Q1) (20 marks) Choose the correct answer and fill it in the answer sheet

1. **For the circuit shown, the current division formula to evaluate I_2:**

a. $I_2 = I_s \dfrac{R1}{R1+R2}$

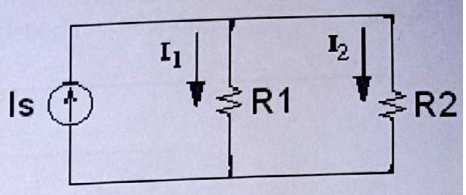
b. $I_2 = I_s \dfrac{R2}{R1+R2}$

c. $I_2 = I_s \dfrac{R1 \times R2}{R1+R2}$

d. $I_2 = I_s \dfrac{R1+R2}{R1 \times R2}$

e. $I_2 = \dfrac{R2}{R1+R2}$

$I_2 = I_s * \dfrac{R_1}{R_1+R_2}$



2. **For the circuit shown , the power absorbed/delivered in component A is:**

a. 60W (delivered)
b. 60W (absorbed)
c. 30W (delivered)
d. 30W (absorbed)
e. None of the above

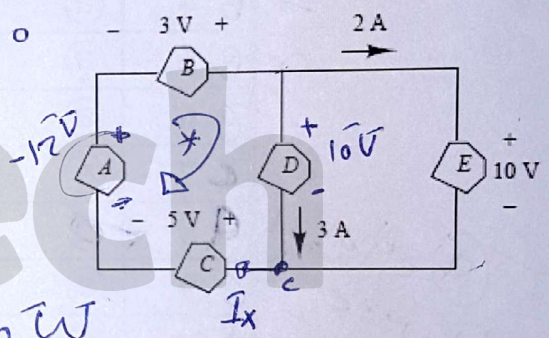
$\sum V @ * = 0$

$-3V + 10V + 5V + V_A = 0$

$V_A = 3 - 10 - 5$

$V_A = 3 - 15$

$V_A = -12$



@node C

$I_{in} = I_{out}$

$2A + 3A = I_x$

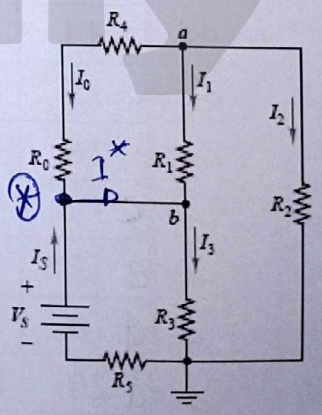
$I_x = 5A$

$\Rightarrow P_i = (\ )(I)(V)$

$= -(5A)(-12) = 60W$

3. **For the circuit shown; if $I_o = -2$ A , $I_1 = -4$ A, $I_s = 8$ A, and $V_s = 12$ V, then the current I_3 i**

a. 4A
b. -2A
c. 2A
d. -4A
e. None of the above



@ node *

$\sum I_{in} = \sum I_{out}$

$-2 + 8 = I^*$

$I^* = 6A$

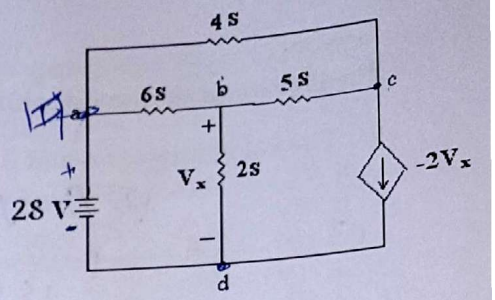
@ node B

$\sum I_{in} = \sum I_{out}$

$6 - 4 = I_3$

$6 - 4 = 2A$

For the circuit shown, answer the questions (4-5)



4. **If node a is the reference node, then the nodal voltage at d is:**
   a. 0V
   b. -28V
   c. 28V
   d. -2V
   e. None of the above

5. **If node d is the reference node, then the nodal equation at node c is:**
   a. $\frac{v_b}{9} - \frac{v_c}{5} = 0$
   b. $\frac{v_b}{9} + \frac{v_c}{5} = 0$
   c. $-7v_b + 9v_c = 112$
   d. . $-7v_b - 9v_c = 112$
   e. None of the above

$V_a = 28V$

$\frac{V_c - 28}{1/4} + \frac{V_c - V_b}{1/5} - 2\left(\frac{V_b - 0}{1/2}\right) = 0$

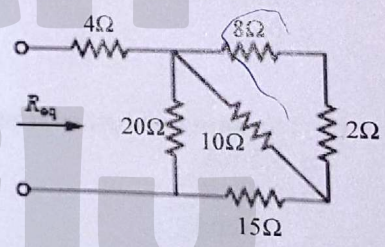
$\frac{V_c - 28}{1/4} + \frac{V_c - V_b}{1/5} - \frac{2V_b}{1/2} = 0$

$4V_c - 112 + 5V_c - 5V_b - 4V_b = 0$

$4V_c + 5V_c - 5V_b - 4V_b = 112$

$9V_c - 9V_b = 112$

6. **For the circuit shown, the equivalent resistance (R_{eq}) is:**
   a. 59Ω
   b. 22Ω
   c. 8Ω
   d. 10Ω
   e. 14Ω



(8,2) series = 8+2 = 10

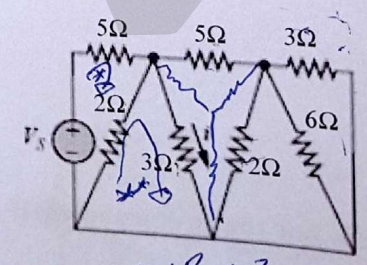
$10//10 = \frac{10*10}{10+10} = \frac{100}{20} = 5\Omega$

(5,15) series = 15+5 = 20Ω

$(20//20) = \frac{20*20}{20+20} = \frac{400}{40} = 10\Omega$

(10,4) series = 14Ω

For the circuit shown; if V_s=18V, answer the questions (7 - 8)



7. **The equivalent resistance seen from the source is:**
   a. 1Ω
   b. 5.5Ω
   c. 6Ω
   d. 26Ω
   e. None of the above

$I_s = \frac{18}{6} = 3A$

$-18 + (3*5) + 2i = 0$

$2i = 18 - 15 = 3V$

$18 * \frac{1}{6}$

$** -3 + vi = 0$

$vi = 3V$

$i = 3/2 = 1A$

$\frac{3*6}{3+6} = \frac{18}{9} = 2$

$\frac{2*2}{2+2} = \frac{4}{4} = 1$

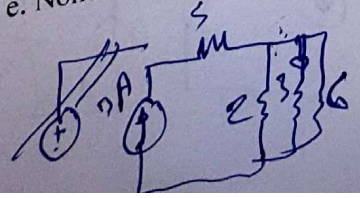
$1+5 = 6 = 2$

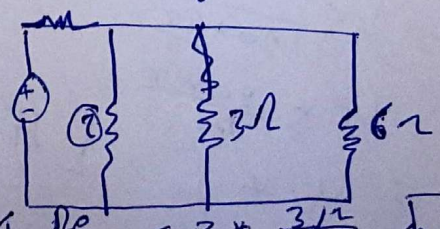
$6//3 = \frac{6*3}{6+3} = \frac{18}{9} = 2$

$2//2 = \frac{2*2}{2+2} = 1$

$1+5 = 6$

8. **The current *i* in the circuit is:**
   a. 1A
   b. 0.5A
   c. 1.5A
   d. 3
   e. None of the above

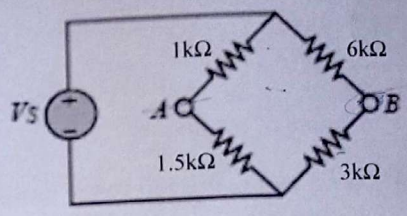




$I_3 = I_s \frac{R_e}{R_3} = 3 * \frac{3/2}{3}$

$= I_s \frac{R_{3/2}}{R_{3/2} + 3}$

For the circuit shown, if V_s=15V. Answer the questions (9 - 12)



9. The voltage across A and B (V_{AB}) is:
   a. 9V
   b. -9V
   c. 4V
   d. -4V
   e. 0V

$V_s \frac{1.5}{2.5} - V_s \frac{3}{9}$

$15\left(\frac{1.5}{2.5}\right) - 15\left(\frac{3}{9}\right)$

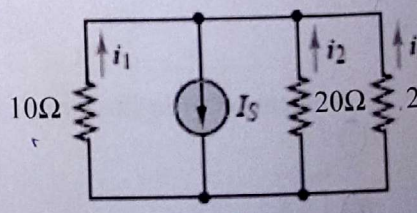
$9 - 5 = 4$

10. The Thevinin resistance seen from A and B is:
   a. 1.96kΩ
   b. 2.74kΩ
   c. 0Ω
   d. inf
   e. 2.6kΩ

11. The maximum power transferred through A and B is:
   a. 1.54mW
   b. 3.46mW
   c. 4.59mW
   d. 2.04mW
   e. 0

12. The short circuit current through A and B is:
   a. 3.5mA
   b. 3.3mA
   c. 1.46mA
   d. 1.54mA
   e. inf

13. For the circuit shown, if I_s = 4 A, then the current I_3 is:



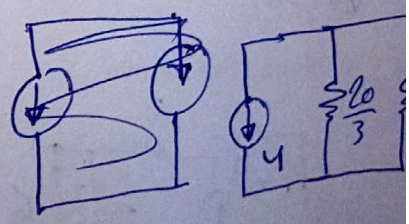
   a. 1A
   b. -1A
   c. 2A
   d. -2A
   e. None of the above

4A

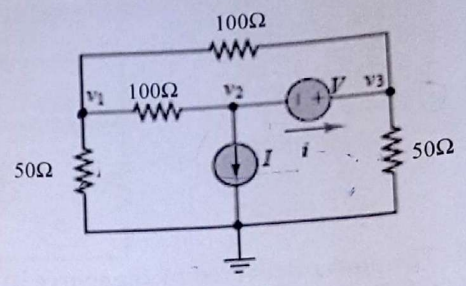
$I_3 = I_s \frac{20/3}{20 + \frac{20}{3}}$

$I_3 = 4 * \frac{20/3}{80/3}$

$= 4 * \frac{1}{4} = 1A$



For the circuit shown below, if the current i through the voltage source was 20mA and after the disconnection of the current source the current i through the voltage source becomes 40mA. Then answer the questions (14 - 16)



14. The value of the current source (I) is:
a. 8mA
b. 16mA
c. 20mA
d. 24mA
e. None of the above

15. The value of the voltage source (V) is:
a. 4V
b. 6V
c. 8V
d. 10V
e. None of the above

$\frac{V_1 - V_3}{100} + \frac{V_1 - 0}{50} + \frac{V_1 - V_2}{100} = 0$

$\left(\frac{1}{100} + \frac{1}{50} + \frac{1}{100}\right)V_1 - \frac{1}{100}V_2 - \frac{1}{100}V_3 = 0$

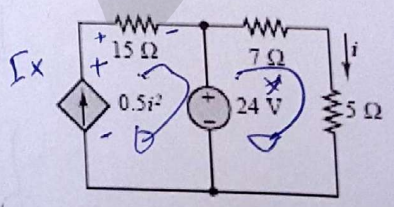
V_2 and V_3 are super node

$V_3 - V_2 = 40 \times 10^{-3}$ A ---- ①

$\frac{V_3 - 0}{50} + \frac{V_3 - V_1}{100} +$

16. The power delivered by the voltage source is:
a. 80mW
b. 160mW
c. 120mW
d. 240mW
e. None of the above

17. For the circuit shown, the voltage across the current source is:
a. 2V
b. 24V
c. 54V
d. 27V
e. None of the above



ΣV @ $* = 0$

$-24 + 7i + 5i = 0$

$12i = 24$

$\Rightarrow i = \frac{24}{12} = 2A$

$i_x = 0.5(2)^2$

$= 0.5(4)$

$= 2$

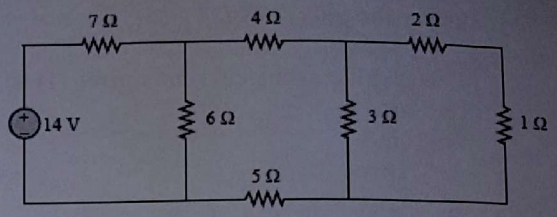
$(2 * 15) + 24 - V_{Ix} = 0$

$V_{Ix} = 30 + 24 = 54$ V

For the circuit shown, answer the questions (18- 19)

18. The equivalent resistance seen by the source is:

a. 28Ω
b. 3.8Ω
c. 9.9Ω
d. 2.5Ω
e. 10.8Ω



1,2 series = 3

$(3 \| 3) = \frac{3*3}{3+3} = \frac{9}{6} = \frac{3}{2}$

$\frac{3}{2} + 4 = 5.5$

19. The power delivered by the source is:

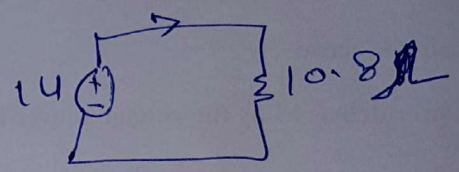
a. 78.4W
b. 51.6W
c. 19.8W
d. 18.15W
e. 7W

$V_s = I_s R_{eq}$

$I_s = \frac{V_s}{R_{eq}}$

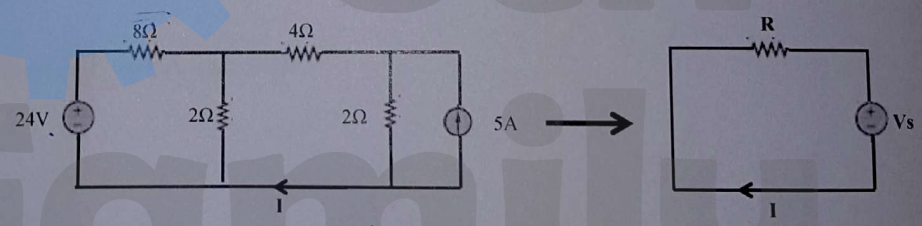
$= \frac{14}{10.81}$

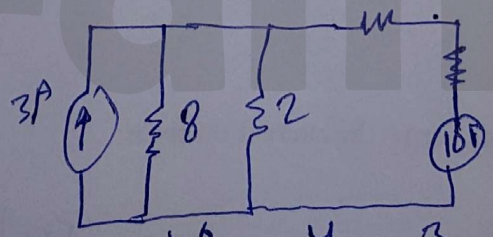
$I_s = 1.29$

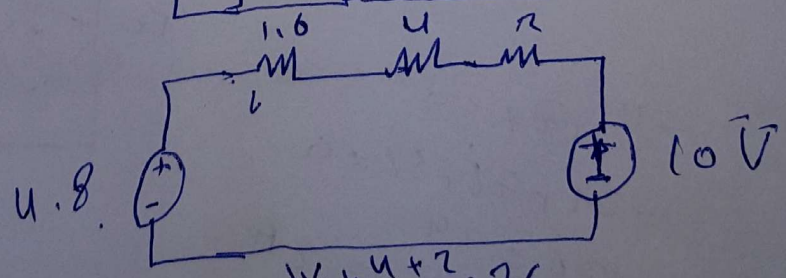


20. By using source transformation for the circuit shown below, the values of *Vs* and *R* on the right circuit are:

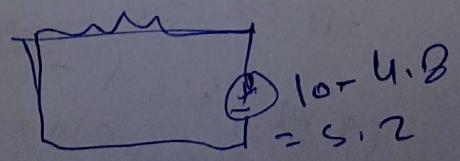
a. 5.2 V, 7.6Ω
b. 14.8V, 7.6Ω
c. 34V, 13Ω
d. 13V, 34Ω
e. None of the above



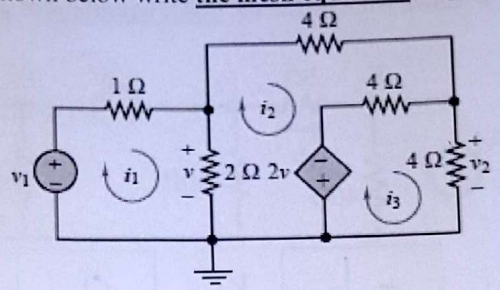




$1.6 + 4 + 2 = 7.6$



Q2) (5 marks) For the circuit shown below write **the mesh equations** as given below:



3.5/5

3	i_1 +	-2	i_2 +	0	i_3	=	V_1
-6	i_1 +	6	i_2 +	-4	i_3	=	0
4	i_1 +	-8	i_2 +	~~8~~ 8	i_3	=	zero

mesh 1

$i_1(1) + (I_1 - I_2)2 - V_1 = 0 \Rightarrow i_1 + 2i_1 - 2i_2 - V_1 = 0$

$3i_1 - 2i_2 - V_1 = 0 \Rightarrow 3i_1 - 2i_2 = V_1$

$\cancel{2(i_2 +} \quad \cancel{-2I_2}$

$2(I_2 - I_1) + 4I_2 + 4(I_2 - I_3) - 4(I_1 - I_2) = 0$

$2I_2 - 2I_1 + 4I_2 + \cancel{4I_2} - 4I_3 - 4I_1 - \cancel{4I_2} = 0$

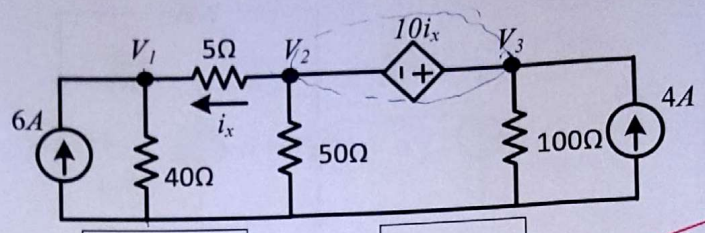
$4(I_3 - I_2) + 4I_3 + 4(I_1 - I_2) = 0$

$4I_3 - 4I_2 + 4I_3 + 4I_1 - 4I_2 = 0$

$8I_3 - 8I_2 + 4I_1$

5/5

Q3) (5 marks) For the circuit shown below write the **nodal equations** as given below:



$\boxed{\frac{1}{40}+\frac{1}{5}}\ V_1 + \boxed{-\frac{1}{5}}\ V_2 + \boxed{0}\ V_3 = \boxed{6A}$

$\boxed{2}\ V_1 + \boxed{-3}\ V_2 + \boxed{1}\ V_3 = \boxed{\text{zero}}$

$\boxed{-\frac{1}{5}}\ V_1 + \boxed{\frac{1}{5}+\frac{1}{50}}\ V_2 + \boxed{\frac{1}{100}}\ V_3 = \boxed{4A}$

@node 1

$-6A + \frac{V_1-0}{40} + \frac{V_1-V_2}{5} = 0 \Rightarrow \left(\frac{1}{40}+\frac{1}{5}\right)V_1 - \frac{V_2}{5} = 6A$ — (1)

node 2 and node 3 are supernode

$V_3 - V_2 = \frac{10(V_2-V_1)}{5}$

$V_3 - V_2 = 2V_2 - 2V_1 \Rightarrow V_3 - 3V_2 + 2V_1 = 0$ — (2)

$\frac{V_2-V_1}{5} + \frac{V_2-0}{50} + \frac{V_3-0}{100} - 4A = 0 \quad \frac{V_2}{5} + \frac{V_2}{50} - \frac{V_1}{5} + \frac{V_3}{100} - 4A = 0$

$\left(\frac{1}{5}+\frac{1}{50}\right)V_2 + \frac{V_3}{100} - \frac{V_1}{5} = 4A$ — (3)