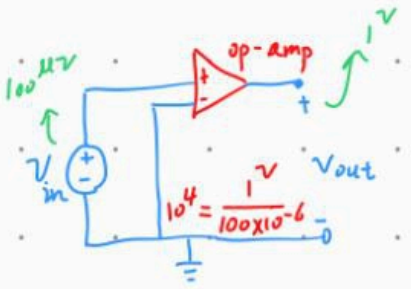
Lecture 4

$V_s = \alpha V_x$

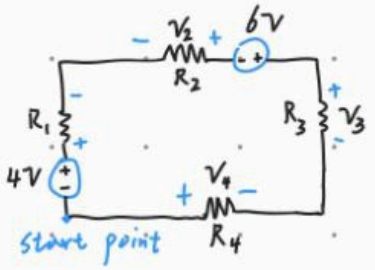
↓

unitless

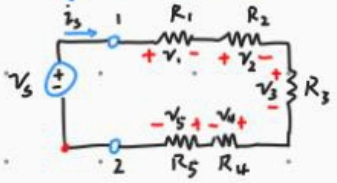


$+4^V - V_1 + V_2 + 6 - V_3 + V_4 =$

$-4^V + V_1 - V_2 - 6^V + V_3 - V_4 = 0$



Equivalent Circuit:



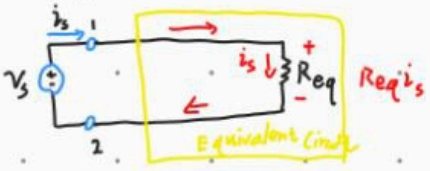
$-V_2 = +V_2$

KVL: $-V_s + V_1 + V_2 + V_3 + V_4 + V_5 = 0$

$-V_s + R_1 i_s + R_2 i_s + R_3 i_s + R_4 i_s + R_5 i_s = 0$

$V_s = (R_1 + R_2 + R_3 + R_4 + R_5)\, i_s$

Original circuit:



KVL: $-V_s + R_{eq} i_s = 0$

$V_s = R_{eq} i_s$

$R_{eq} = R_1 + R_2 + \cdots + R_5 > R_1$

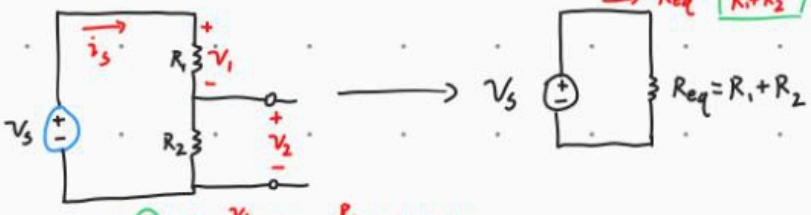
R_2

R_3

$\vdots$

R_5

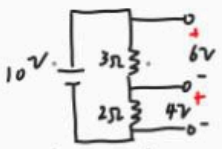
Voltage Divider:



$i = \frac{V_s}{R_{eq}} = \frac{V_s}{R_1 + R_2}$

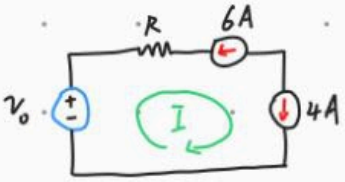
$V_1 = R_1 i = R_1 \frac{V_s}{R_1 + R_2} = \frac{R_1}{R_1 + R_2} V_s < V_s$

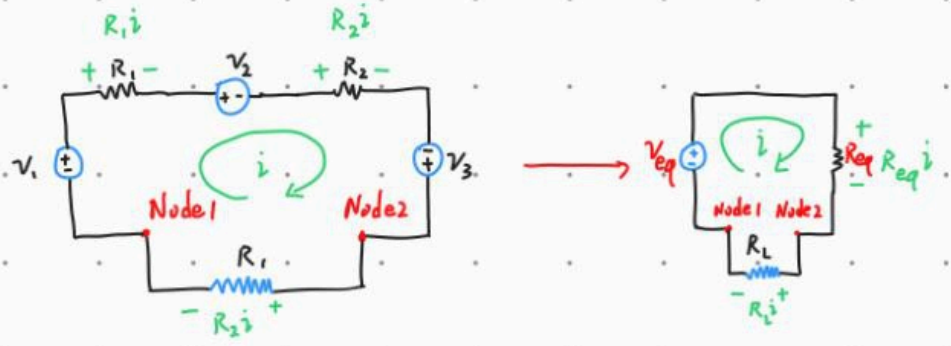
$V_2 = R_2 i = R_2 \frac{V_s}{R_1 + R_2} = \frac{R_2}{R_1 + R_2} V_s < V_s$



$v_1 = R_1 i = 10\left(\frac{3\Omega}{5\Omega}\right) = 6^{V}$

$v_2 = R_2 i = 10\left(\frac{2\Omega}{5\Omega}\right) = 4^{V}$





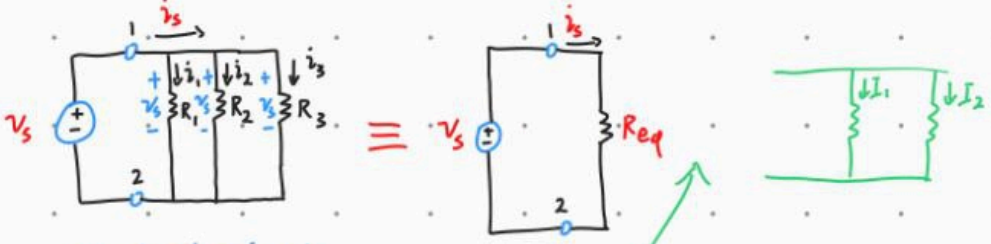
$-v_1 + R_1 i + v_2 + R_2 i - v_3 + R_L i = 0$

$-(v_1 - v_2 + v_3) + (R_1 + R_2) i +$

$-v_{eq} + R_{eq} i + R_L i = 0$

$v_{eq} = (v_1 - v_2 + v_3)$

$R_{eq} = (R_1 + R_2)$



KCL: $i_s = i_1 + i_2 + i_3$

$i_s = \frac{v_s}{R_1} + \frac{v_s}{R_2} + \frac{v_s}{R_3}$

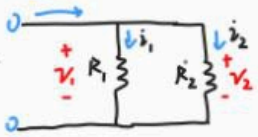
$i_s = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) v_s$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$R_{eq} < R_1$
R_2
R_3

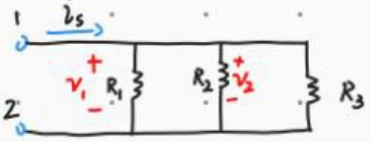
$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R_1 R_2}$

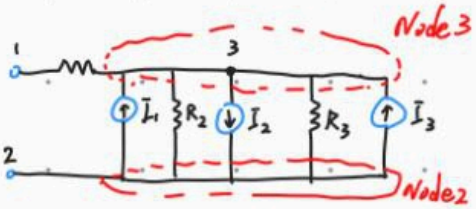
$R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \underbrace{\frac{R_2}{R_1 + R_2}}_{<1} \cdot R_1 < R_2 = \underbrace{\frac{R_1}{R_1 + R_2}}_{<1} R_2 < R_2$

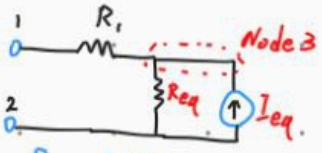


* Voltage Division :

* Current Division :



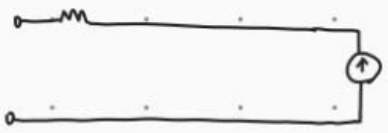


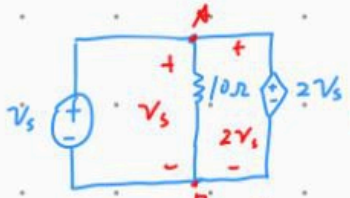


$R_{eq} = R_2 \parallel R_3$

$I_{eq} = I_1 - I_2 + I_3$

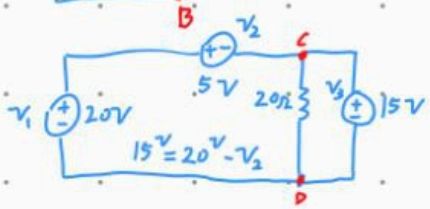
$I'_{eq} = I_2 - I_1 - I_3$





$V_s \neq 2V_s$

NOT ALLOWED!



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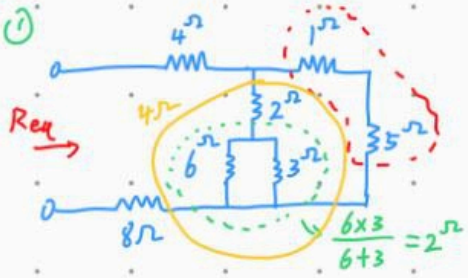
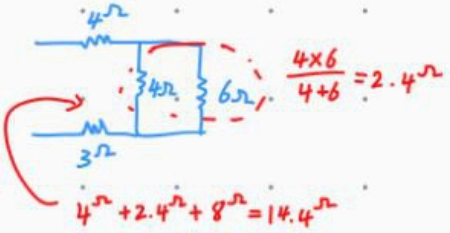
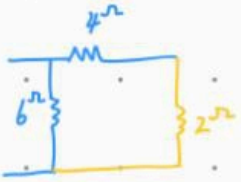
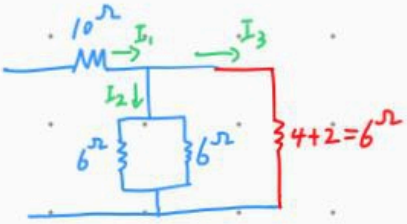




$\frac{R_0 \times R_0}{R_0 + R_0} = \frac{R_0^2}{2R_0} = \frac{R_0}{2}$

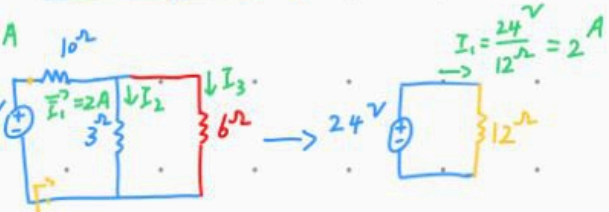


$R_{eq} = 6\Omega \,||\, (4\Omega + 2\Omega)$



$I_2 = \frac{6\Omega}{6\Omega + 3\Omega} 2A = \frac{4}{3} A$

$I_3 = \frac{3\Omega}{6+3} 2A = \frac{2}{3} A$



$R_{eq} = 10\Omega + (3 \,||\, 6) = 10 + 2 = 12\Omega$