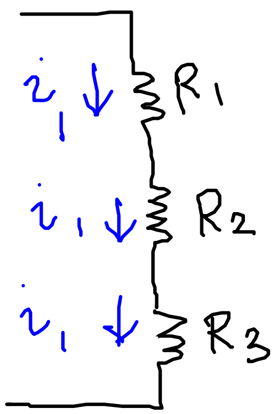
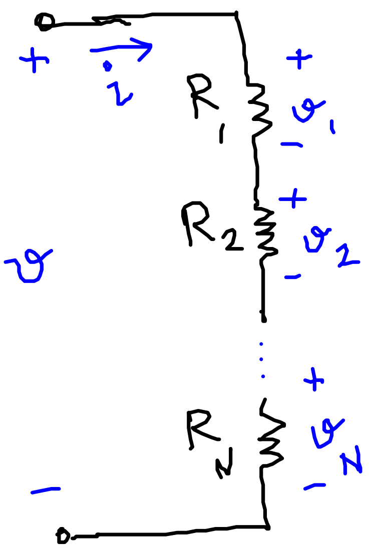
Resistances in series:



same current flows through all of the resistances in series

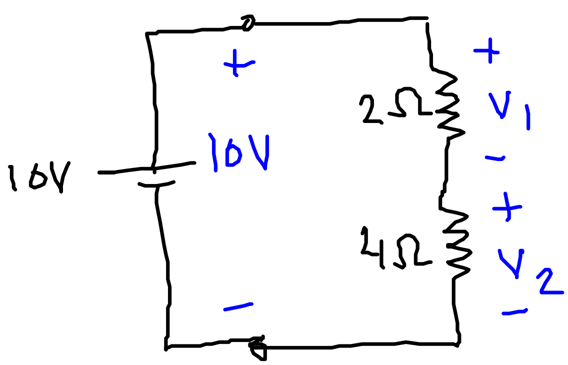
Voltage division



$$v_1 = \frac{R_1}{R_1 + R_2 + \cdots + R_N} v$$

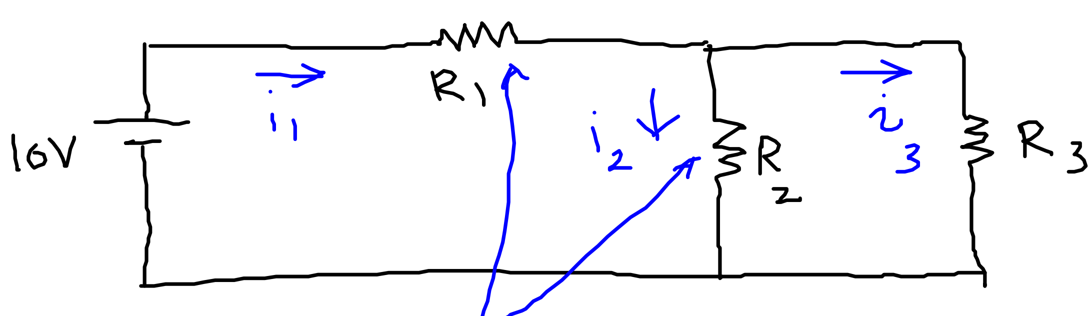
$$v_2 = \frac{R_2}{R_1 + R_2 + \cdots + R_N} v$$

$$\vdots$$



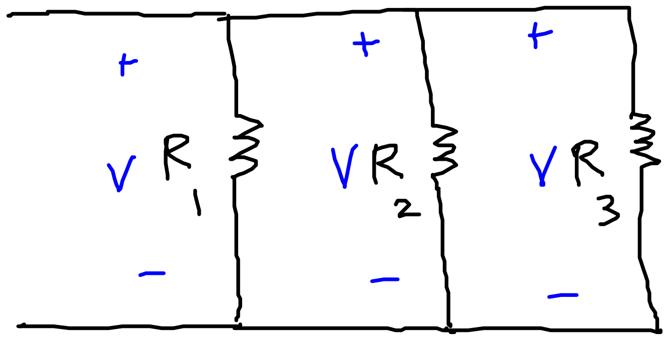
$$V_1 = \frac{2}{2+4} 10V = \frac{20}{6} V$$

$$V_2 = \frac{4}{2+4} 10V = \frac{40}{6} V$$



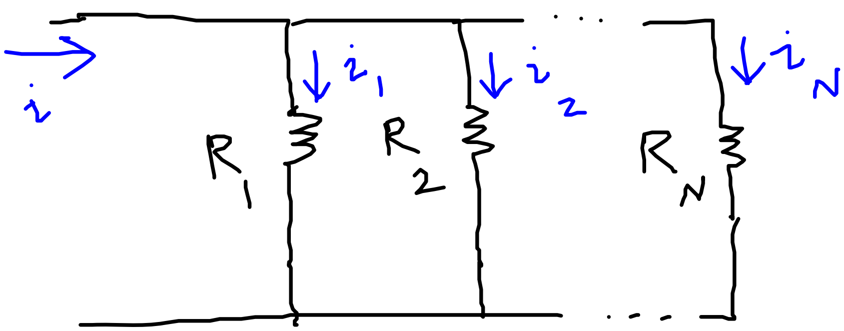
$i_1 \neq i_2 \therefore$ not in series – can not use voltage division

Parallel Resistors



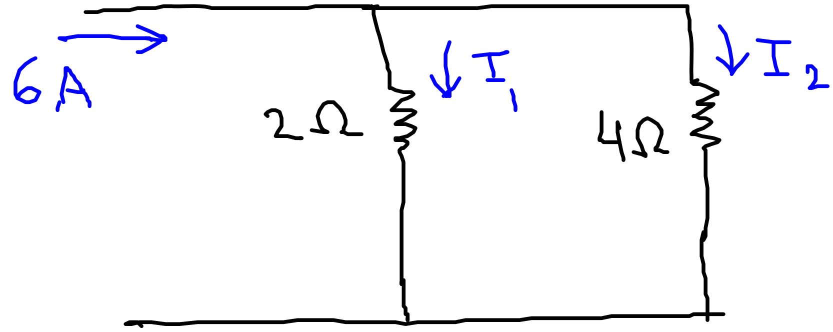
Same voltage across them

Current Division Rule



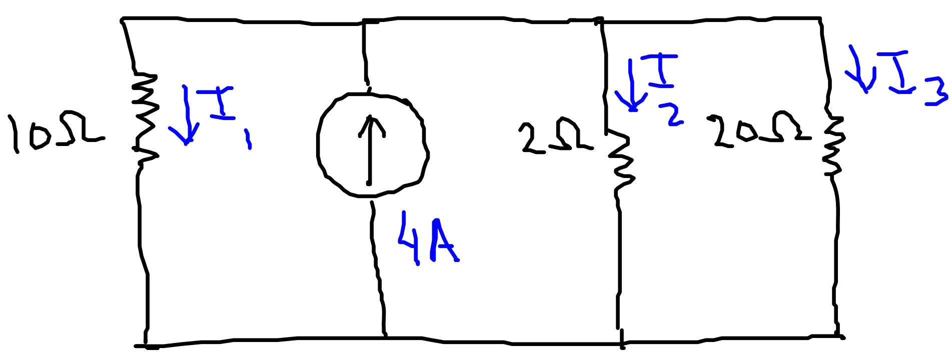
$$i_1 = \frac{\frac{1}{R_1}}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N}}\, i = \frac{G_1}{G_1 + G_2 + \cdots + G_N}\, i$$

$$i_2 = \frac{\frac{1}{R_2}}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N}}\, i = \frac{G_2}{G_1 + G_2 + \cdots + G_N}\, i$$



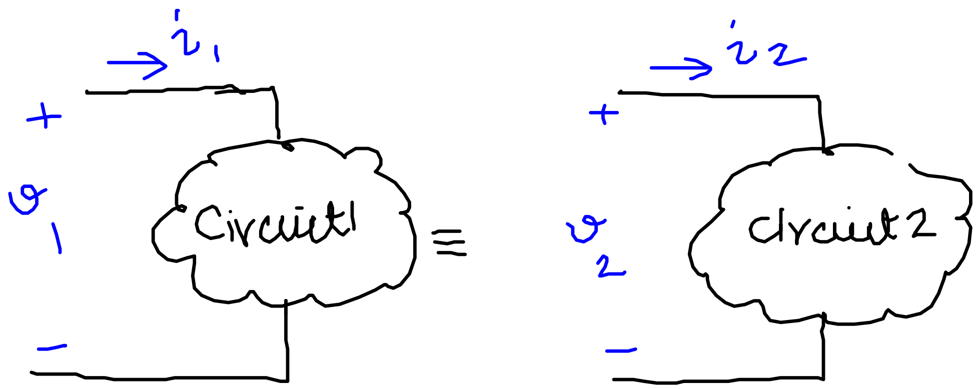
$$I_1 = \frac{\frac{1}{2}}{\frac{1}{2}+\frac{1}{4}} 6A = 4A$$

$$I_2 = \frac{\frac{1}{4}}{\frac{1}{2}+\frac{1}{4}} 6A = 2A$$



$$I_1 = \frac{\frac{1}{10}}{\frac{1}{10}+\frac{1}{2}+\frac{1}{20}} 4A = 0.6154A$$

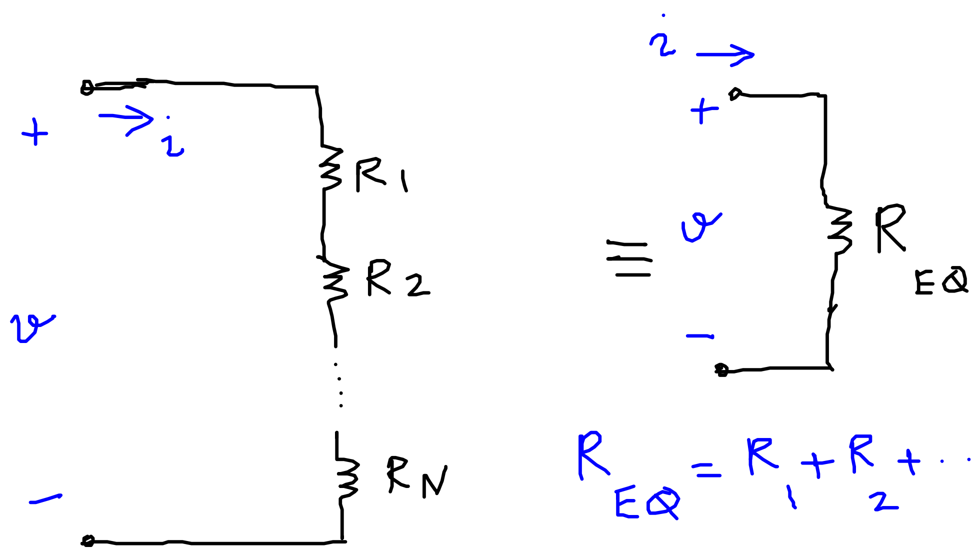
Equivalent Circuits



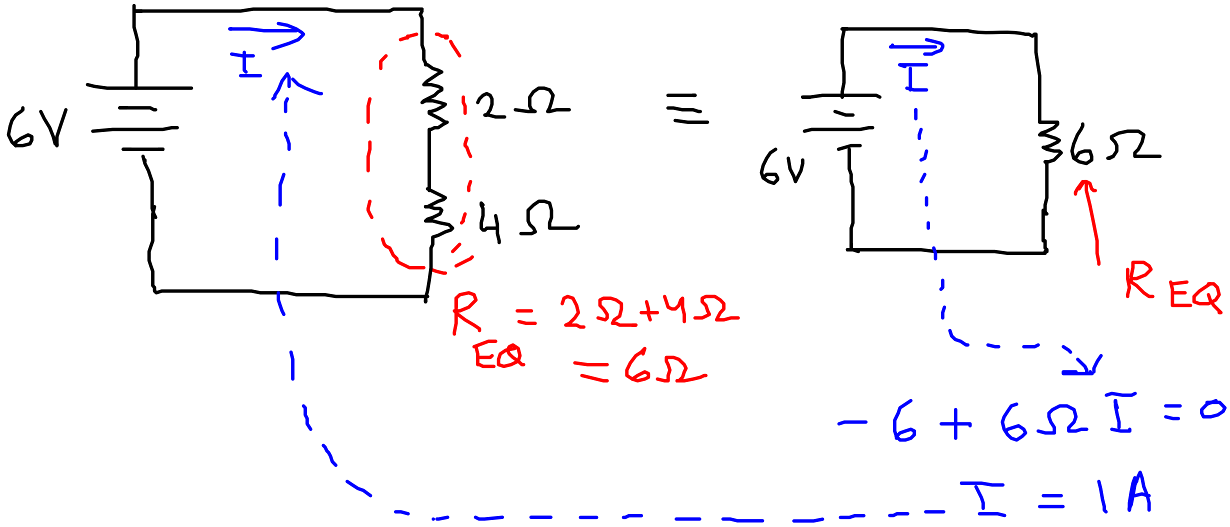
circuit 1 & circuit 2 are equivalent

if $v_1 = v_2$ & $i_1 = i_2$

Series resistance



$$R_{EQ} = R_1 + R_2 + \cdots + R_N$$

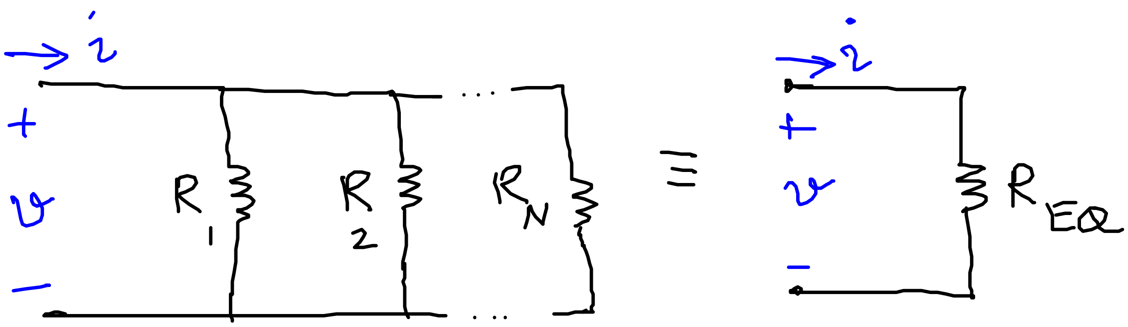


$$R_{EQ} = 2\Omega + 4\Omega = 6\Omega$$

$$-6 + 6\Omega\, I = 0$$

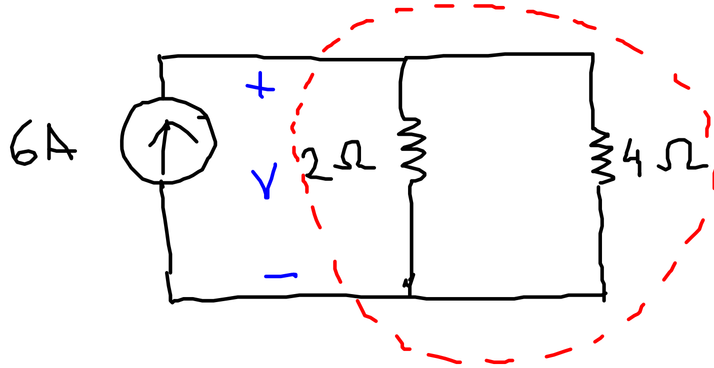
$$I = 1A$$

Parallel Resistances



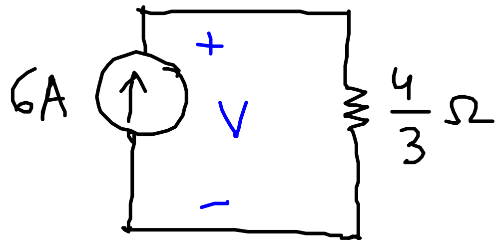
$$\frac{1}{R_{EQ}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_N}$$

$$G_{EQ} = G_1 + G_2 + \cdots + G_N$$



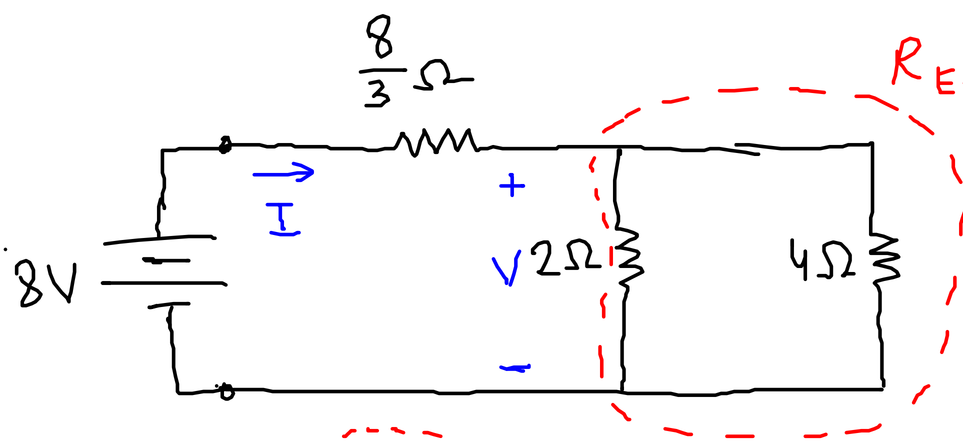
$$\frac{1}{R_{EQ}} = \frac{1}{2\Omega} + \frac{1}{4\Omega}$$

$$R_{EQ} = \frac{4}{3}\,\Omega$$

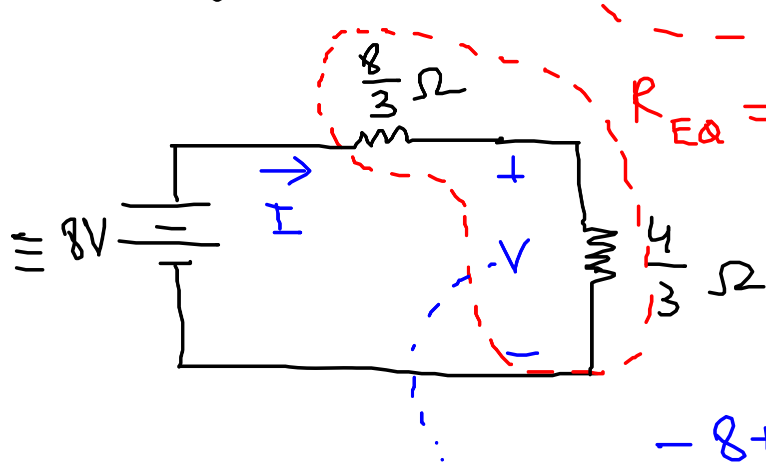


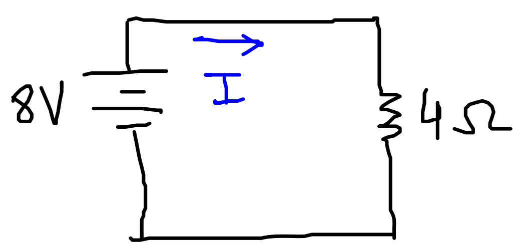
$$V = \frac{4}{3}\Omega \times 6A = 8V$$

$$R_{EQ} = \frac{4}{3}\,\Omega$$



$$R_{EQ} = 4\,\Omega$$

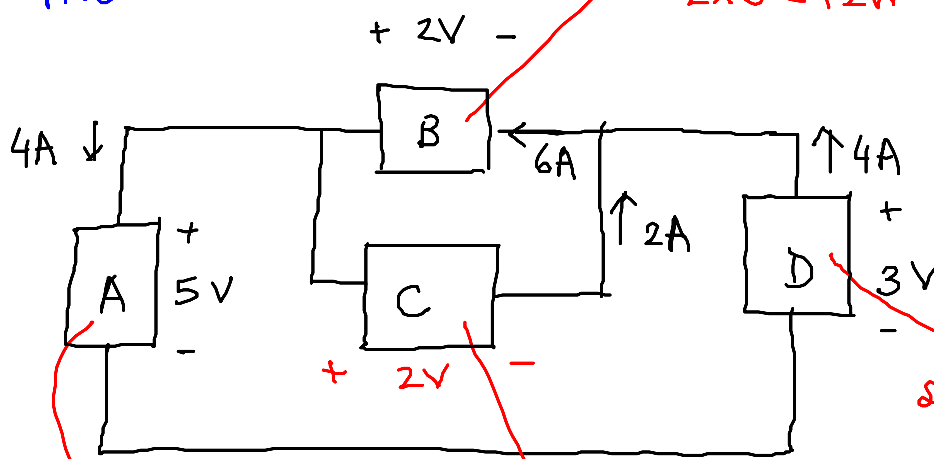




$$-8 + 4\Omega\, I = 0 \qquad I = 2A$$

$$V = \frac{4}{3}\Omega \times I = \frac{4}{3}\Omega \times 2A = \frac{8}{3}V$$

Prob



Determine power being consumed or supplied

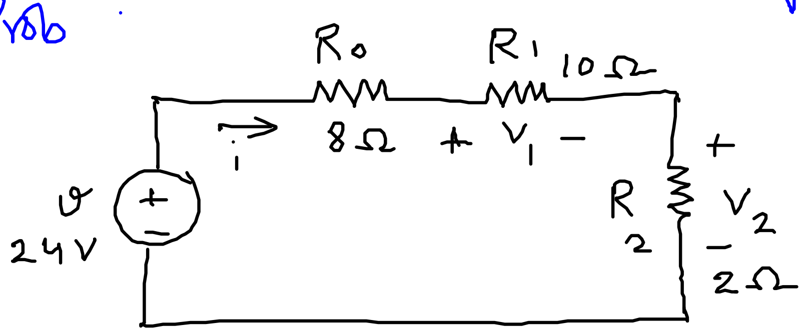
B: supplying power $2 \times 6 = 12W$

A: consuming power $4 \times 5 = 20W$

C: consuming power $2V \times 2A = 4W$

D: supplying power $4 \times 3 = 12W$

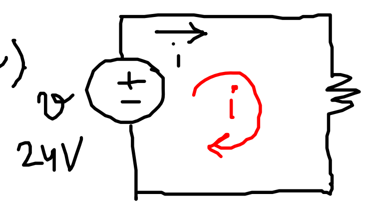
Prob



V_1? V_2?

Determine power supplied by the voltage source

a)



$R_{eq} = 8 + 10 + 2 = 20\Omega$

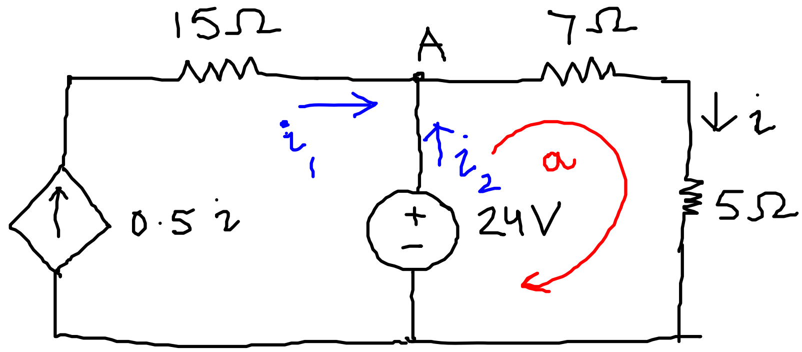
b) ① $-24V + i\,20\Omega = 0$ $\quad i = 1.2A$

c) $24V \times 1.2A = 28.8W$

d) $V_1 = i \times R_1 = 1.2A \times 10\Omega = 12V$

$V_2 = i \times R_2 = 1.2A \times 2\Omega = 2.4V$

Prob.



Determine Power delivered by the independent source

ⓐ $-24V + 7i + 5i = 0$

$i = \frac{24V}{12\Omega} = 2A$

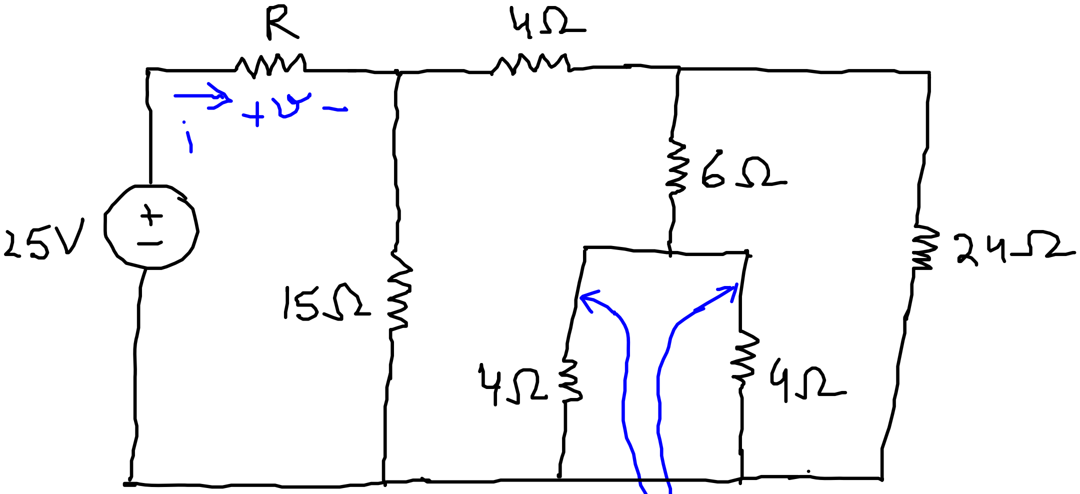
$i_1 = 0.5i = 0.5 \times 2 = 1A$

KCL at A: $i_1 + i_2 - i = 0$

$i_2 = i - i_1 = 2A - 1A = 1A$

Power delivered by the ind. source $= 24V \times i_2 = 24W$

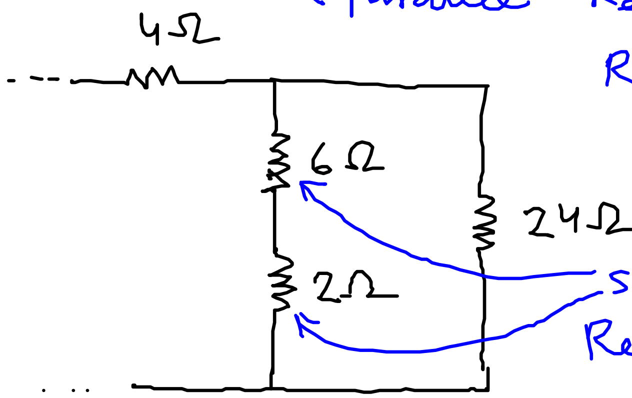
Prob.



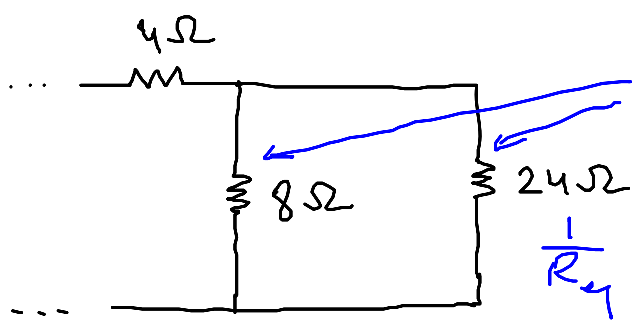
Given:
Power consumed by the 15 Ω resistance = 15W
Determine R

Parallel $\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{4}$

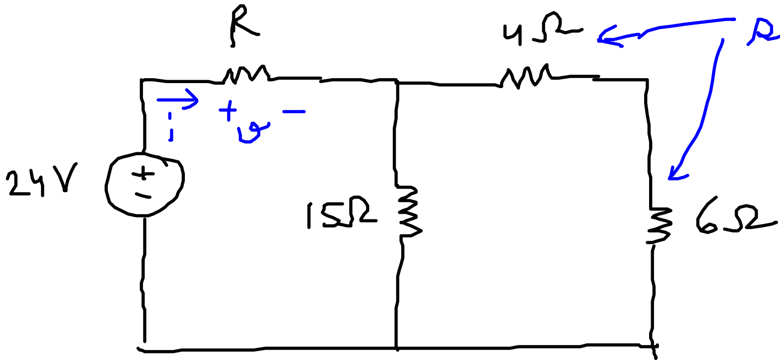
$R_{eq} = 2\Omega$



series
$R_{eq} = 6\Omega + 2\Omega$
$= 8\Omega$

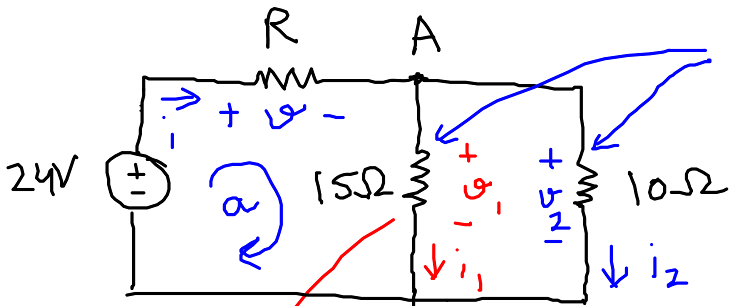


parallel
$\frac{1}{R_{eq}} = \frac{1}{8} + \frac{1}{24}$
$R_{eq} = 6\Omega$



series

$R_{eq} = 4 + 6 = 10\,\Omega$



parallel

$$\frac{1}{R_{eq}} = \frac{1}{15\,\Omega} + \frac{1}{10\,\Omega}$$

$R_{eq} = 6\,\Omega$

ohms Law

$$P = i_1 v_1 = \left(\frac{1}{15\,\Omega} v_1\right) v_1 = \frac{v_1^2}{15\,\Omega}$$

$$15\,W = \frac{v_1^2}{15\,\Omega} \qquad v_1 = 15\,V$$

$$i_1 = \frac{1}{15\,\Omega} v_1 = 1A$$

$$v_2 = v_1 = 15\,V$$

$$i_2 = \frac{1}{10\,\Omega} v_2 = 1.5\,A$$

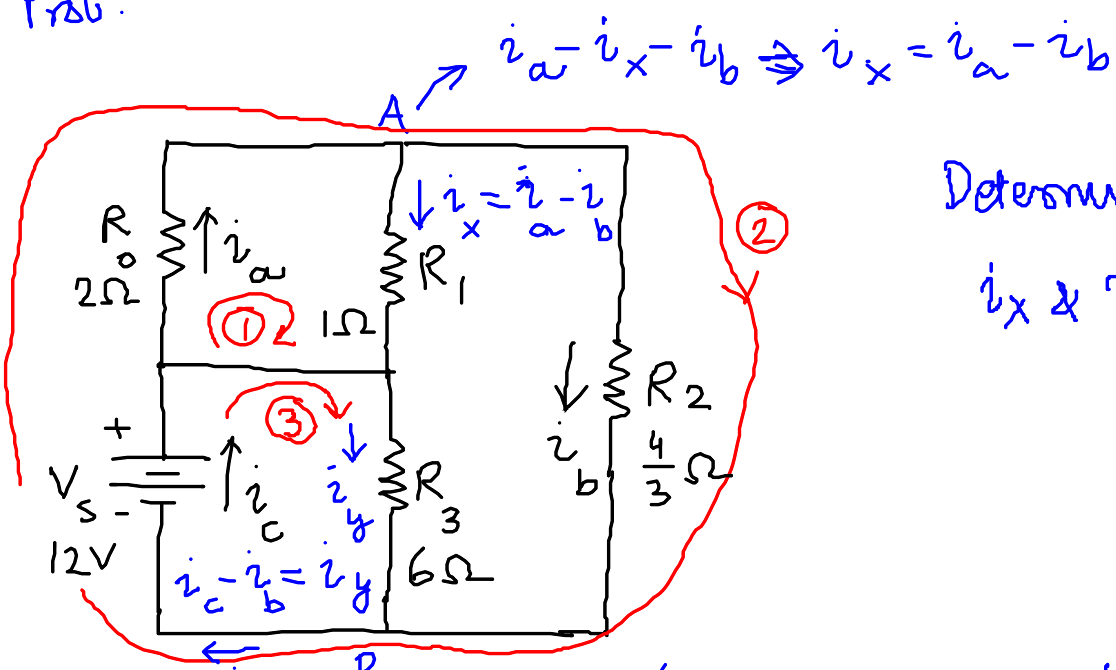
KCL at A: $i - i_1 - i_2 = 0 \qquad i = i_1 + i_2$

$$i = 1A + 1.5A = 2.5A$$

KVL a: $-24 + v + 15 = 0 \qquad v = 9V$

$$R = \frac{v}{i} = \frac{9V}{2.5A} = 3.6\,\Omega$$

Prob.



Determine i_x & i_y

$-i_c + i_y + i_b = 0 \quad i_y = i_c - i_b$

Three unknowns: i_a, i_b & i_c

KVL ①: $i_a 2\Omega + 1\Omega(i_a - i_b) = 0$

$i_b = 3 i_a$

KVL ②: $-12V + 2 i_a + \frac{4}{3} i_b = 0$

$-12V + 2 i_a + 4 i_a = 0$

$i_a = 2A$

$i_b = 3 \times 2 = 6A$

KVL ③: $-12V + 6 i_y = 0$

$$-12V + 6(i_c - i_b) = 0$$

(i_b = 6A)

$$-12V + 6 i_c - 36V = 0$$

$$6 i_c = 48V$$

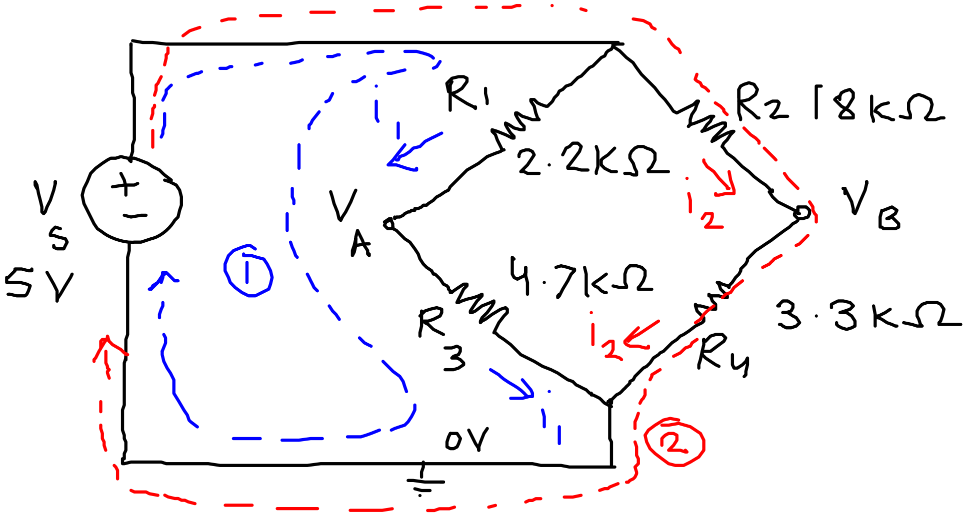
$$i_c = 8A$$

$$i_x = i_a - i_b = 2A - 6A = -4A$$

$$i_y = i_c - i_b = 8A - 6A = 2A$$

Prob.

Determine $V_A - V_B$



KVL ①: $-5 + 2.2K\,i_1 + 4.7k\Omega\,i_1 = 0$

$$i_1 = \frac{5V}{6.9k\Omega} = \frac{5}{6.9}\,mA$$

KVL ②: $-5 + 18K\,i_2 + 3.3k\,i_2 = 0$

$$i_2 = \frac{5V}{21.3k\Omega} = \frac{5}{21.3}\,mA$$

$$V_A - 0 = R_3 i_1 = 4.7k\Omega \times \frac{5}{6.9}mA = 3.4V$$

$$V_B - 0 = R_4 i_2 = 3.3k\Omega \times \frac{5}{21.3}mA = 0.77V$$

$$V_A - V_B = 3.4V - 0.77V = 2.63V$$