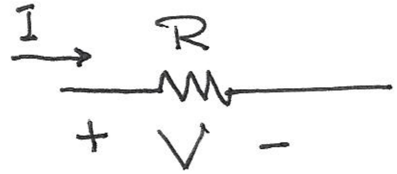
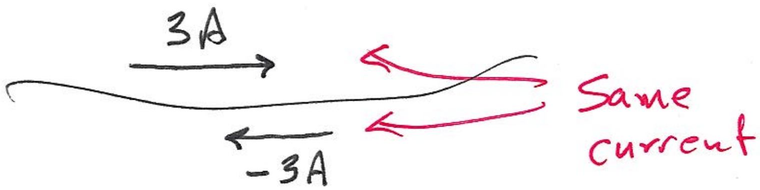
Resistors





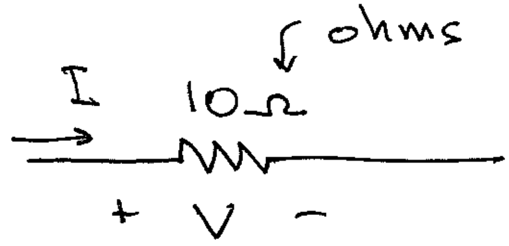
Passive Sign Convention

⇒ **always** absorb power

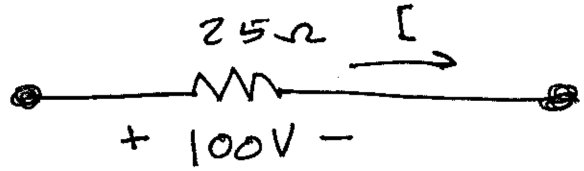
$P = V I$

V and I satisfy Ohm's Law

$V = R \cdot I$



If $I = 3A$, then $V = R \cdot I = 10 \cdot 3 = 30V$



$V = RI \Rightarrow I = \frac{V}{R} = \frac{100}{25} = 4A$

Alternately,

$I = GV$

↑ conductance

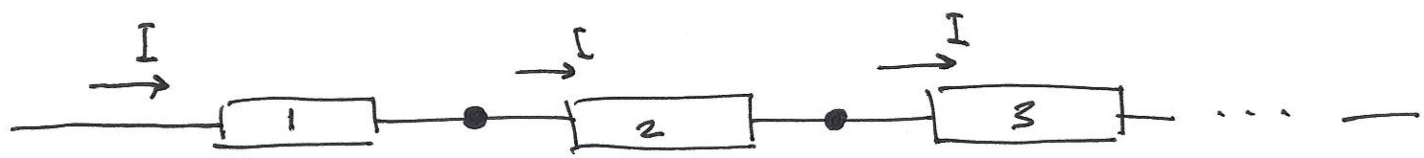
$G = \frac{1}{R}$

mhos
℧
Siemens
S

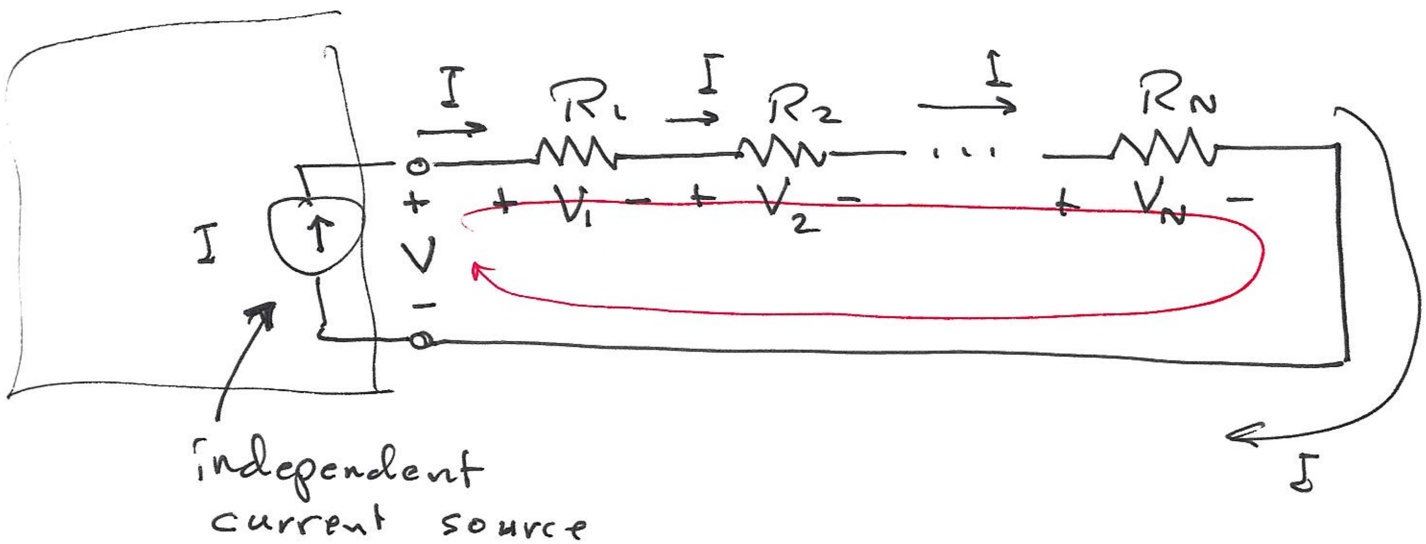
For this problem:

$G = \frac{1}{R} = \frac{1}{25} = .04\,S$

$= 40\,mS$



Connected in series



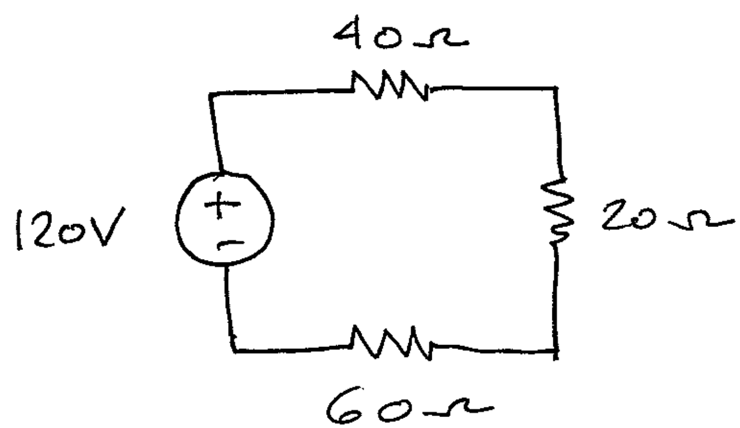
KVL: $-V + V_1 + V_2 \cdots + V_N = 0$

$$V = V_1 + V_2 + \cdots + V_N$$

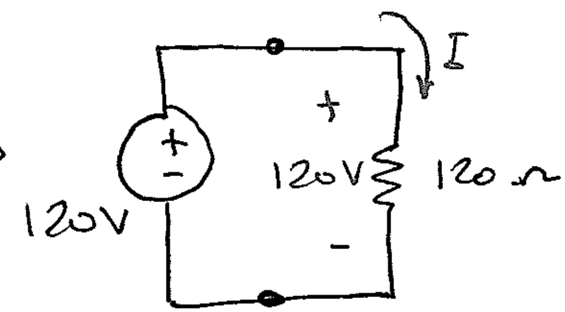
$$V = R_1 I + R_2 I + \cdots + R_N I$$

$$V = \underbrace{(R_1 + R_2 + \cdots + R_N)}_{R_{eq}} I$$

For resistors in series, $R_{eq} = R_1 + \cdots + R_N$

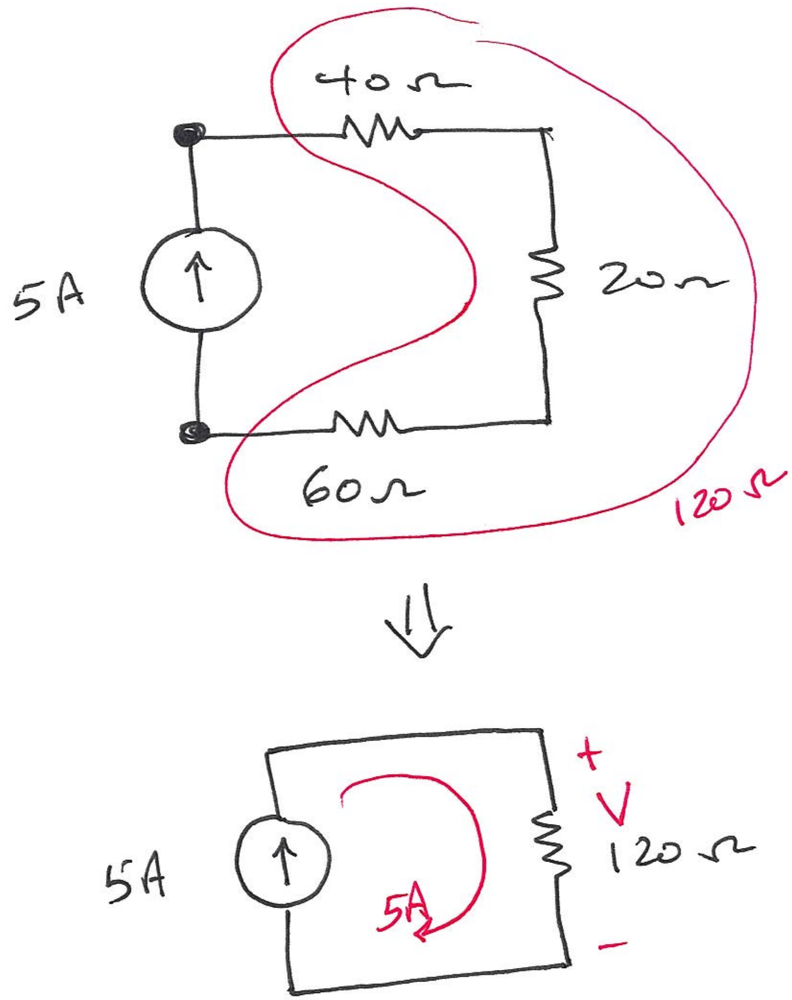


⇒



$$R_{eq} = 40 + 20 + 60 = 120\,\Omega$$

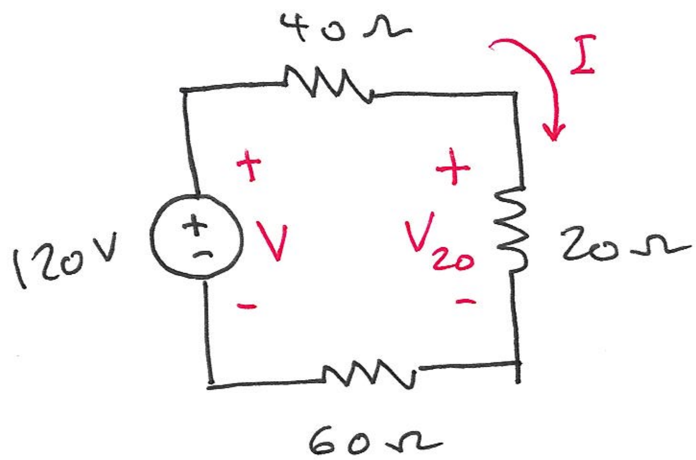
$$I = \frac{V}{R} = \frac{120}{120} = 1A$$



$$V = RI$$

$$= (120\,\Omega)(5\,A)$$

$$= 600\,V$$

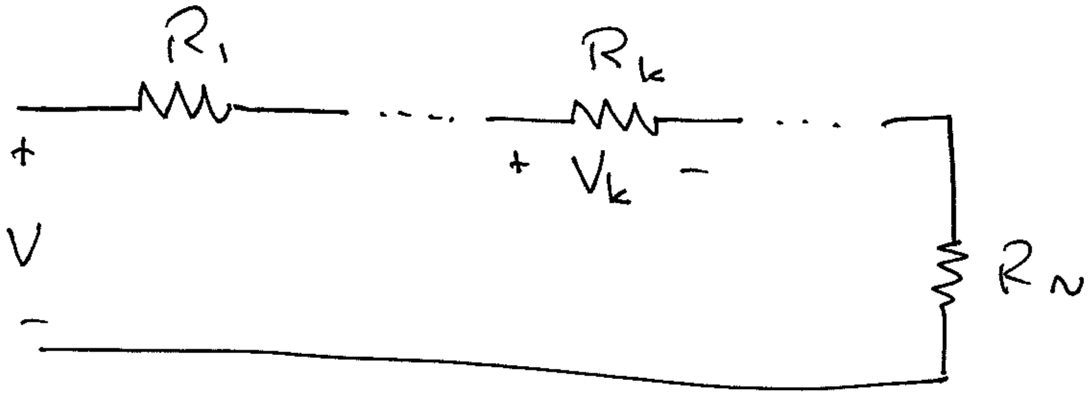


$$V = \underbrace{(40 + 20 + 60)}_{R_{eq}} I$$

$$V_{20} = 20\, I$$

$$\frac{V_{20}}{V} = \frac{20\, I}{(40 + 20 + 60)\, I} = \frac{20}{40 + 20 + 60} = \frac{1}{6}$$

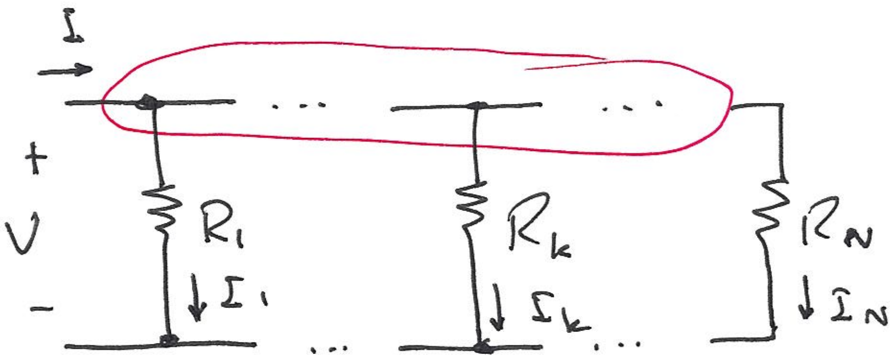
$$V_{20} = \frac{1}{6} V = \frac{1}{6} \cdot 120V = 20\, V$$



$$\frac{V_k}{V} = \frac{R_k}{R_1 + \cdots + R_k + \cdots + R_N}$$

Voltage Divider Equation

$$\frac{V_k}{V} = \frac{R_k}{R_{eq}}$$



parallel connection

All are connected to the same pair of nodes

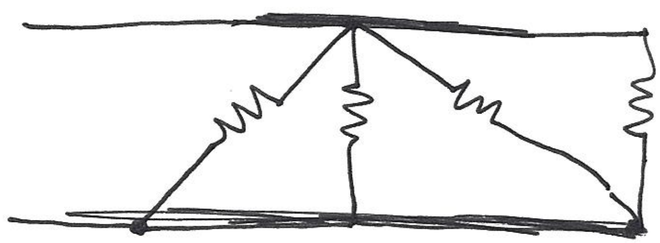
$$I_1 = \frac{V}{R_1} = G_1 V$$

$$\vdots$$

$$I_k = \frac{V}{R_k} = G_k V$$

$$\vdots$$

$$I_N = \frac{V}{R_N} = G_N V$$



$$I = I_1 + \cdots + I_k + \cdots + I_N$$

$$= G_1 V + \cdots + G_k V + \cdots + G_N V$$

$$= \underbrace{(G_1 + \cdots + G_k + \cdots + G_N)}_{G_{eq}} V$$

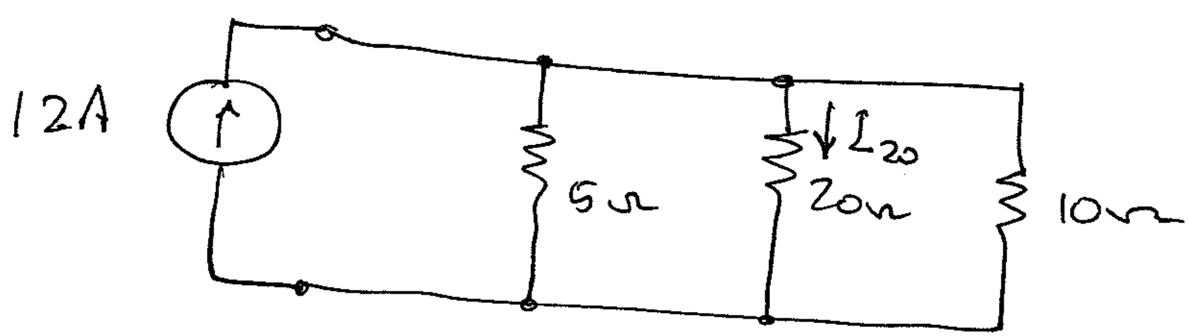
$$I = G_{eq} V$$

$$I_k = G_k V = \frac{1}{R_k} V$$

$$\frac{I_k}{I} = \frac{G_k V}{G_{eq} V} = \frac{G_k}{G_{eq}} = \frac{G_k}{\sum_{n=1}^{N} G_n}$$

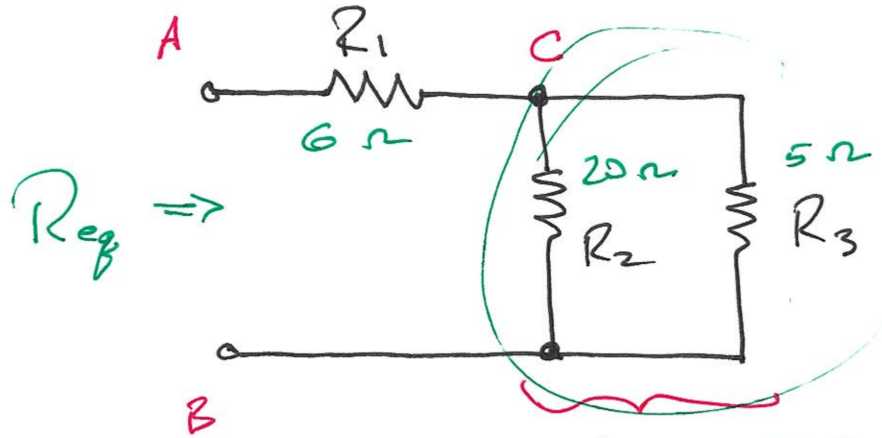
$$\boxed{\frac{I_k}{I} = \frac{\frac{1}{R_k}}{\frac{1}{R_1} + \cdots + \frac{1}{R_k} + \cdots + \frac{1}{R_N}}}$$

Current Divider Equation



$$\frac{I_{20}}{12A} = \frac{\frac{1}{20}}{\frac{1}{5} + \frac{1}{20} + \frac{1}{10}} = \frac{1}{7}$$

$$I_{20} = \frac{1}{7}(12A) = \frac{12}{7}A$$



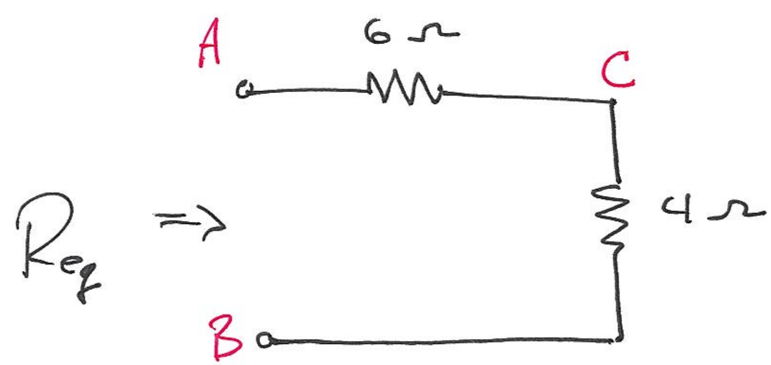
in parallel

$R_{eq} = 4\ \Omega$

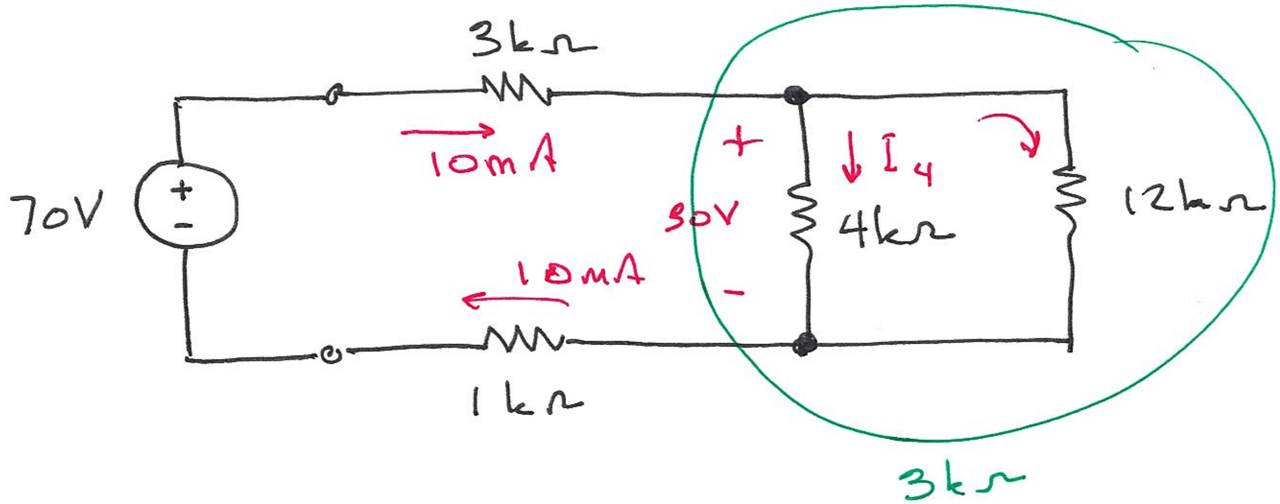
$$\frac{1}{R_{eq}} = \frac{1}{R_2} + \frac{1}{R_3}$$

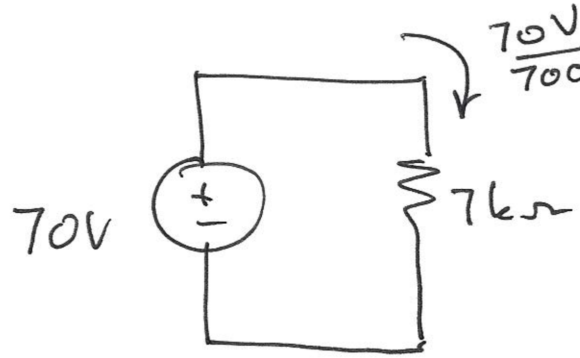
$$R_{eq} = \frac{1}{\frac{1}{R_2} + \frac{1}{R_3}} \cdot \frac{R_2 R_3}{R_2 R_3}$$

$$= \frac{R_2 R_3}{R_3 + R_2}$$



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



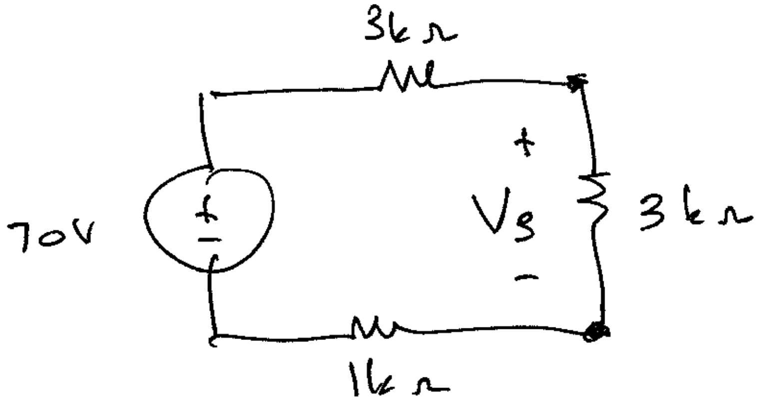


$$\frac{70V}{7000\Omega} = 10mA$$

$$I_4 = \frac{30V}{4k\Omega} = 7.5mA$$

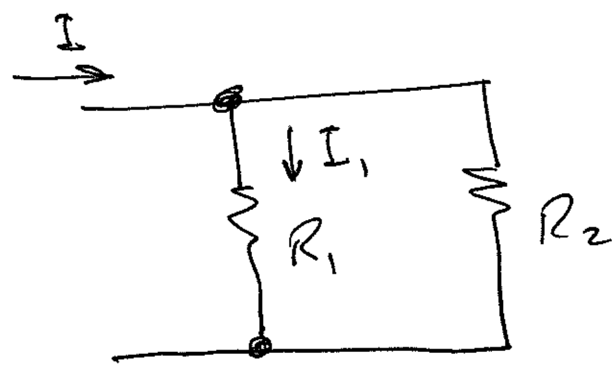
$$I_4 = \frac{\frac{1}{4k\Omega}}{\frac{1}{4k\Omega} + \frac{1}{12k\Omega}} \cdot 10mA$$

$$= 7.5mA$$



$$V_3 = \frac{3k}{3k + 3k + 1k} \cdot 70$$

$$= 30V$$



$$\frac{I_1}{I} = \frac{\frac{1}{R_1}}{\frac{1}{R_1} + \frac{1}{R_2}} \cdot \frac{R_1 R_2}{R_1 R_2} = \frac{R_2}{R_1 + R_2}$$

For 2 resistors:

$$\boxed{\frac{I_1}{I} = \frac{R_2}{R_1 + R_2}}$$