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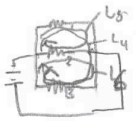
PSP Homework 21 7/8/20

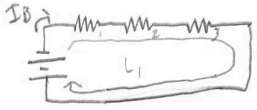
PSP: This assignment is designed to test your understanding of the current chapter's content. You will be required to solve the problem AND briefly explain your solution using the model provided. Answering the question without explanation will result in a grade of 20% for the assignment.

1) There are 4 possible circuits that can be created from 3 resistors. [Note: Use the circuits from class notes to guide your efforts] Create these four circuits, each with a 10V battery and three, 25Ω resistors. For each circuit, …
   1) Determine the total equivalent resistance and the current coming from the battery
   2) Write the Kirchoff's Law Equations for these circuits.
   3) Find Current, Voltage and Power for each resistor.



Circuits

3 series



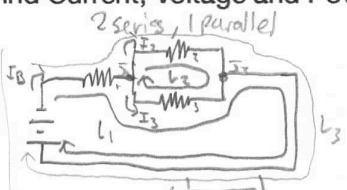
1) $R_{Total} = R_1 + R_2 + R_3$
$= 25 + 25 + 25$
$= 75\,\Omega$

$V = IR$
$I = \frac{V}{R} = \frac{10}{75} = 0.1\overline{3}\,A$

2) loop: $V - I_B R_1 - I_B R_2 - I_B R_3 = 0$
Junction: None

3) In series $I_1 = I_2 = I_3$
$V = IR$
$P = IV$
Resistor$_1$: $I = 0.1\overline{3}\,A$
$V = IR = 0.1\overline{3} \cdot 25 = 3.\overline{33}\,V$
$P = IV = 0.1\overline{3} \cdot 3.\overline{33} = 0.4\overline{4}\,W$
Resistors 2,3: Same as Resistor$_1$ because they are in series and have the same resistance

2 series, 1 parallel



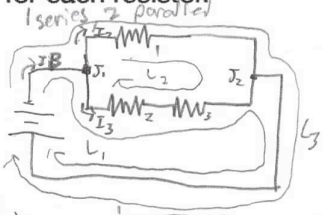
1) $R_{Total} = R_1 + \left(\frac{1}{\frac{1}{R_2} + \frac{1}{R_3}}\right)$
$= 25 + \frac{1}{\frac{1}{25} + \frac{1}{25}}$
$= 37.5\,\Omega$

$V = IR$
$I = \frac{V}{R} = \frac{10}{37.5} = 0.2\overline{6}\,A$

2) Loop: $V - I_B R_1 - I_3 R_3 = 0$ (L_1)
$-I_2 R_2 + I_3 R_3 = 0$ (L_2)
$V - I_B R_1 - I_2 R_2 = 0$ (L_3)
Junction: $I_2 + I_3 = I_B$ (J_2)
$I_B = I_2 + I_3$ (J_1)

3)
Resistor$_1$: $I = 0.2\overline{6}\,A$
$V = IR = 0.2\overline{6} \cdot 25 = 6.\overline{6}\,V$
$P = IV = 0.2\overline{6} \cdot 6.66 = 1.7\overline{7}\,W$
Resistor$_2$: $V - I_B R_1 - I_2 R_2 = 0$
$V = I_B R_1 + I_2 R_2$
$10 = 0.26 \cdot 25 + I_2 25$
$I_2 = 0.1\overline{3}\,A$
$V = IR = 0.1\overline{3} \cdot 25 = 3.\overline{33}\,V$
$P = IV = 0.1\overline{3} \cdot 3.\overline{33} = 0.4\overline{4}\,W$
Resistor$_3$: $I_B = I_2 + I_3$
$I_3 = I_B - I_2$
$= 0.2\overline{6} - 0.1\overline{3} = 0.1\overline{3}\,A$
$V = IR = 0.1\overline{3} \cdot 25 = 3.\overline{33}\,V$
$P = IV = 0.1\overline{3} \cdot 3.\overline{33} = 0.4\overline{4}\,W$

1 series 2 parallel



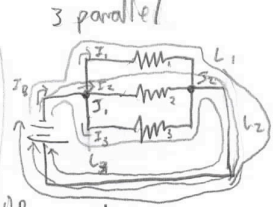
1) $R_{Total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2 + R_3}}$
$= \frac{1}{\frac{1}{25} + \frac{1}{25+25}}$
$= 16.6\overline{6}\,\Omega$

$V = IR$
$I = \frac{V}{R} = \frac{10}{16.6\overline{6}} = 0.6\,A$

2) Loop: $V - I_3 R_2 - I_3 R_3 = 0$ (L_1)
$-I_2 R_1 + I_3 R_3 + I_3 R_2 = 0$ (L_2)
$V - I_2 R_1 = 0$ (L_3)
Junction: $I_2 + I_3 = I_B$ (J_2)
$I_B = I_2 + I_3$ (J_1)

3)
Resistor$_1$: $V - I_2 R_1 = 0$
$I_2 R_1 = V$
$I_2 \cdot 25 = 10$
$I_2 = 0.4\,A$
$V = IR = 0.4 \cdot 25 = 10V$
$P = IV = 0.4 \cdot 10 = 4W$
Resistor$_2$: $-I_2 R_1 + I_3 R_3 + I_3 R_2 = 0$
$I_3(R_3 + R_2) = I_2 R_1$
$I_3(25+25) = 0.4(25)$
$I_3 = 0.2\,A$
$V = IR = 0.2 \cdot 25 = 5\,V$
$P = IV = 0.2 \cdot 5 = 1W$
Resistor$_3$: Same as Resistor$_1$ because they are in series and have the same voltage

3 parallel



1) $R_{Total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$
$= \frac{1}{\frac{1}{25} + \frac{1}{25} + \frac{1}{25}}$
$= 8.\overline{3}\,\Omega$

$V = IR$
$I = \frac{V}{R} = \frac{10}{8.\overline{3}} = 1.2\,A$

2) Loop: $V - I_1 R_1 = 0$ (L_1)
$V - I_2 R_2 = 0$ (L_2)
$V - I_3 R_3 = 0$ (L_3)
$-I_1 R_1 + I_3 R_3 = 0$ (L_4)
$-I_1 R_1 + I_2 R_2 = 0$ (L_5)
$-I_2 R_2 + I_3 R_3 = 0$ (L_6)
Junction: $I_B = I_1 + I_2 + I_3$ (J_1)
$I_1 + I_2 + I_3 = I_B$ (J_2)

3)
Resistor$_1$: $V - I_1 R_1 = 0$
$V = I_1 R_1$
$10 = I_1 \cdot 25$
$I_1 = 0.4\,A$
$V = IR = 0.4 \cdot 25 = 10V$
$P = IV = 0.4 \cdot 10 = 4W$
Resistor$_2$: $V - I_2 R_2 = 0$
$V = I_2 R_2$
$10 = I_2 \cdot 25$
$I_2 = 0.4\,A$
$V = IR = 0.4 \cdot 25 = 10V$
$P = IV = 0.4 \cdot 10 = 4W$
Resistor$_3$: $V - I_3 R_3 = 0$
$V = I_3 R_3$
$10 = I_3 \cdot 25$
$I_3 = 0.4\,A$
$V = IR = 0.4 \cdot 25 = 10V$
$P = IV = 0.4 \cdot 10 = 4W$

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