CKt1

Fall 2014

م. رجب الدبس

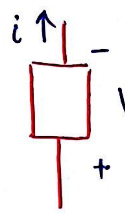
First Exam

circuits1

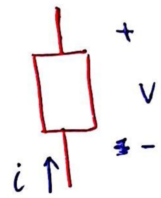
Problem 1 : (1 pt)

Find the absorbed power for each element of the following:

1. $i = 3A$ & $V = 8V$

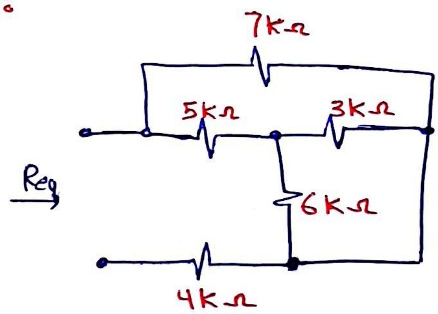


2. $i = 3A$ & $V = -8V$



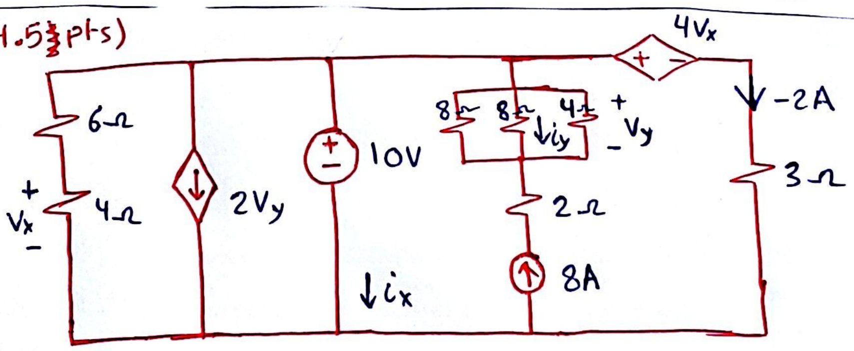
Problem 2: (1.5 pt)

Find Req of the following connection:



Problem 3 (4.5 pts)

Don't Use Mesh or Nodal or Superposition.



1. Find V_x by Voltage division rule only.
2. find i_y by current division rule only.
3. find V_y
4. find i_x using KCL only

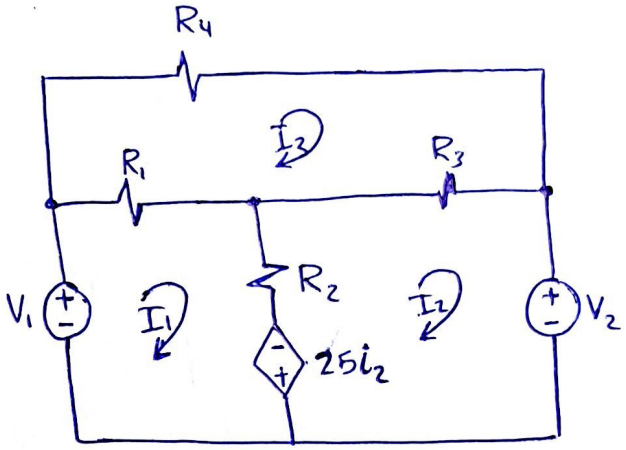
Problem #4 : The Mesh equations of the following circuit are given by: (4pts)

[1] $20i_1 - 40i_2 - 5i_3 = V_1$

[2] $-15i_1 + 65i_2 - 25i_3 = -V_2$

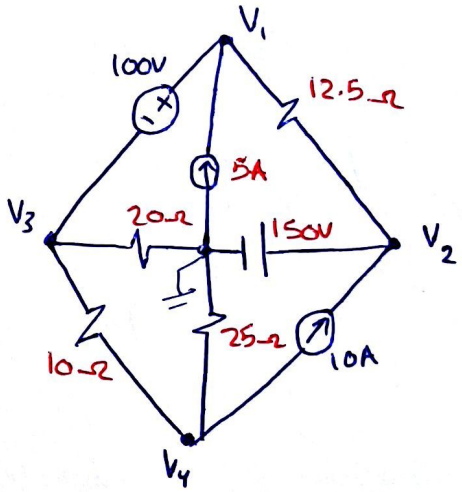
[3] $-5i_1 - 25i_2 + 35i_3 = 0$

Find R_1, R_2, R_3 and R_4



Problem #5 : (5pts)

write the Nodal voltage equations for the following circuits (Don't Solve them ; just arrange them to fill the blanks below)

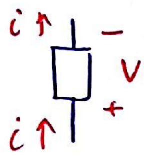


Solutions:

Problem 1:

P absorbed? $P = IV$

1) $i = 3A$, $V = 8V$



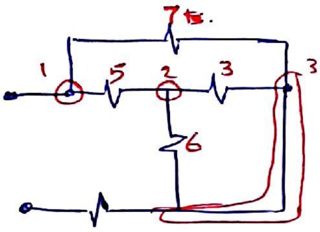
2) $i = 3A$, $V = -8V$

$P = IV$
$= 3 * 8$
$\boxed{P = 24W}$

$P = IV$
$= 3 * 8$ (8 → $-V$)
$\boxed{P = 24W}$

Problem 2:

R_{eq}??



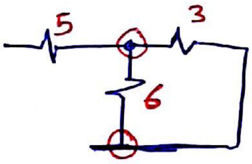
طريقة الحل :

① حدد ال Nodes

② حدد ال Series وال Parallel

① → The ckt from node 1 to node 3 is in series with the 4kΩ

② → The 7kΩ is // with the equivalent of 5kΩ, 3kΩ, 6kΩ ckt



③ → The 3kΩ // 6kΩ and their equivalent is in series with 5kΩ

$$R_{eq} = 4 + \frac{7 * \left(5 + \frac{3*6}{6+3}\right)}{7 + \left(5 + \frac{3*6}{6+3}\right)}$$

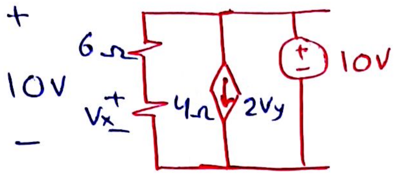
$$R_{eq} = 7.5 \ k\Omega$$

Problem #3 :

① find V_x by voltage division :

بدنا V ال 4Ω

وعنا V ال 4Ω مع ال 6Ω



$$V_{4\Omega} + V_{6\Omega} = 10\ V$$

voltage division:

$$V_4 = 10 * \frac{4}{6+4}$$

$$\boxed{V_4 = 4\ V}$$

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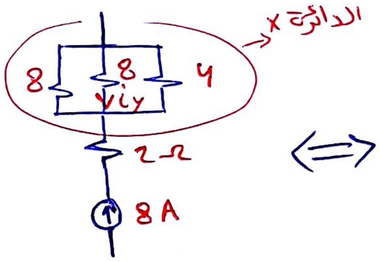
② find i_y by current division



~~$i_{2\Omega}$ (لا تؤثر في الدائرة X)~~

~~$i_y = -8 * \frac{2}{8+2}$~~

~~$i_y = -1.6\ A$~~

~~③ find V_y~~

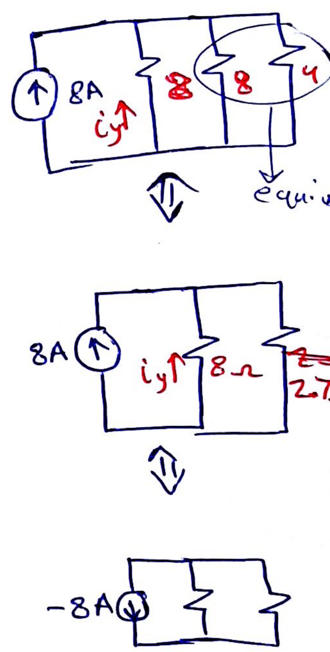
$i_{2\Omega}$ (لا تؤثر في ال ckt X)

$$i_y = -8 * \frac{2.7}{8+2.7}$$

2.7 → 2.66667

$$\boxed{i_y = -2.02\ A}$$

$-2.000001875 \simeq -2$



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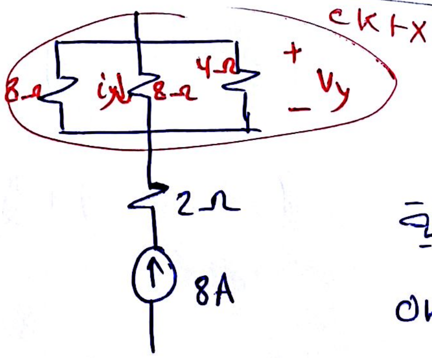
③ find V_y



في طريقتين للحل اما منطلع $V_{8\Omega}$

ولأن $4\Omega // 8\Omega$ فنفس الفولتية

أو منطلع R_{xeq} و بعدها Ohm's law

$$V_{4\Omega} = R_x * 8$$

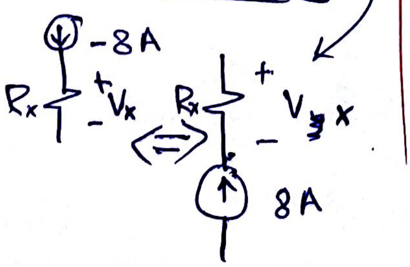
الطريقة 1

$$R_{xeq} = \left(\frac{1}{8} + \frac{1}{8} + \frac{1}{4}\right)^{-1}$$

$$R_{xeq} = 2\ \Omega$$

$$V_{4\Omega} = 2 * -8$$

$$\boxed{V_y = V_{4\Omega} = -16\ V}$$



الطريقة 2

$$V_{8\Omega} = -2 * 8$$

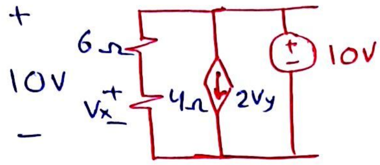
$$= -16\ V = V_y$$

Problem #3 :

① find V_x by voltage division :

بدنا الـ V الـ 4Ω

وعنا الـ V الـ 4Ω مع الـ 6Ω



$V_{4\Omega} + V_{6\Omega} = 10\ V$

voltage division :

$V_4 = 10 * \frac{4}{6+4}$

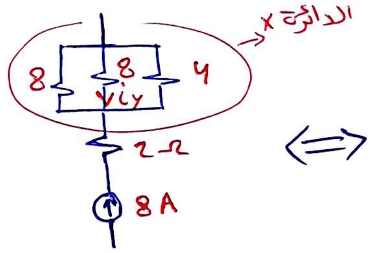
$\boxed{V_4 = 4V}$

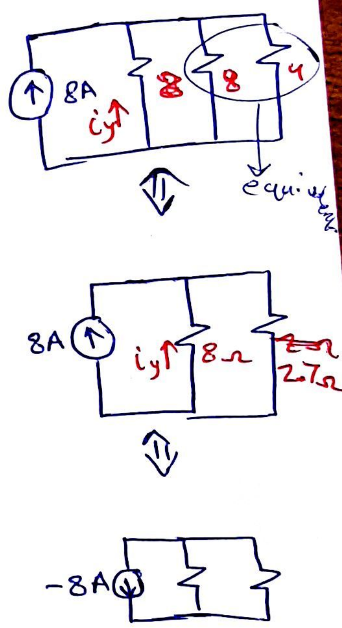
② find i_y by current division

~~$i_{2\Omega}$ (لا تؤثر في الدائرة X)~~

~~$i_y = -8 * \frac{2}{8+2}$~~

~~$\boxed{i_y = -1.6\ A}$~~





$i_{2\Omega}$ (لا تؤثر في الـ ckt X)

$i_y = -8 * \frac{2.7}{8+2.7}$ → 2.66667

$\boxed{i_y = -2.02\ A}$

$-2.000001875 \simeq -2$

~~③ find V_y~~

③ find V_y

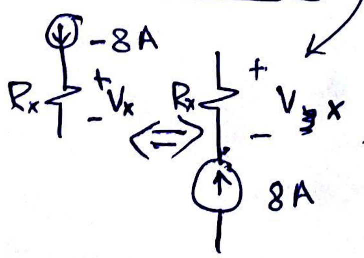
الطريقة 1

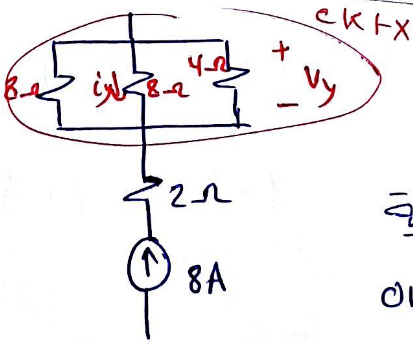
$R_{xeq} = \left(\frac{1}{8}+\frac{1}{8}+\frac{1}{4}\right)^{-1}$

$R_{xeq} = 2\ \Omega$

$V_{4\Omega} = 2 * -8$

$\boxed{V_y = V_{4\Omega} = -16\ V}$





الطريقة 2

$V_{8\Omega} = -2 * 8$

$= -16\ V = V_y$

في طريقتين للحل اما منطلع $V_{8\Omega}$

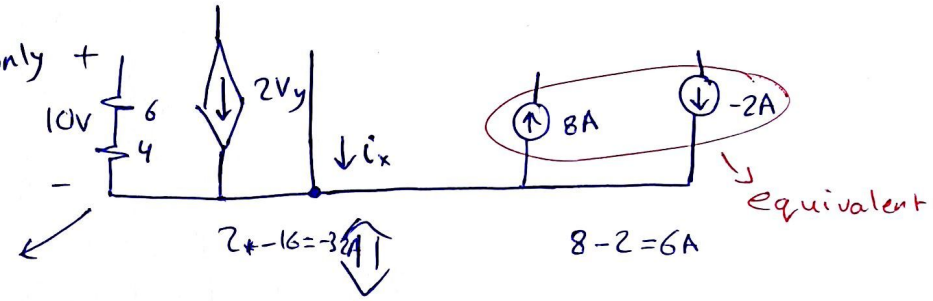
ولأن 8Ω // 4Ω فنفس الفولتية

أو منطلع R_{xeq} و بعدها Ohm's law

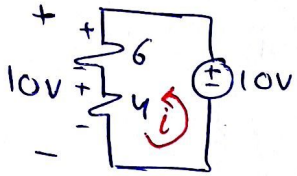
$V_{4\Omega} = R_x * 8$

Problem #3

① find i_x using KCL only +

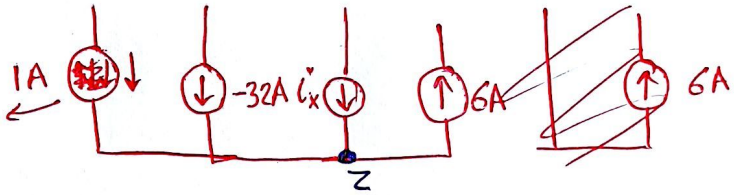


$V_y = -16V$



$-10 + 4i + 6i = 0$

$i = 1A$ ↓



Now find i_x

KCL #2 $i_{in} = i_{out}$

$i_x - 32 + 1 = 6$

$\boxed{i_x = 37A}$

Problem #4

$20i_1 - 40i_2 - 5i_3 = V_1$

$-15i_1 + 65i_2 - 25i_3 = -V_2$

$-5i_1 - 25i_2 + 35i_3 = 0$

② Mesh2

$0 = R_3(i_2 - i_3) + V_2 + 25i_2 + 15(i_2 - i_1)$ (R_2)

$-V_2 = i_2(R_3 + 15 + 25) + i_1(-15) + i_3(-R_3)$

$65i_2 = R_3 + 40$

$\boxed{R_3 = 25}$ ⟷ $\boxed{R_3 = 25\Omega}$

$-25i_3 = -R_3 i_3$

وقارن بـ equations طلع الـ ① Mesh1:

$R_1(i_1 - i_3) + R_2(i_1 - i_2) - 25i_2 - V_1 = 0$

$V_1 = R_1(i_1 - i_3) + R_2(i_1 - i_2) - 25i_2$

$20i_1 = (R_1 + R_2)i_1$

$-40i_2 = -R_2 i_2 - 25i_2$

$-5i_3 = -R_1 i_3$

$\boxed{R_1 = 5\Omega}$

$\boxed{R_2 = 15\Omega}$

② Mesh3

$0 = R_4 i_3 + 25(i_3 - i_2) + 5(i_3 - i_1)$

$-5i_1 - 25i_2 + 35i_3 = i_3(R_4 + 25 + 5) + i_1(-5) + i_2(-25)$

$35 = R_4 + 25 + 5$

$\boxed{R_4 = 5\Omega}$

$R_1 = 5\Omega$

$R_2 = 15\Omega$

$R_3 = 25\Omega$

$R_4 = 5\Omega$

Problem #5

@ Node 1

$$\frac{V_1 - V_2}{12.5} + 5 = 0$$

$$\frac{V_1}{12.5} - \frac{V_2}{12.5} = -5$$

@ Node 2

$$V_2 = 150\,V$$

@ Node 3

$$\frac{V_3 - V_4}{10} + \frac{V_3}{20} = 0$$

$$V_3\left(\frac{1}{10}+\frac{1}{20}\right) - V_4\left(\frac{1}{10}\right) = 0$$

@ Node 4

$$\frac{V_4 - V_3}{10} + 10 + \frac{V_4}{25}$$

$$V_4\left(\frac{1}{10}+\frac{1}{25}\right) - V_3\left(\frac{1}{10}\right) = -10$$

$$V_1 - V_3 = 100\,V$$

Super node (1-3)

$$\frac{V_1}{12.5} - \frac{V_2}{12.5} + V_3\left(\frac{1}{10}+\frac{1}{20}\right) - V_4\left(\frac{1}{10}\right) = -5$$

$$V_1 - V_3 = 100\,V$$

$$\boxed{\frac{1}{12.5}}V_1 + \boxed{-\frac{1}{12.5}}V_2 + \boxed{\frac{1}{10}+\frac{1}{120}}V_3 + \boxed{-\frac{1}{10}}V_4 = \boxed{-5}$$

$$\boxed{1}V_1 + \boxed{0}V_2 + \boxed{-1}V_3 + \boxed{0}V_4 = \boxed{100}$$

$$\boxed{0}V_1 + \boxed{1}V_2 + \boxed{0}V_3 + \boxed{0}V_4 = \boxed{150}$$

$$\boxed{0}V_1 + \boxed{0}V_2 + \boxed{-\frac{1}{10}}V_3 + \boxed{\frac{1}{10}+\frac{1}{25}}V_4 = \boxed{-10}$$