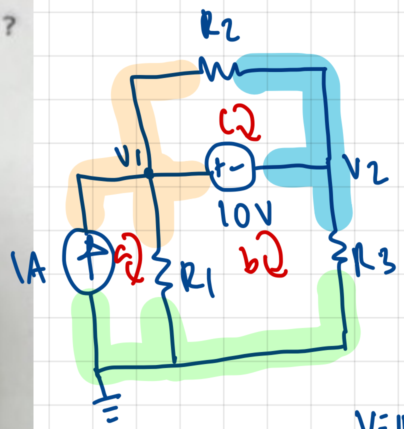




$V = IR$

mesh $a = 1A$

mesh $b = (i_b - i_a)R_1 + i_b(R_3) = -10$

$i_bR_1 - R_1 + R_3 i_b = -10$

$110i_b - 110 + 110i_b = -10$

$220i_b = 100$

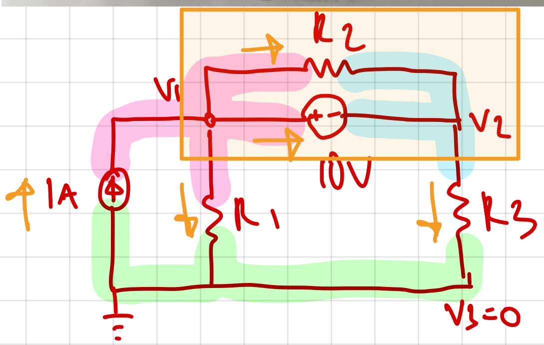
$i_b = 0.4545$

~~$V_1 - V_2 = 10$~~

~~$V_2 = (0.4545)(110) = 50$~~

~~$V_1 - 50 = 10$~~

$V_1 = 60$



$V = IR$

$I = \frac{V}{R}$

node voltage method:

$1 = \frac{V_1}{R_1} + \frac{V_2}{R_3}$

$110 = V_1 + V_2$ — (1)

$V_1 - V_2 = 10$

$V_1 = 10 + V_2$ — (2)

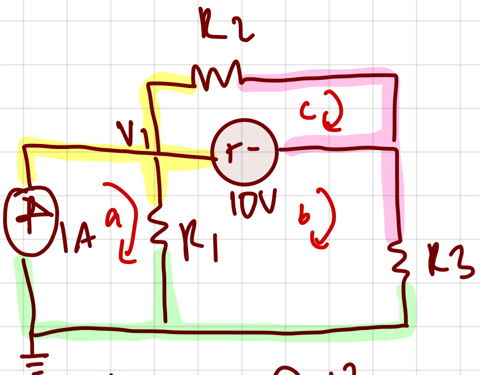
Sub (2) into (1)

$110 = 10 + V_2 + V_2$

$2V_2 = 100$

$V_2 = 50$

$V_1 = 10 + 50$



$V = IR$

node voltage @ 1?

mesh a: 1A

mesh b: $(R_1)(i_b - 1) + R_3(i_b) = -10$

$110i_b - 110 + 110i_b = -10$

$220i_b = 100$

$i_b = 0.45455$

$V_1 = (i_a - i_b)(R_1)$

$= (1 - 0.45455)(110)$

$= 60$

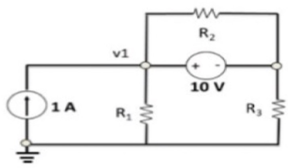
$I = R\frac{V}{2}$

Question 5

In the circuit below, what is the node voltage v1?

Given $R_1 = R_2 = R_3 = 30\ \Omega$

$i = \frac{V}{R_3}$



Selected Answer: 20.0 V

Answers: 40.0 V

30.0 V

10.0 V

20.0 V

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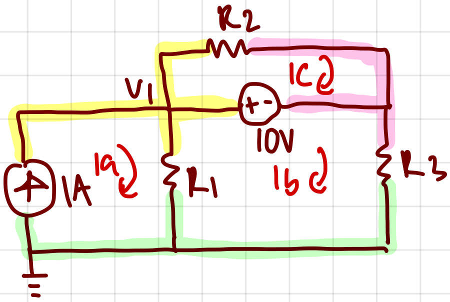
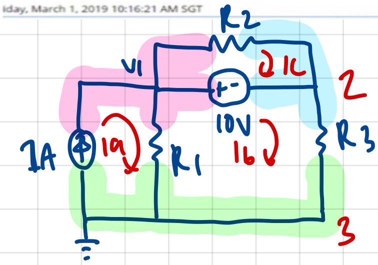


$V = IR$



$I_a : 1A$

$I_b : -10 = (I_b - I_a)(R_1) + (I_b)(R_3)$

$-10 = (I_b - 1)(30) + I_b(30)$

$-10 = 30 i_b - 30 + 30 i_b$

$20 = 60 I_b$

$I_b = \frac{1}{3}$

$V = IR \quad I = \frac{V}{R}$

$V_1 = (1 - \frac{1}{3})(30) = 20V$

using mesh current:

OR!

mesh $a = 1$

mesh $b = (I_b - I_a)R_1 + I_b(R_3) = -10$

$(I_b - 1)(30) + I_b(30) = -10$

$30 I_b - 30 + 30 I_b = -10$

$60 I_b = 20$

$I_b = \frac{20}{60} = \frac{1}{3}$

$V_3 = \frac{1}{3}(30) = 10$

$V_1 - V_3 = 10$

$V_1 - 10 = 10$

$V_2 = 20V$

$V_1 - V_2 = 10$

$V_1 - 10 = 10$

$V_1 = 20V$

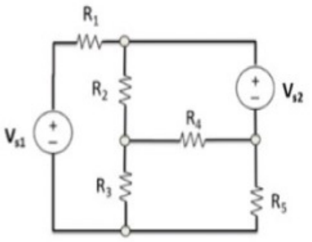
$V = IR$

$V = \frac{1}{3}(30)$

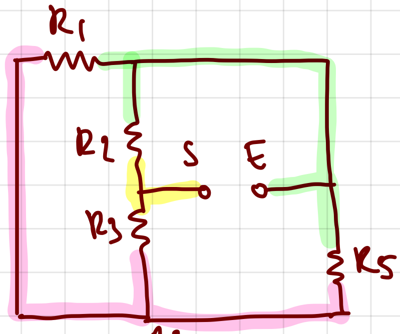
$= 10$

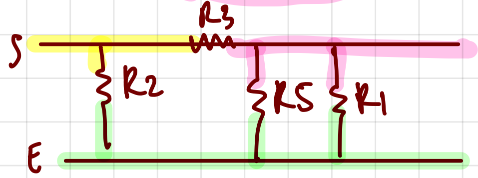
What's the equivalent resistance seen by R_4 in the following circuit? (Hint: short circuit V_{s1} and V_{s2})

Given $R_1 = R_2 = R_3 = R_4 = R_5 = 14\,\Omega$



- 9.4 Ω
- 7.4 Ω
- 6.4 Ω
- 8.4 Ω

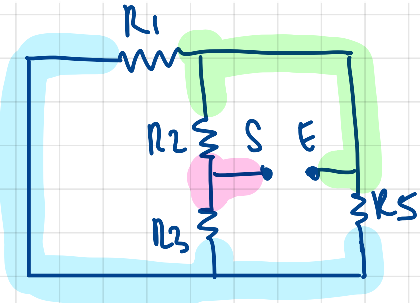


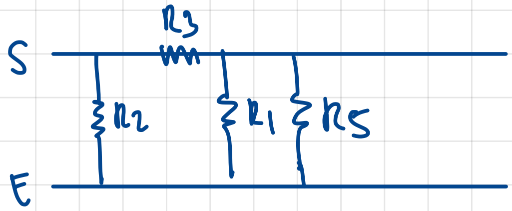


$$R_{eq_1} = R5 \parallel R1 = \frac{1}{\frac{1}{14} + \frac{1}{14}} = 7$$

$$R_{eq_2} = R_{eq_1} + R3 = 7 + 14 = 21$$

$$R_{eq_2} \parallel R2 = \frac{1}{\frac{1}{21} + \frac{1}{14}} = 8.4$$





$$R_{eq_1} = R1 \parallel R5 = \frac{1}{\frac{1}{14} + \frac{1}{14}} = 7$$

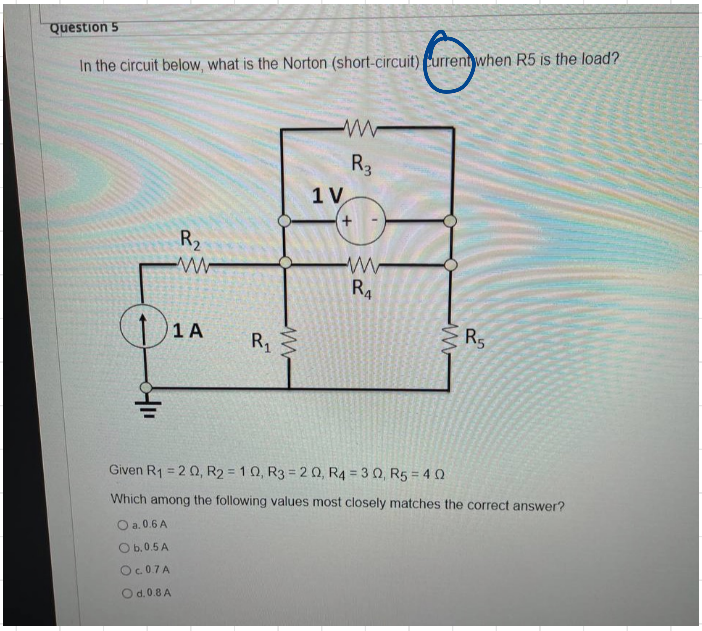
$$R_{eq_2} = R_{eq_1} + R3 = 7 + 14 = 21$$

$$R_{eq} \parallel R_2 = \frac{1}{\frac{1}{21} + \frac{1}{14}} = 8.4$$

If resistors $= 13\,\Omega$,
$R_{eq_1} = 6.5$

$R_{eq_2} = R_{eq_1} + R3 = 19.5$

$R_{eq_2} \parallel R_2 = 7.8$



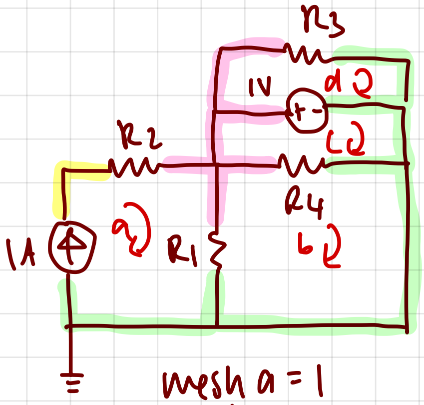
Question 5

In the circuit below, what is the Norton (short-circuit) current when R5 is the load?

Given $R_1 = 2\ \Omega$, $R_2 = 1\ \Omega$, $R_3 = 2\ \Omega$, $R_4 = 3\ \Omega$, $R_5 = 4\ \Omega$

Which among the following values most closely matches the correct answer?

- a. 0.6 A
- b. 0.5 A
- c. 0.7 A
- d. 0.8 A



mesh a = 1

mesh b = $R_1(i_b - i_a) + R_4(i_b - i_c) = 0$

$2i_b - 2 + 3i_b - 3i_c = 0$

$5i_b - 3i_c = 2$

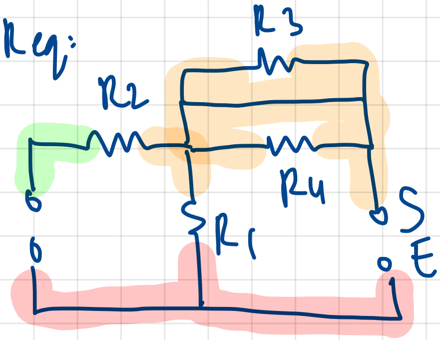
mesh c: $R_4(i_c - i_b) = -1$

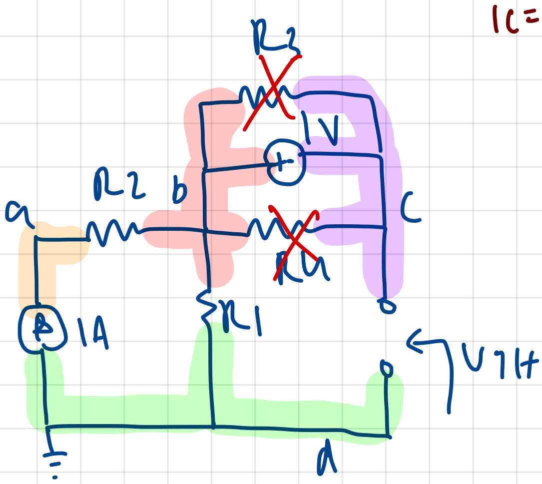
$3(i_c - i_b) = -1$

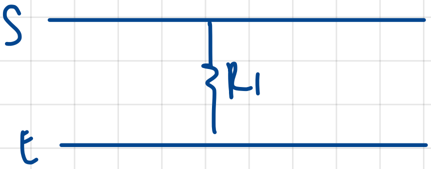
$i_c = \frac{1}{6}$ $\quad i_b = \frac{1}{2}$

VTH Req

Req:







Req = R_1 = 2

$V_b = (2)(1) = 2$

$V_b - V_c = 1$

$2 - V_c = 1$

$V_c = 1$

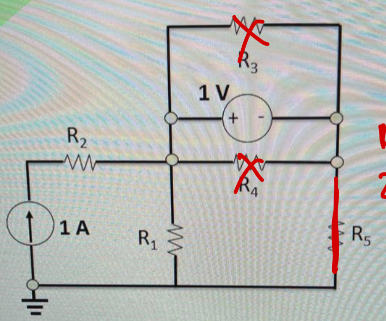
$\therefore V = IR$

$1 = I(2)$

$I = \frac{1}{2}$ //

Question 5

In the circuit below, what is the Norton (short-circuit) current when R5 is the load?

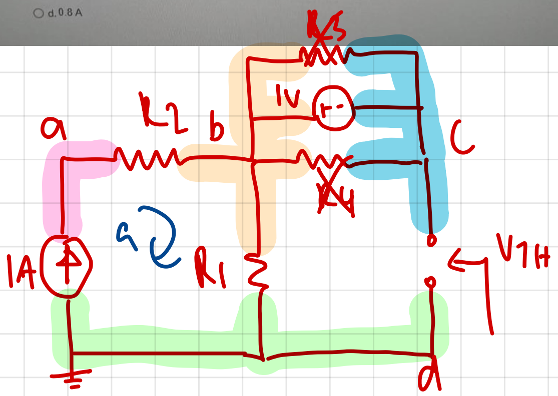


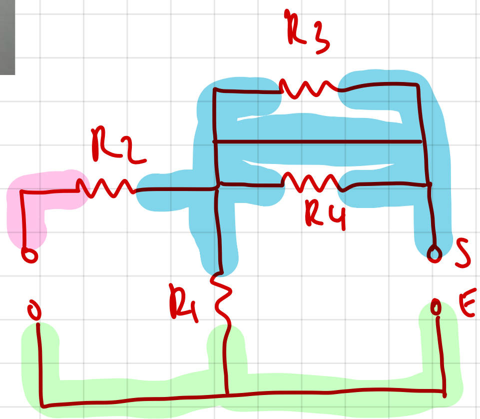
$R_1(i_b - i_a) + 1 = 0$
$2(i_b - 1) + 1 = 0$
$2i_b = -1 + 2$
$i_b = 0.5$

Given $R_1 = 2\ \Omega$, $R_2 = 1\ \Omega$, $R_3 = 2\ \Omega$, $R_4 = 3\ \Omega$, $R_5 = 4\ \Omega$

Which among the following values most closely matches the correct answer?

- a. 0.6 A
- b. 0.5 A
- c. 0.7 A
- d. 0.8 A





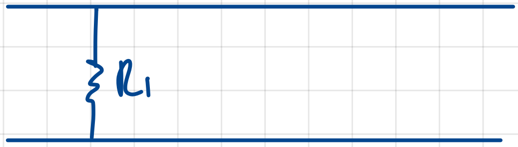
current?

V=IR

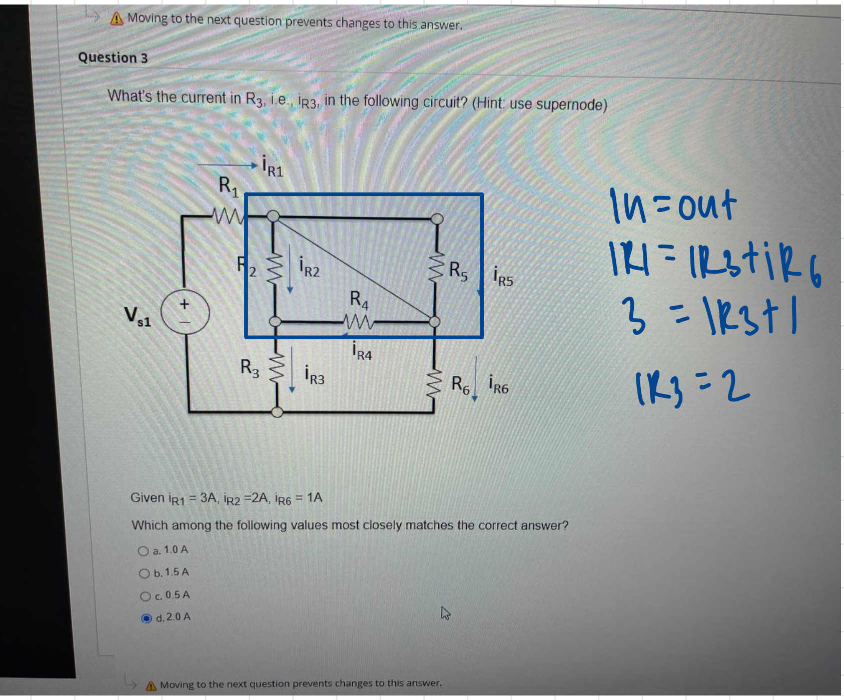
mesh a = 1A

$V_b = (1)(2) = 2V$
$V_b - V_c = 1$
$2 - V_c = 1$
$V_c = 1$

$I = \frac{V}{R} = \frac{1}{2} = 0.5$



$R_{eq} = R_1 = 2$



Moving to the next question prevents changes to this answer.

Question 3

What's the current in R_3, i.e., i_{R3}, in the following circuit? (Hint: use supernode)

Given i_{R1} = 3A, i_{R2} =2A, i_{R6} = 1A

Which among the following values most closely matches the correct answer?

- a. 1.0 A
- b. 1.5 A
- c. 0.5 A
- d. 2.0 A

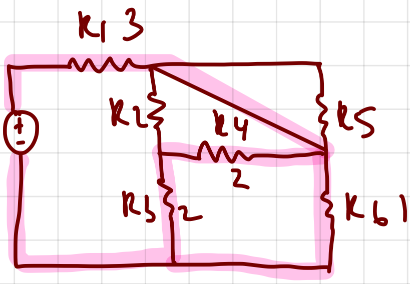
Moving to the next question prevents changes to this answer.

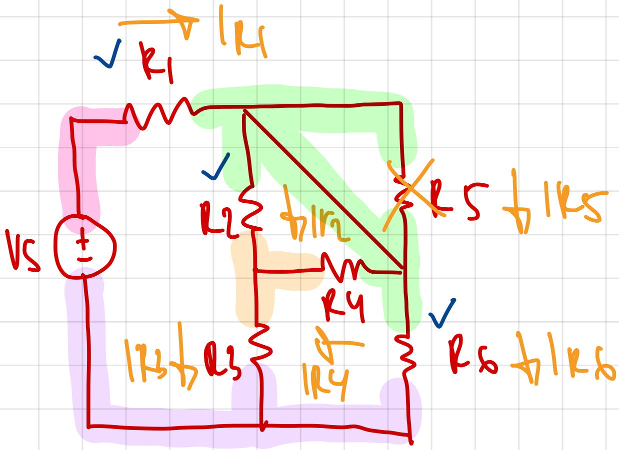
In = out

$I_{R1} = I_{R3} + i_{R6}$

$3 = I_{R3} + 1$

$I_{R3} = 2$





$I_{R1} = 3A$

$I_{R2} = 2A$

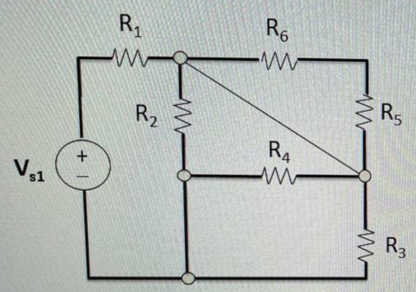
$I_{R6} = 1A$

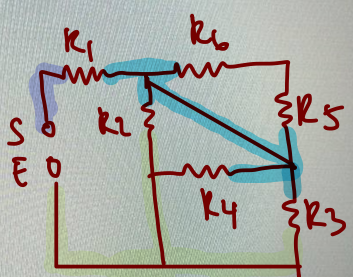
node voltage method

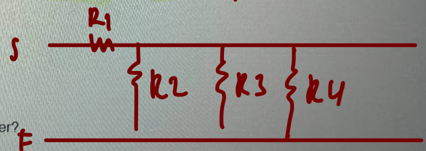
I_{R1}

Question 1

What's the equivalent resistance seen by V_{s1} in the following circuit? (Hint: label different node with different color)







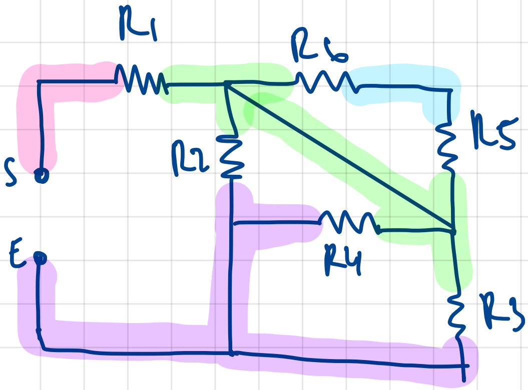
Given $R_1 = 2\ \Omega$, $R_2 = 3\ \Omega$, $R_3 = 3\ \Omega$, $R_4 = 3\ \Omega$, $R_5 = 1\ \Omega$, $R_6 = 2\ \Omega$

Which among the following values most closely matches the correct answer?

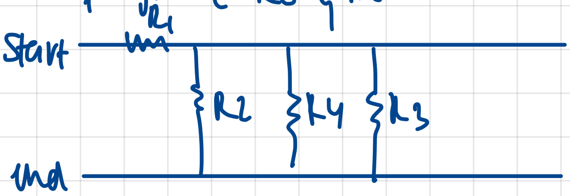
- a. 4 Ω
- b. 1 Ω
- c. 3 Ω
- d. 2 Ω

$R_{eq} = 3$

Moving to the next question prevents changes to this answer.



* ignore R5 & R6:

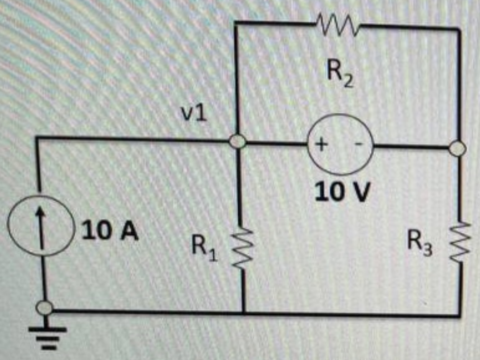


$$R_2 // R_3 // R_4 = \frac{1}{\frac{1}{3}+\frac{1}{3}+\frac{1}{3}} = 1$$

$$R_1 + R_{eq} = 3$$

Question 2

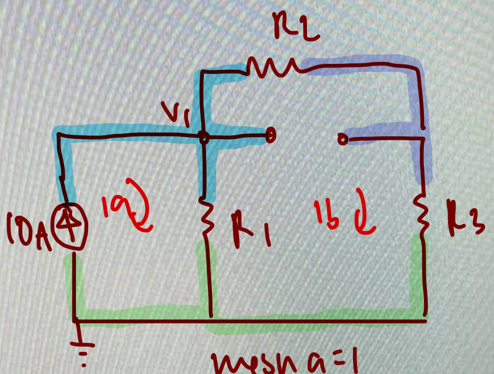
In the circuit below, what is the Thevenin (open-circuit) voltage when the voltage source is the load?



Given R1 = R2 = R3 = 1.5 Ω

Which among the following values most closely matches the correct answer?

- (●) a. 5 V
- ( ) b. 8 V
- ( ) c. 7 V
- ( ) d. 6 V



*If use mesh current method make sure minus current

mesh a = 1

mesh b = $R_1(I_b - I_a) + R_3(I_b) + I_b(R_2) = 0$

$1.5(I_b - 10) + 1.5 I_b + 1.5 I_b = 0$

$4.5 I_b = 15$

$I_b = 3.3333$

$V_1 = (10 - 3.3333)(1.5)$

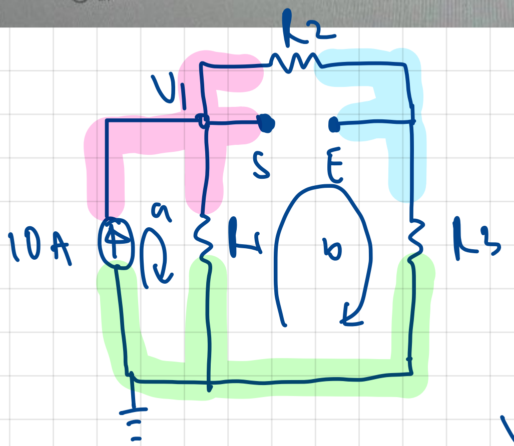
$= 10$

$V_1 - V_3 = V_{TH}$

$3.3333 \times 1.5 = 5$

$10 - 5 = V_{TH}$

$V_{TH} = 5$



$V = IR$

mesh b

$(i_b - i_a)R_1 + i_b R_2 + i_b R_3 = 0$

$(i_b - i_a)(1.5) + i_b(1.5) + i_b(1.5) = 0$

$i_b - i_a + i_b + i_b = 0$

$3i_b - i_a = 0$

mesh a = 10

$3i_b - 10 = 0$

$i_b = \frac{10}{3}$

$V_3 = IR$

$= \frac{10}{3}(1.5) = 5$

$V_1 = IR$

$= (10 - \frac{10}{3})(1.5)$

$= 10$

$V_1 - V_2 = V_{TH}$

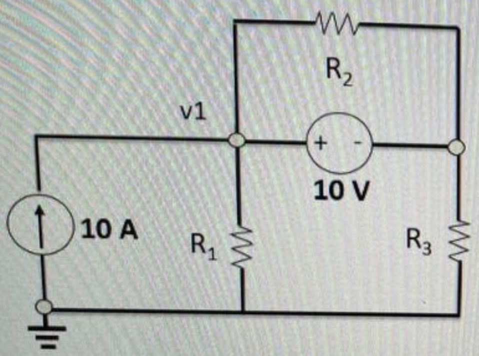
$10 - 5 = V_{TH}$

$V_{TH} = 5$

Question 2

vLolo

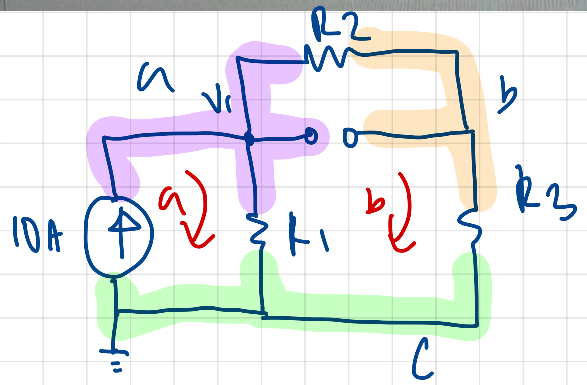
In the circuit below, what is the Thevenin (open-circuit) voltage when the voltage source is the load?



Given R1 = R2 = R3 = 1.5 Ω

Which among the following values most closely matches the correct answer?

- (•) a. 5 V
- ( ) b. 8 V
- ( ) c. 7 V
- ( ) d. 6 V



$V_{TH} = V_a - V_b$

$V_a = 10$

$V_b = (I_b - I_a)R_1 + I_b(R_2) + I_b(R_3) = 0$

$(I_b - i_a)\cancel{1.5} + I_b(1.\cancel{5}) + I_b(\cancel{1.5}) = 0$

$3I_b - i_a = 0$

$3I_b - 10 = 0$

$I_b = \frac{10}{3}$

$V_3 = \frac{10}{3}(1.5) = 5$

$V_1 = (10 - \frac{10}{3})(1.5)$

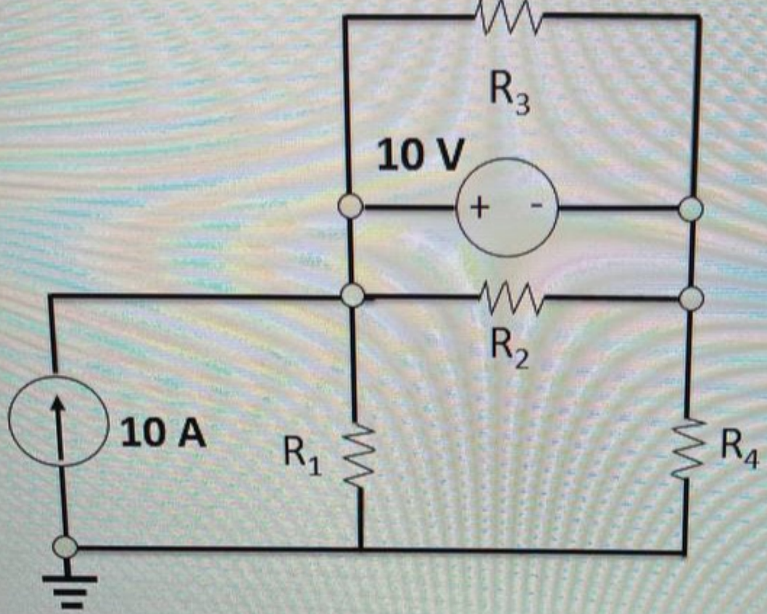
$= 10$

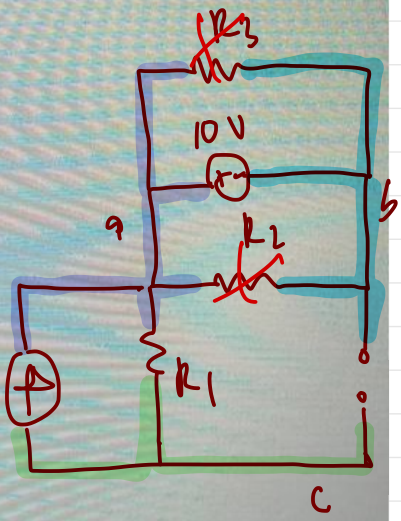
$V_a - V_b = V_{TH}$

$10 - 5 = V_{TH}$

$V_{TH} = 5$

In the circuit below, what is the Thevenin (open-circuit) voltage when R4 is the load?





$V_a = (10)(7.5) = 75$

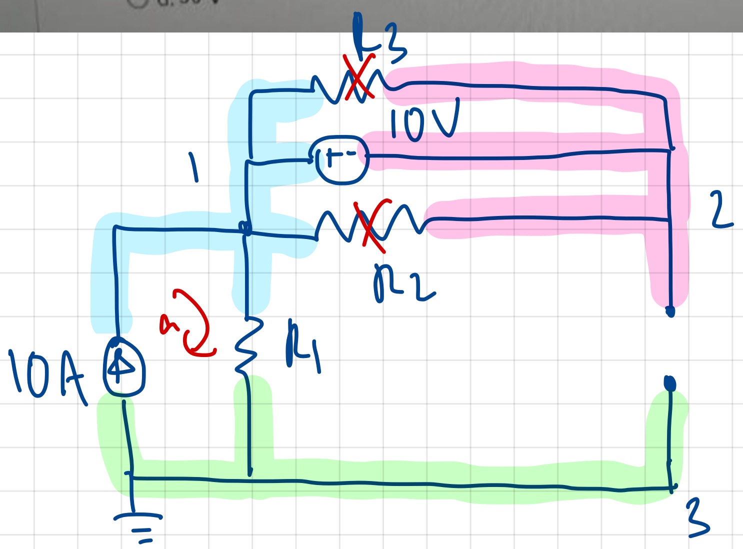
$75 - V_b = 10$

$V_b = 65$

Given $R_1 = R_2 = R_3 = R_4 = 7.5\ \Omega$

Which among the following values most closely matches the correct answer?

- a. 60 V
- b. 65 V
- c. 45 V
- d. 30 V



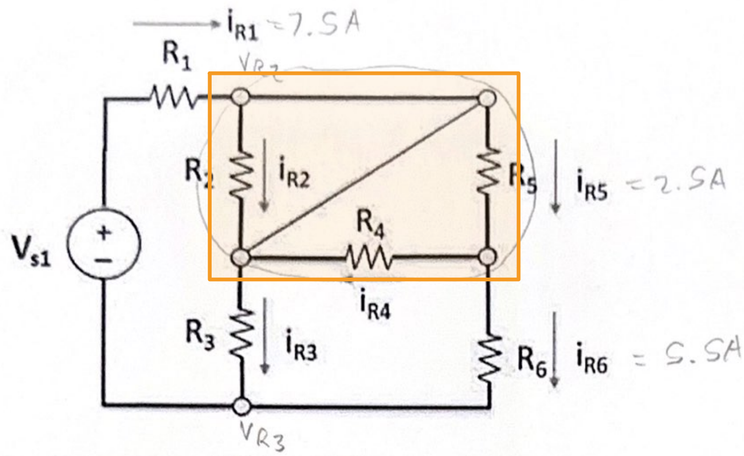
$V = IR$

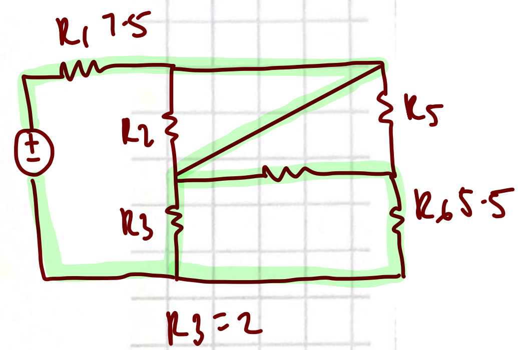
mesh A = 10A

$V_1 = (10)(7.5)$
$= 75$

$75 - 10 = V2$
$V2 = 65$

What's the current in R_3, i.e., i_{R3}, in the following circuit? (Hint: use supernode)





Given i_{R1} = 7.5A, i_{R5} = 2.5A, i_{R6} = 5.5A

Which among the following values most closely matches the correct answer?

- a. 2.5A
- b. 3.0A
- ✓ c. 2.0A
- d. 1.5A

KCL of supernode: current in = current out

$$i_{R1} = i_{R3} + i_{R6}$$

$$7.5A = i_{R3} + 5.5A$$

$$i_{R3} = 2A$$

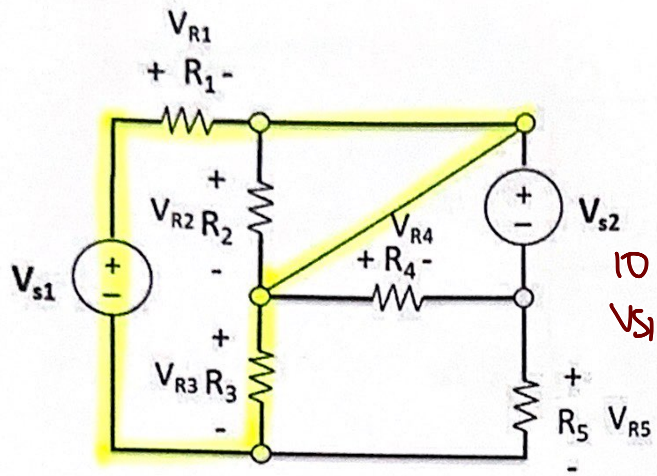
Ans: 2A

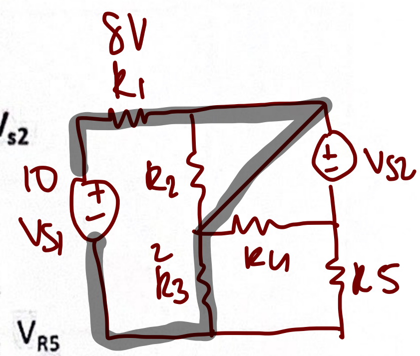
$$IR1 = IR3 + IR6$$

$$7.5 = IR3 + 5.5$$

$$IR3 = 2$$

What's the voltage across R_3, i.e., V_{R3}, in the following circuit? (Hint: label different node with different color)





Given V_{R1} = 8V, V_{R5} = 1 V, V_{S1} = 10 V, and V_{S2} = 1 V
Which among the following values most closely matches the correct answer?

- a. 1V
- b. 3V
- c. 4V
- d. 2V

KVL of highlighted loop:

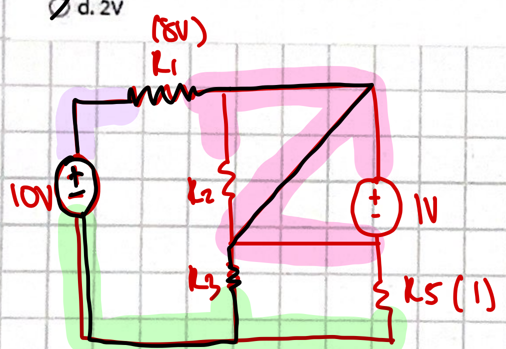
$V_{S1} - V_{R1} - V_{R3} = 0$

$10 - 8 - V_{R3} = 0$

$2 - V_{R3} = 0$

$V_{R3} = 2V$

Ans: 2V



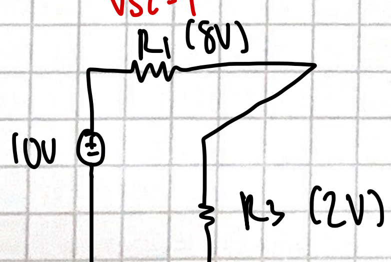
$V_{R1} = 8V$

$V_{R5} = 1$

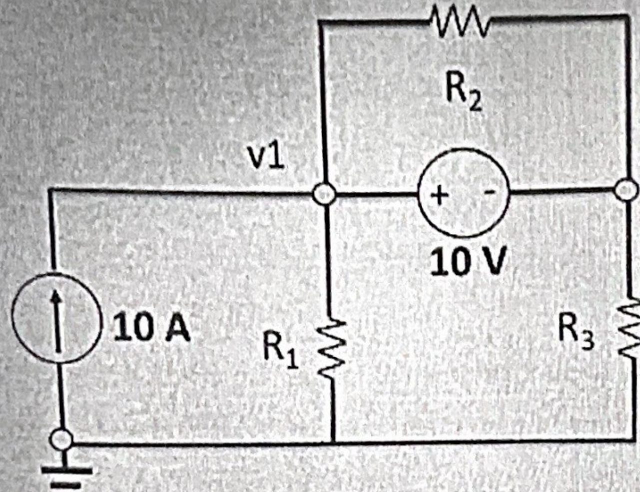
$V_{S1} = 10$

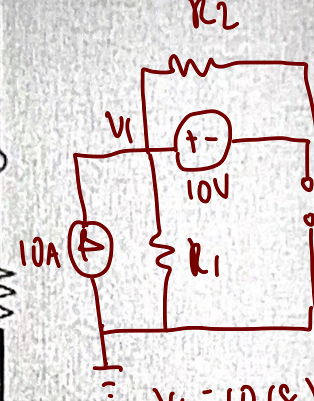
$V_{S2} = 1$

* ignore VS2 & R2



In the circuit below, what is the Thevenin (open-circuit) voltage when R_3 is the load?

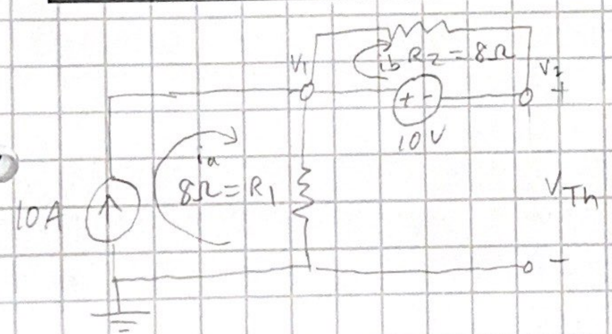




$V_1 = 10(8) = 80$
$80 - V_{TH} = 10$
$V_{TH} = 70$ //

Given $R_1 = R_2 = R_3 = 8\ \Omega$
Which among the following values most closely matches the correct answer?

- a. 65V
- b. 75V
- c. 60V
- d. 70V



KVL at (a)
$i_a = 10A$

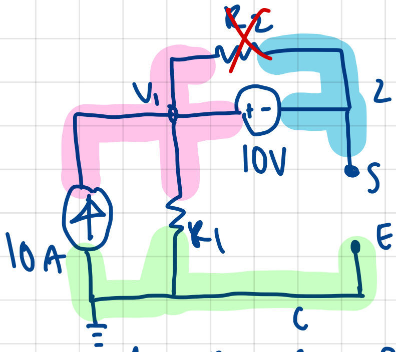
KVL at (b)
$I_b = \frac{10}{8} = 1.25A$

$\Delta V = I R_1$

$V_{TH} - 0 = I R_1$
$V_{TH} = 10 \times 8$
$= 80V$

$V_1 - V_2 = 10V$
$V_{TH} - V_2 = 10$
$80 - V_2 = 10$
$V_2 = 70V$

Ans: 70V //



$R_1 = R_2 = R_3 = 8$

$V = IR$

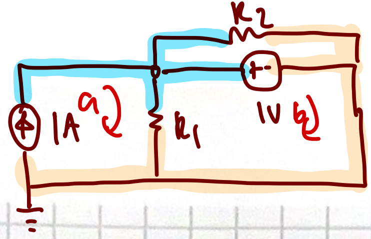
$= (10)(8) = 80$

$V_1 - V_2 = 10$

$80 - V_2 = 10$

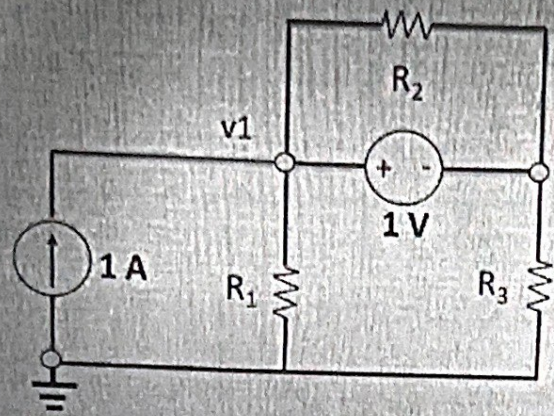
$-V_2 = -70$

$V_2 = 70$



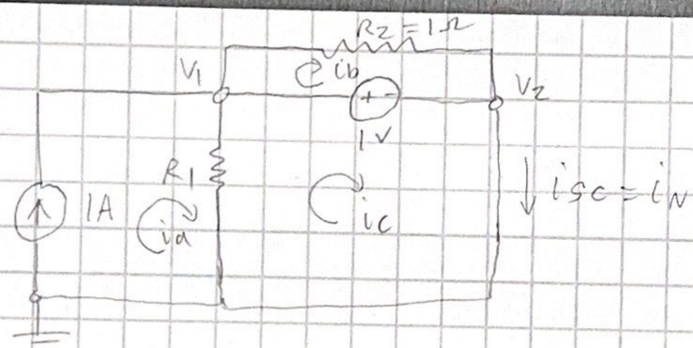
mesh a = 1
mesh b = $(I_b - I_a)R_1 = -1$
$2.5 I_b - 2.5 = -1$
$I_b = 0.6$

In the circuit below, what is the Norton (short-circuit) current when R_3 is the load?



Given $R_1 = 2.5\ \Omega$, $R_2 = 1\ \Omega$ Which among the following values most closely matches the correct answer?

- a. 0.8A
- b. 0.5A
- c. 0.6A ✓
- d. 0.7A

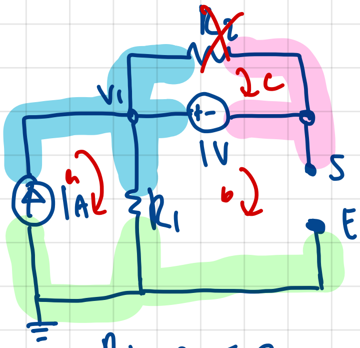


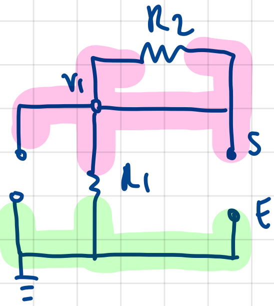
KVL at (a):
$i_a = 1A$

KVL at (b):
$i_b = 1A$

KVL at C:
$-(i_c - i_a)2.5 - 1 = 0$
$-2.5 i_c + 2.5(1) - 1 = 0$
$-2.5 i_c + 1.5 = 0$
$i_c = 0.6A$
$i_{sc} = i_c = 0.6A$

Ans: 0.6A





$R_1 = 2.5\,\Omega$

$R_2 = 1\,\Omega$ $V = IR$

$Req = R_1 = 2.5$

$V_{TH} =$

using mesh current method,

mesh A = 1

mesh b X

mesh C = $1 = (iC)(R_2$

$IC = 1$

$V_1: V = (1)(2.5 = 2.5$

$V_2: V_1 - V_2 = 1$

$2.5 - V_2 = 1$

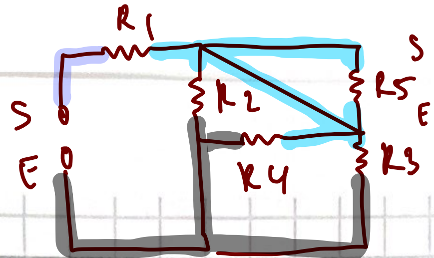
$V_2 = 1.5$

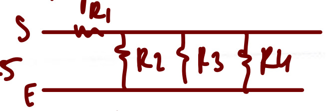
$\therefore V = IR$

$1.5 = I(2.5)$

$I = 0.6$

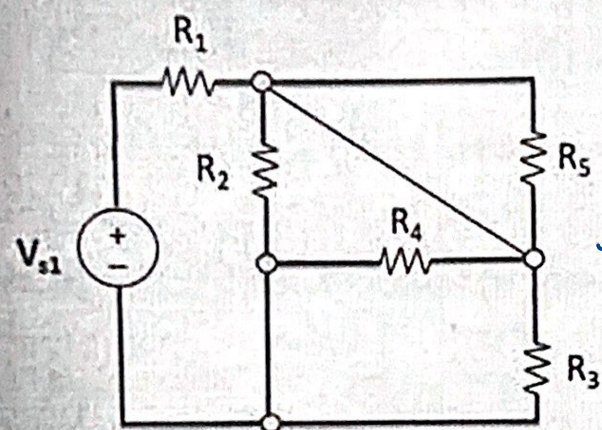
Ignore R5

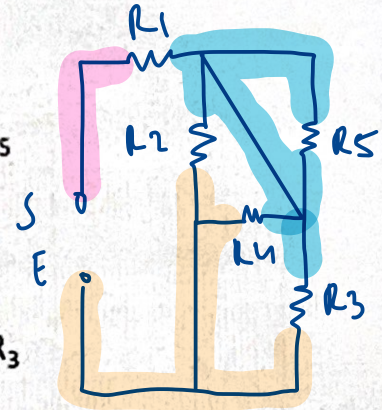




$\frac{1}{3}+1=1.5$

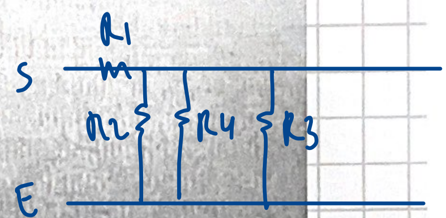
What's the equivalent resistance seen by V_{s1} in the following circuit? (Hint: label different node with different color)





Given $R_1 = 1\,\Omega$, $R_2 = 1\,\Omega$, $R_3 = 1\,\Omega$, $R_4 = 1\,\Omega$, $R_5 = 2\,\Omega$

Which among the following values most closely matches the correct answer?



a. 1.3 Ω

b. 2.6 Ω

c. 3.6 Ω

d. 1.6 Ω

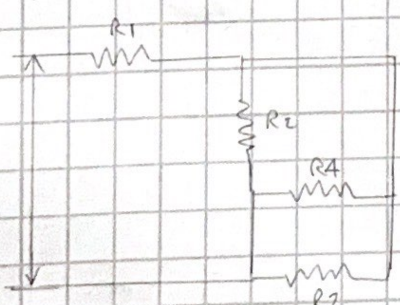
$R_2 // R_4 // R_3 = \frac{1}{3}$

$\frac{1}{3}+1=1.3$

$R_T = (R_3 \| R_4 + R_5) \| R_2 + R_1$

$= 1.714\,\Omega$

R5 ⇒ Short



$R34 = R3 // R4 = \left(\frac{1}{1}+\frac{1}{1}\right)^{-1} = \frac{1}{2}\,\Omega$

$R234 = R2 // R34 = \left(\frac{1}{\frac{1}{2}}+\frac{1}{1}\right)^{-1} = \frac{1}{3}\,\Omega$

$R_1 + R234 = 1 + \frac{1}{3}\,\Omega$

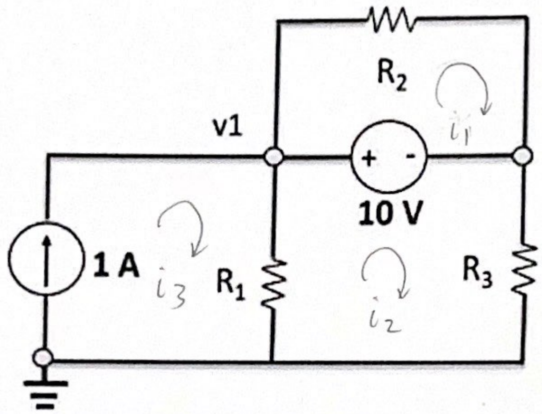
$= 1.3\,\Omega$

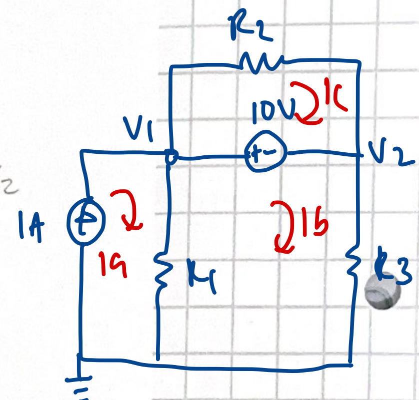
Ans: 1.3 Ω

Question 1

In the circuit below, what is the node voltage v1?

Given $R_1 = R_2 = R_3 = 110\ \Omega$





mesh a = 1A

mesh b = $R_1(i_b - 1) + R_3(i_b) = -10$

$110 i_b - 110 + 110 i_b = -10$

$220 i_b = 100$

$i_b = 0.4545$

$V_2 = (0.4545)(110)$

$= 50$

$V_1 - V_2 = 10$

$V_1 - 50 = 10$

$V_1 = 60$

Selected Answer: 60.0 V

Answers:

65.0 V

30.0 V

35.0 V

60.0 V

$R_2 i_1 + 10 = 0 \rightarrow i_1 = \frac{1}{11}$

$-10 + R_3 i_2 + R_1(i_2 - 1) = 0$

$-10 + i_2(R_3 + R_1) - R_1 = 0 \rightarrow i_2 = \frac{6}{11}$

since node on R_3 = node on R_1,

$i_2 R_3 = V_1$

$V_1 = \frac{6}{11}(110)$

$= 60$

$i_3 = 1A$

$-R_2 i_1 - 10 = 0$

$-R_2 i_1 = -10$

$i_1 = \frac{1}{11}$

$-R_3 i_2 - R_1(i_2 - 1) + 10 = 0$

$-R_3 i_2 - R_1 i_2 + R_1 + 10 = 0$

$-i_2(R_3 + R_1) + R_1 + 10 = 0$

$-i_2(110 + 110) + 110 + 10 = 0$

$-220 i_2 + 120 = 0$

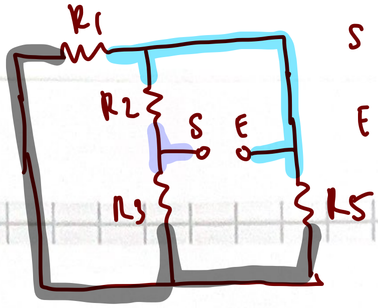
$i_2 = \frac{6}{11}$

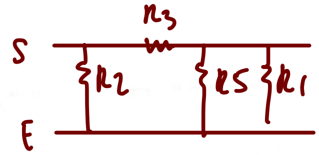
$V_1 = i_2 R_3$

$= \frac{6}{11}(110)$

$= 60V$

Ans: 60V





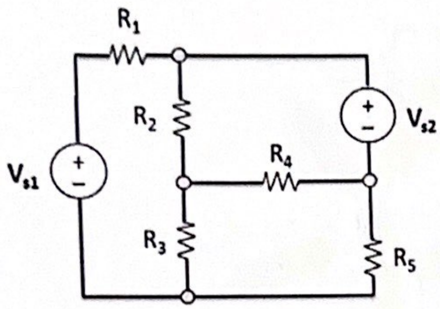
7.8Ω

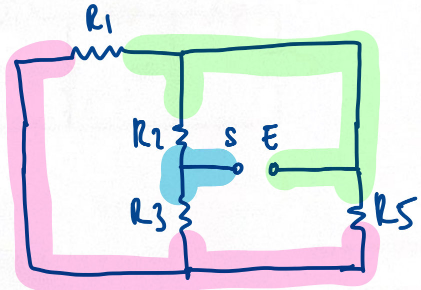
Question 2

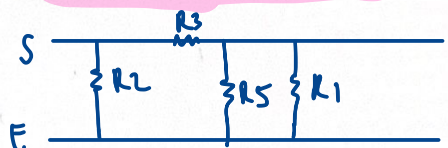
20 o

What's the equivalent resistance seen by R_4 in the following circuit? (Hint: short circuit V_{s1} and V_{s2})

Given $R_1 = R_2 = R_3 = R_4 = R_5 = 13\ \Omega$







Selected Answer: 7.8 Ω

Answers:
- 6.8 Ω
- 7.8 Ω
- 9.8 Ω
- 8.8 Ω

$R_{eq1} = R_1 // R_5 = 6.5$

$R_{eq2} = R_{eq1} + R_3 = 19.5$

$R_{eq2} // R = 7.8$

$R_4 = [(R_1 \| R_5) + R_2] \| R_3$

$= 7.8\ \Omega$

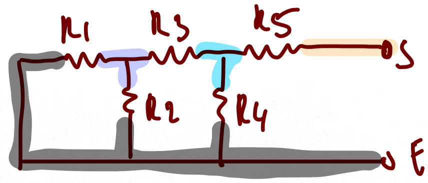
$R_{12} = R_1 // R_2$

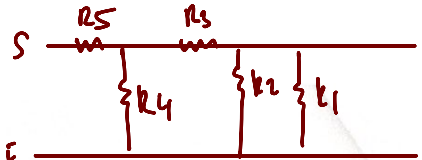
$= 6.5\ \Omega$

$R_{12} + R_3 = 19.5$

$(R_{12} + R_3) // R_5 = 7.8\ \Omega$

Ans: $7.8\ \Omega$

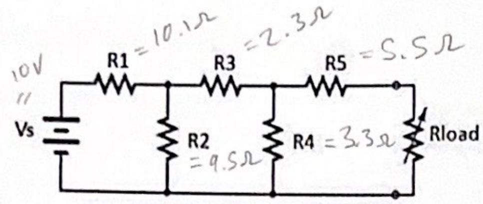




7.7624

Question 3

Referring to the following circuit



and knowing that

Vs = 10 [V]
R1 = 10.1 [Ohms]
R2 = 9.5 [Ohms]
R3 = 2.3 [Ohms]
R4 = 3.3 [Ohms]
R5 = 5.5 [Ohms]

$R_1 // R_2 = 4.895\,\Omega$

$(R_1//R_2) + R_3 = 7.195\,\Omega$

$((R_1//R_2)+R_3)//R_4 = 2.262\,\Omega$

$(((R_1//R_2)+R_3)//R_4)+R_5 = 7.762\,\Omega$

↓

Rload

determine the value of Rload which ensures maximum power transfer.

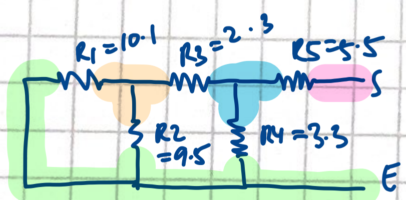
Allowing for some numerical approximation, which among the following values most closely matches the correct answer?

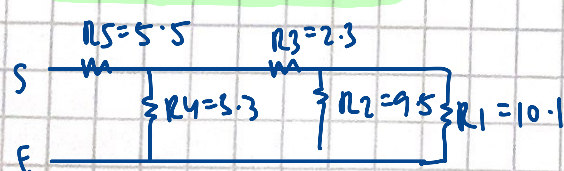
Selected Answer: Rload = 7.7624 [Ohms]

Answers:
- Rload = 15.5248 [Ohms]
- Rload = -2.2376 [Ohms]
- Rload = 7.7624 [Ohms]
- Rload = 30.7 [Ohms]

$R_T = [(R_1 \| R_2) + R_3] \| R_4 + R_5$

$= 7.7624\,\Omega$





$R_{eq_1} = R_1 // R_2 = 4.8954$

$R_{eq_2} = R_{eq_1} + R_3 = 7.1954$

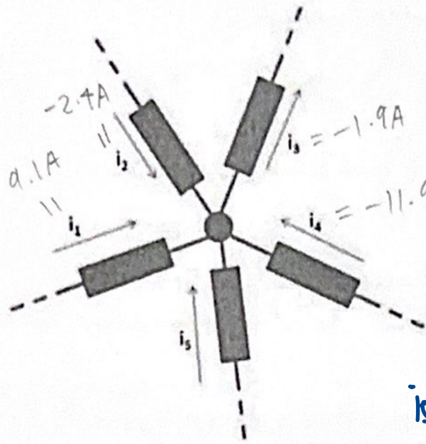
$R_{eq_3} = 7.1954 // R_4 = 2.2624$

$R_{eq_3} + 5.5 = 7.7624\,\Omega$

Question 4

In=out
$I2+I_1+I5+I4=I3$
$I5=3.3$

Referring to the following circuit



In=out
$I5-11.9-2.4+9.1=-1.9$
$i5=3.3$

and knowing that

I1 = 9.1 [A]
I2 = -2.4 [A]
I3 = -1.9 [A]
I4 = -11.9 [A]

$i_5+i_1+i_2+i_4=i_3$
$i_5+9.1+(-2.4)+(-11.9)=-1.9$
$i_5-5.2=-1.9$
$i_5=3.3A$

determine the value of I5.

Allowing for some numerical approximation, which among the following values most closely matches the correct answer?

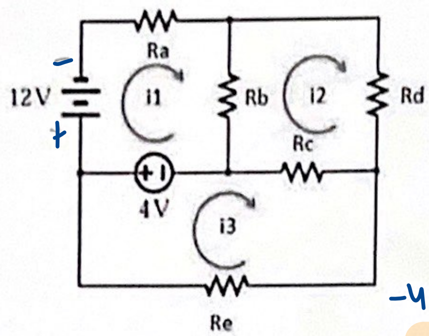
Selected Answer: I5 = 3.3 A

Answers:
I5 = -3.3 A
I5 = -1.3 A
I5 = 0.3 A
I5 = 3.3 A

$i_1+i_2+i_4+i_5=i_3$
$i_5=i_3-i_1-i_2-i_4$
$=3.3A$

Question 5

The mesh-current method, applied to the following circuit



mesh 1:
$-8 = Ra(i_1) + Rb(i_1 - i_2)$
$7.6 i_1 - 4.5 i_2 = -8$
mesh 2:
$rb(i_2 - i_1) + Rc(i_2 - i_3) + Rd(i_2) = 0$
$-4.5 i_1 + 45 i_2 - 20.2 i_3 = 0$
mesh 3:
$-4 = Rc(i_3 - i_2) + Re(i_3)$
$-20.2 i_2 + 35.7 i_3 = -4$

$V = IR$
mesh a:
$-8 = 3.1 i_1 + (i_1 - i_2) 4.5$
mesh b:
$(i_2 - i_1) 4.5 + 20.3(i_2) + (i_2 - i_3)(20.2) = 0$
mesh c:
$-4 = (i_3 - i_2) 20.2 + (i_3)(15.5)$

$(3.1 + 4.5) i_1 - 4.5 i_2 = -8$
$7.6 i_1 - 4.5 i_2 = -8$
$-4.5 i_1 + (4.5 + 20.3 + 20.2) i_2 - 20.2 i_3 = 0$
$-4.5 i_1 + 45 i_2 - 20.2 i_3 = 0$
$-20.2 i_2 + 35.7 i_3 = -4$

will lead to a 3x3 system of equations such as

$$\begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix} \cdot \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} -8V \\ 0V \\ -4V \end{bmatrix}$$

Allowing for some numerical approximation and knowing

Ra = 3.1 [Ohms]
Rb = 4.5 [Ohms]
Rc = 20.2 [Ohms]
Rd = 20.3 [Ohms]
Re = 15.5 [Ohms]

$7.6 i_1 - 4.5 i_2 = -8$ — ①
$-4.5 i_1 + 45 i_2 - 20.2 i_3 = 0$ — ②
$-20.2 i_2 + 35.7 i_3 = -4V$ — ③

which among the following matrices best represents the resistance matrix [Rij] in the equation above?

Selected Answer:

$$\begin{bmatrix} 7.6 & -4.5 & 0 \\ -4.5 & 45 & -20.2 \\ 0 & -20.2 & 35.7 \end{bmatrix}$$

$12V + i_1 Ra + (i_1 - i_2) Rb - 4V = 0$
$i_1(Ra + Rb) - Rb i_2 = -8V$
$(i_2 - i_1) Rb + i_2 Rd + (i_2 - i_3) Rc = 0$
$-Rb i_1 + i_2 (Rb + Rd + Rc) - Rc i_3 = 0$
$4V + (i_3 - i_2) Rc + i_3 Re = 0$
$-Rc i_2 + i_3 (Rc + Re) = -4V$

Answers:

$$\begin{bmatrix} 7.6 & 0 & 0 \\ 0 & 45 & 0 \\ 0 & 0 & 35.7 \end{bmatrix}$$

$$\begin{bmatrix} 7.6 & -4.5 & -20.2 \\ 0 & 45 & 40.6 \\ 0 & 0 & 35.7 \end{bmatrix}$$

$$\begin{bmatrix} 3.1 & 4.5 & 20.2 \\ 4.5 & 20.3 & 15.5 \\ 20.2 & 15.5 & 18.6 \end{bmatrix}$$

$$\begin{bmatrix} 7.6 & -4.5 & 0 \\ -4.5 & 45 & -20.2 \\ 0 & -20.2 & 35.7 \end{bmatrix}$$

7