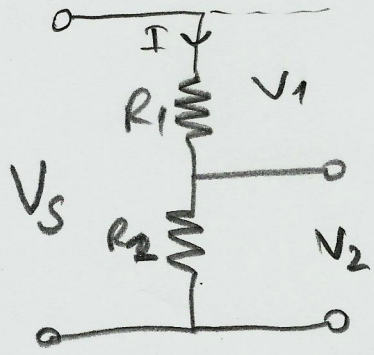
Voltage Divider



$$I = \frac{V_S}{R_1+R_2} \Rightarrow V_1 = R_1 . I = R_1 . \frac{V_S}{R_1+R_2}$$

$$\boxed{V_1 = \frac{R_1}{R_1+R_2} . V_S}$$

$$V_2 = R_2 . I = R_2 \frac{V_S}{R_1+R_2} \Rightarrow \boxed{V_2 = \frac{R_2}{R_1+R_2} . V_S}$$

Example-1

In fig.1, total power of R_1 and R_2 is 30W. Voltage of R_2 is 20V. (V_2=20V) Then

a) Calculate R_1=?, R_2=?

b) The load R_L=400Ω is connected as parallel to R_2. Then calculate V_2'=?

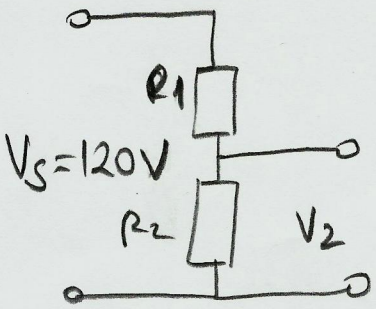


Figure-1

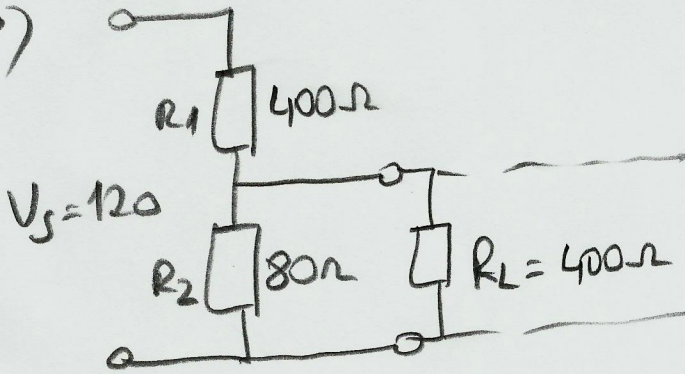
Solution

a) $P_T = 30W = \frac{V_S^2}{R_1+R_2} \Rightarrow 30 = \frac{120^2}{R_1+R_2} \Rightarrow R_1+R_2 = 480\Omega$

$$\frac{V_2}{V_S} = \frac{20}{120} = \frac{R_2}{R_1+R_2} \Rightarrow \frac{1}{6} = \frac{R_2}{480} \Rightarrow \boxed{R_2 = 80\Omega}$$

$R_1+R_2 = 480 \Rightarrow R_1 = 480 - R_2 = 480 - 80 \Rightarrow \boxed{R_1 = 400\Omega}$

b)

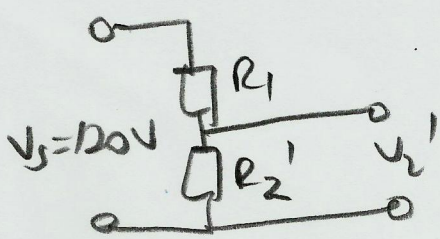


$$R_2' = R_2 // R_L$$

$$R_2' = \frac{R_2 . R_L}{R_2+R_L} = \frac{80.400}{80+400}$$

$$R_2' = 66,67\Omega$$

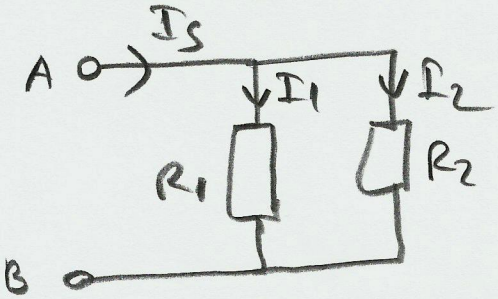
$\equiv$



$$V_2' = \frac{R_2'}{R_1+R_2'} . V_S = \frac{66,67}{400+66,67} . 120$$

$$\boxed{V_2' = 17,14V}$$

Current Divider



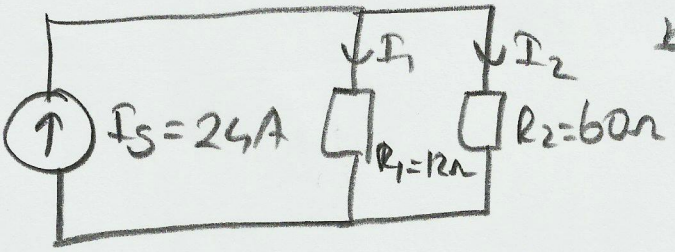
$$R_{eq} = \frac{R_1 . R_2}{R_1 + R_2} \qquad V_{AB} = R_{eq} . I_s$$

$$V_{AB} = \frac{R_1 . R_2}{R_1 + R_2} . I_s$$

$$I_1 = \frac{V_{AB}}{R_1} = \left(\frac{R_1 . R_2}{R_1 + R_2} . I_s\right) \frac{1}{R_1} \Rightarrow \boxed{I_1 = \frac{R_2}{R_1 + R_2} . I_s}$$

$$I_2 = \frac{V_{AB}}{R_2} = \left(\frac{R_1 . R_2}{R_1 + R_2} . I_s\right) \frac{1}{R_2} \Rightarrow \boxed{I_2 = \frac{R_1}{R_1 + R_2} . I_s}$$

Example



a) $I_2 = ?$

b) Tolerance of R_1 and R_2 resistor is $\pm$%10. Then calculate minimum and maximum value of I_2

Solution

$$I_2 = \frac{R_1}{R_1 + R_2} I_s = \frac{12}{12 + 60} . 2 = 4A$$

I_2 is minimum when R_1 is min and R_2 is max.

$$I_{2min} = \frac{R_{1min}}{R_{1min} + R_{2max}} . I_s = \frac{12.0,9 . 2}{12.0,9 + 60.1,1} \Rightarrow \boxed{I_{2min} = 3,37A}$$

I_2 is maximum when R_1 is max and R_2 is min.

$$I_{2max} = \frac{R_{1max}}{R_{1max} + R_{2min}} . I_s = \frac{12.1,1}{12.1,1 + 60.0,9} . 2$$

$$\boxed{I_{2max} = 4,71A}$$

Example

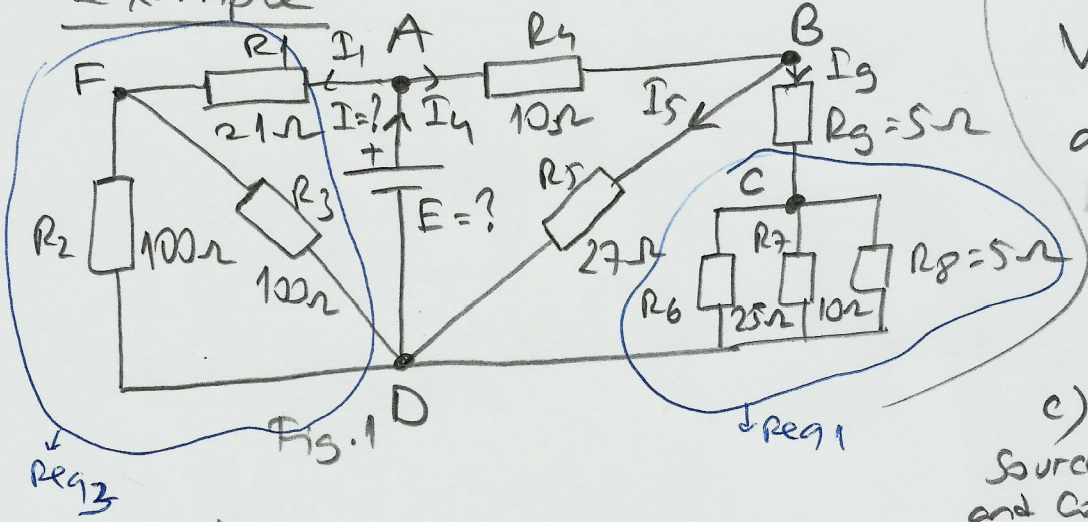


Fig.1

In Fig.1 $V_{BD} = 270\,V$ then Calculate

a) Voltage of source $E = ?$

Calculate

b) Current of source $I = ?$

c) Calculate charge of Source ($Q = I.t$) as Ampee-hour and Coulomb for a day

Solution

a) $Req_1 = R6 // R7 // R8 \Rightarrow \frac{1}{Req_1} = \frac{1}{25} + \frac{1}{10} + \frac{1}{5} \Rightarrow \boxed{Req_1 = \frac{50}{17}\,\Omega}$

$(25)\ (10)\ (5)$

$Req_2 = R_g + Req_1 = 5 + \frac{50}{17} = \frac{135}{17}\,\Omega \Rightarrow I_g = \frac{V_g}{Req_2} = \frac{V_{BD}}{Req_2} = \frac{270}{\frac{135}{17}}$

$\boxed{I_g = 34A}$ $\quad I_5 = \frac{V_5}{R_5} = \frac{V_{BD}}{R_5} = \frac{270}{27} = 10A$

$I_4 = I_5 + I_g = 10 + 34 \Rightarrow \boxed{I_4 = 44A}$

$V_{AB} = V_4 = R_4.I_4 = 10.44 = 440V$

$E = V_{AD} = V_4 + V_5 = V_{AB} + V_{BD} = 440 + 270$

$\boxed{E = 710V}$

b) $Req_3 = R_1 + \frac{R_2.R_3}{R_2+R_3} = 21 + \frac{100.100}{100+100} = 71\,\Omega$

$I_1 = \frac{E}{Req_3} = \frac{710}{71} = 10A$

$I = I_1 + I_4 = 10 + 44 \Rightarrow \boxed{I = 54A}$

c) $Q = I.t = 54.24 = \underline{1296\,Ah}$

$Q = I.t = 54.24.3600 = \underline{4,66.10^6\,C}$

$1h = 60dk = 60.60 = 3600s$