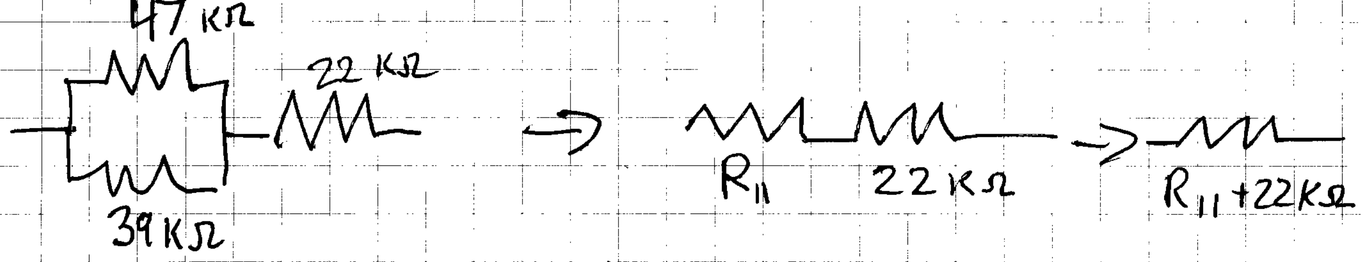
28 4

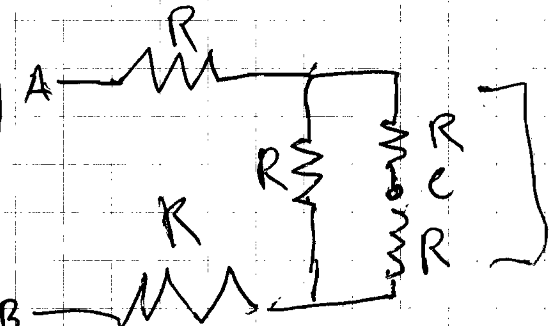
$\mathcal{E} = 9V \Rightarrow V = 9V$

8



$\frac{1}{R_{\parallel}} = \frac{1}{47} + \frac{1}{39}$ $\quad R = \frac{1}{\frac{1}{47}+\frac{1}{39}} + 22$

10)



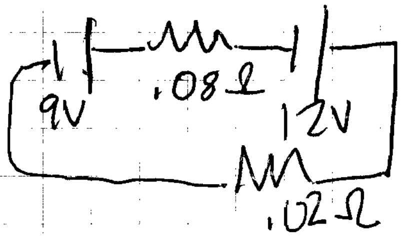
$\frac{1}{\frac{1}{2R} + \frac{1}{R}} = \frac{2}{3}R$

a) $R_{eff} = \frac{8}{3}R \quad A \to B$

b) $\cancel{I = V/R_{eff}}$

$R + \frac{2}{3}R = \frac{5}{3}R$

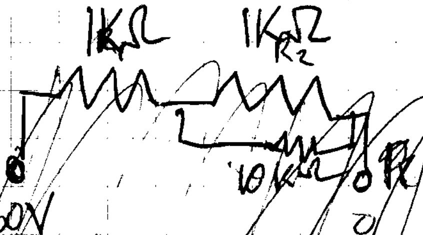
17)



$V = 21\,V \quad R = .1\Omega$

$I = V/R = 210$ amps

24)



~~across means parrallel too~~

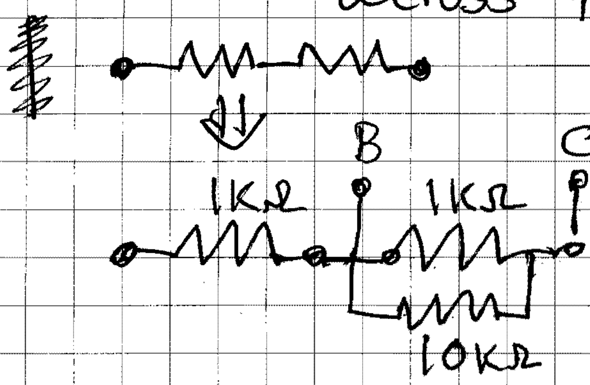
$\frac{1}{\frac{1}{10}+1} = \frac{1}{1.1}$

$V = IR$

$I = V/R$

$\frac{160}{\frac{1}{1.1}+1} = I$

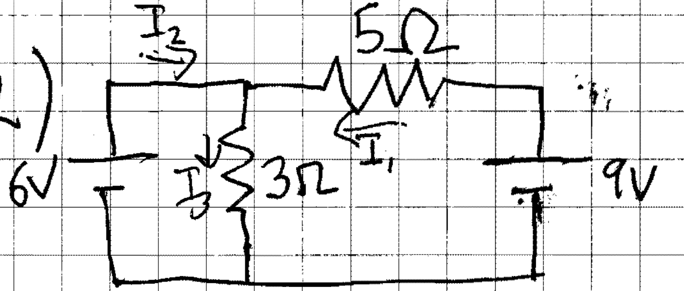
24) across means parallel too



$V = I R_{eff}$ $\qquad R_{eff} = 1 + \frac{1}{\frac{1}{10} + 1}\ K\Omega = 1.91\ K\Omega$

$V_{BC} = I R_{BC} = I \cdot .91 = \frac{V \cdot .91}{1.91}$

22)



$I_3 = I_1 + I_2$

$6 - (I_1 + I_2)3 = 0$

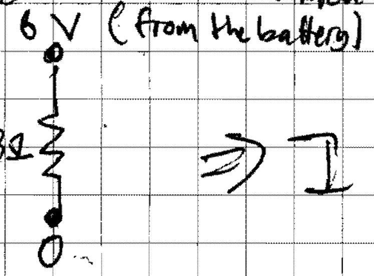
$9 - 5I_1 - 3(I_1 + I_2) = 0$

$3 - 5I_1 = 0 \quad I_1 = \frac{3}{5}\frac{V}{\Omega}$

$6 - \frac{9}{5} - 3I_2 = 0$

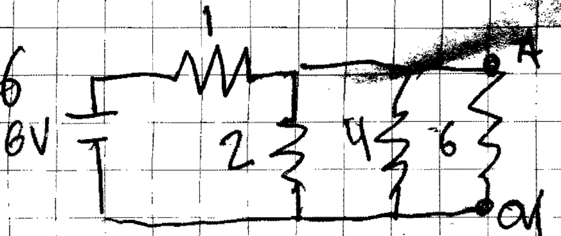
$21 - 15I_2 = 0 \quad I_2 = \frac{7}{5}\frac{V}{\Omega} \quad I_3 = 2$ amps

$7 - 5I_2 = 0$ which is what you would get by noting



$\Rightarrow I = 2$ amps

26)



$$\frac{\cancel{4}}{\cancel{12}} + \frac{2}{\cancel{12}} = \frac{10}{12} = \frac{5}{6}$$

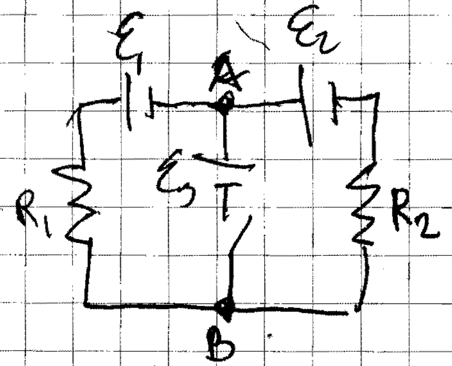
$$R_{eff} = 1 + \frac{1}{\frac{1}{2}+\frac{1}{4}+\frac{1}{6}} = 1 + \frac{1}{\frac{5}{6}} = 1+\frac{6}{5} = \frac{11}{5}$$

$$V = IR \Rightarrow I = \frac{6}{11/5} = \frac{30}{11} \text{ amps}$$

$$V_A = 6 - \frac{30}{11}\text{amp} \cdot 1\Omega = \frac{36}{11}V$$

$$I = \frac{36}{11}V/6\Omega = \frac{6}{11} \text{ amps}$$

29)



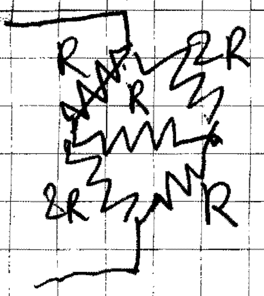
to make the circuits the same the voltage drop accross the $\mathcal{E}_3$ battery ($A \to B$) must be $\mathcal{E}_3$ with the switch open

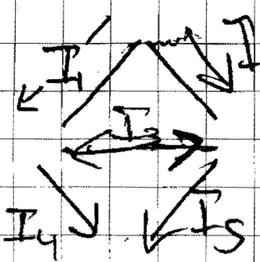
let B be at $0V$ $\quad I = \frac{\mathcal{E}_1 + \mathcal{E}_2}{R_1 + R_2}$

$$\mathcal{E}_1 - R_1\left(\frac{\mathcal{E}_1+\mathcal{E}_2}{R_1+R_2}\right) = \mathcal{E}_3$$

Voltage change from $A \to B$

31)





based on symmetry

$I_1 = I_5 \quad I_2 = I_4$

long way

$\cancel{I_1 + I_3 =}$ $\quad I_1 = I_3 + I_2$

$$V - I_1 R - I_2(2R) = 0$$

$$I_1 R + I_3 R - I_2(2R) = 0$$

$$\begin{pmatrix} -1 & 1 & 1 \\ -R & -2R & 0 \\ R & R & -2R \end{pmatrix} \begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} = \begin{pmatrix} 0 \\ V \\ 0 \end{pmatrix} \Rightarrow \begin{pmatrix} -1 & 1 & 1 \\ -1 & -2 & 0 \\ 1 & 1 & -2 \end{pmatrix} \begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} = \begin{pmatrix} 0 \\ V/R \\ 0 \end{pmatrix}$$

inverting this gives

$I_1 = +\frac{3V}{5R} \quad I_2 = \frac{V}{5R} \quad I_3 = \frac{2V}{5R}$ so $I = I_1 + I_2$

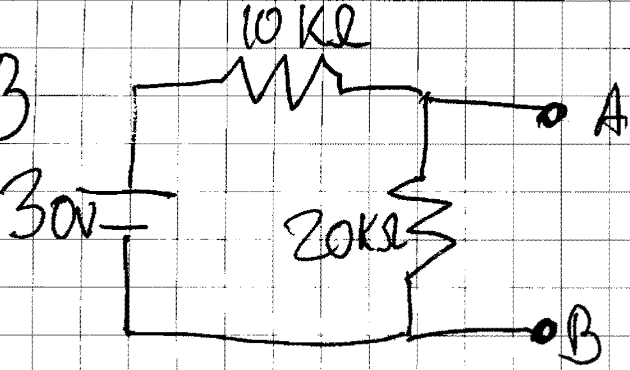
$= V/R \Rightarrow R_{eff} = R$

short way: there are 3 paths with total resistance 3R

$$\frac{1}{3R} + \frac{1}{3R} + \frac{1}{3R} = \frac{1}{R_{eff}} = \frac{1}{R} \Rightarrow R_{eff} = R$$

(this method has limited use)

43

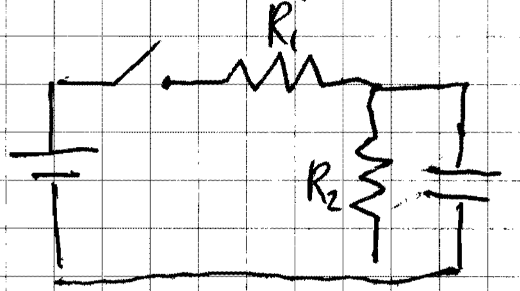


$I = 1mA$

a) 20V

b) 0 amps (Ammeters must be hooked up in series)

55) $\mathcal{E} = 100$ $R_1 = 4K\Omega$ $R_2 = 6K\Omega$



a) When the switch is closed all the current goes through the capacitor since the voltage drop accross the capacitor is Q/C and there is no charge yet

$I_1 = 25 mA$

$I_2 = 0$

b) once the capacitor is fully charged no current can flow to it

$I_1 = I_2 - 10mA$ (note $V_C = 60V$)

c) once the switch opens R_1 is out of the circuit and the capacitor

$V_C = 60V$ $R = 6K\Omega \Rightarrow I = 10mA$

d) a long time later $V_C = 0 \Rightarrow Q = 0$ so $I = 0$