ELVINAS RIBINSKAS

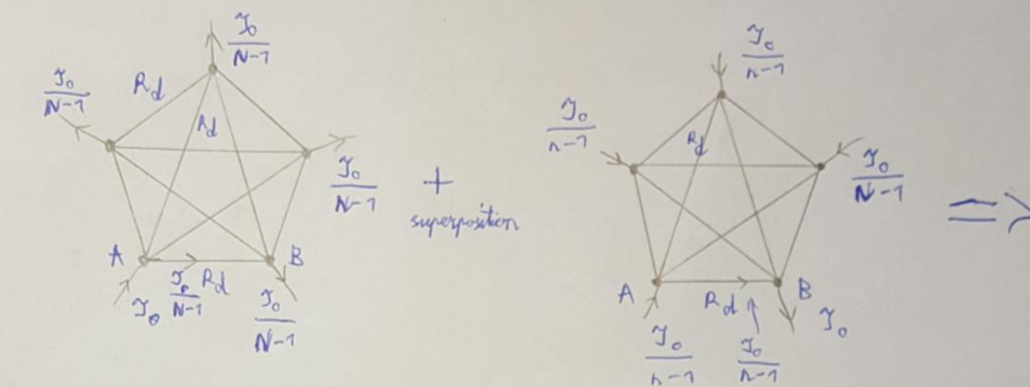
R_n - ?

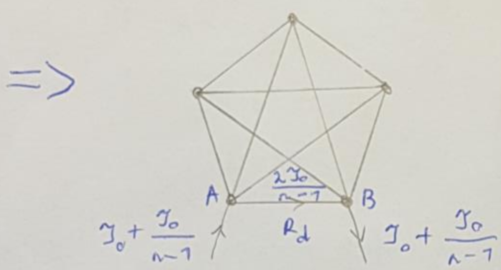
$R_s = 2\,\Omega$

$R_d = 1\,\Omega$

n

$\boxed{1.}$ Let us initially consider ~~the same~~ similar circuit that has all resistances equal to R_d. All the points are equivalent.





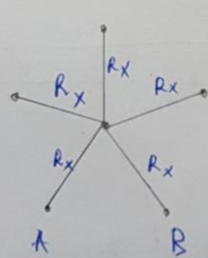
If R_{AB} is the resistance between points A and B, then

$$\frac{2I_0}{n-1} R_d = U_{AB} = \left(I_0 + \frac{I_0}{n-1}\right) R_{AB}$$

$$\Downarrow$$

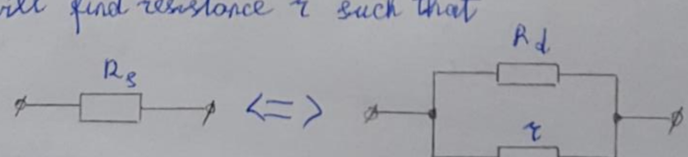
$$R_{AB} = \frac{2R_d}{n}$$

Resistances between any two points are equal, hence, ~~this circuit~~ the equivalent circuit looks like that:



, where $R_x = R_{AB}/2 = \frac{R_d}{n}$,

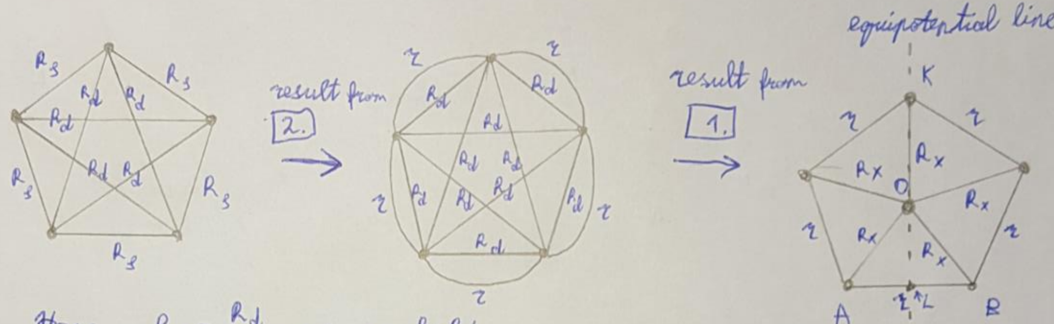
$\boxed{2.}$ We will find resistance r such that



The total resistance of this circuit

$$\frac{R_d\, r}{R_d + r} = R_s \implies r = \frac{R_s R_d}{R_d - R_s}$$

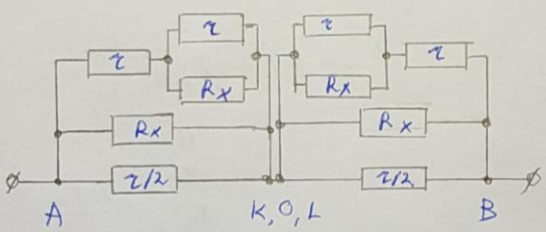
$\boxed{3.}$ We can use equivalencies found in $\boxed{1.}$ and $\boxed{2.}$ to simplify the circuit.



Here $R_x = \frac{R_d}{n}$ and $r = \frac{R_s R_d}{R_d - R_s}$.

$\phi_K = \phi_O = \phi_L$

$\boxed{4.}$ The last ~~cho~~ circuit is equivalent to



Thus, for $n=5$

$$R_5 = 2\,\cfrac{1}{\cfrac{1}{r/2} + \cfrac{1}{R_x} + \cfrac{1}{r + \cfrac{1}{\cfrac{1}{r} + \cfrac{1}{R_x}}}}$$

Similarly, for any odd n

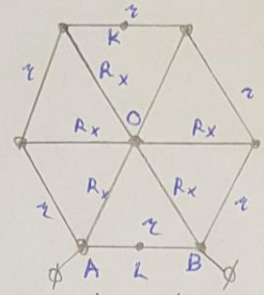
$$\xcancel{R_n = \cfrac{2}{\cfrac{2}{r} + \cfrac{1}{R_x} + \cfrac{1}{\cfrac{r}{R_x} + \cfrac{1}{\cdots}}}}$$

$$R_n = \cfrac{2}{\cfrac{2}{r} + \cfrac{1}{R_x} + \cfrac{1}{r + \cfrac{1}{\cfrac{1}{R_x} + \cfrac{1}{r + \cfrac{1}{\cfrac{1}{R_x} + \cfrac{1}{r + \dots}}}}}}$$

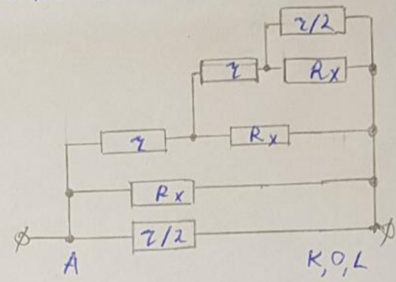
where $\frac{1}{R_x}$ occurs $\frac{n-1}{2}$ times and the continued fraction ends with

$$\dots + \cfrac{1}{\cfrac{1}{R_x} + \cfrac{1}{r}}, \text{ except } R_3 = \cfrac{2}{\cfrac{2}{r} + \cfrac{1}{R_x} + \cfrac{1}{r}}.$$

As an example of even n we take $n = 6$.



$\Longleftrightarrow$



$\times 2$ (in series)

$$\phi_K = \phi_O = \phi_L .$$

Thus, $$R_G = 2\,\frac{1}{\frac{1}{r/2}+\frac{1}{R_x}+\frac{1}{r+\frac{1}{\frac{1}{R_x}+\frac{1}{r+\frac{1}{\frac{1}{r/2}+\frac{1}{R_x}}}}}},$$

Similarly, for any even n

$$R_n = \frac{2}{\frac{2}{r}+\frac{1}{R_x}+\frac{1}{r+\frac{1}{\frac{1}{R_x}+\frac{1}{r+\frac{1}{\frac{1}{R_x}+\frac{1}{r+\dots}}}}}}$$, where $\frac{1}{R_x}$ occurs $\frac{n}{2}$ times

and the continued fraction ends with $$\dots+\frac{1}{\frac{1}{R_x}+\frac{2}{r}}.$$

$\boxed{5.}$ $R_x = \frac{R_d}{n} = \frac{1\,\Omega}{N}$; $r = \frac{R_3 R_d}{R_d - R_3} = -2\,\Omega$.

$$R_3 = \frac{2}{\frac{2}{r}+\frac{1}{R_x}+\frac{1}{r}} = \underline{\frac{4}{3}\,\Omega} ;$$

$$R_4 = \frac{2}{\frac{2}{r}+\frac{1}{R_x}+\frac{1}{r+\frac{1}{\frac{1}{R_x}+\frac{2}{r}}}} = \underline{\frac{5}{6}\,\Omega} ; \quad R_5 = \frac{2}{\frac{2}{r}+\frac{1}{R_x}+\frac{1}{r+\frac{1}{\frac{1}{R_x}+\frac{1}{r}}}} = \underline{\frac{32}{55}\,\Omega}$$