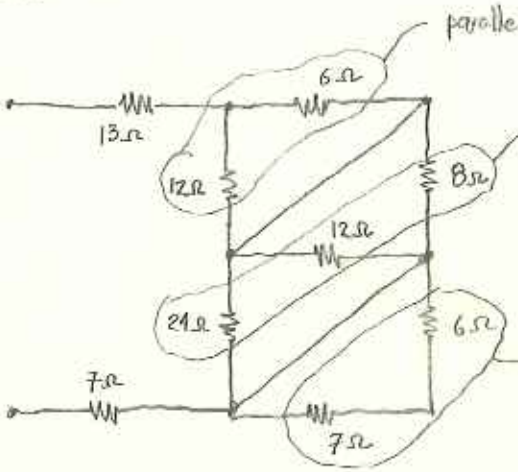
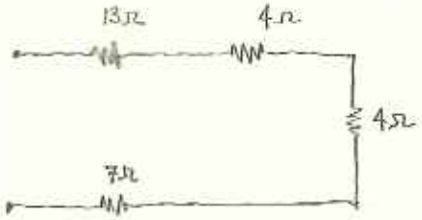
Question 1



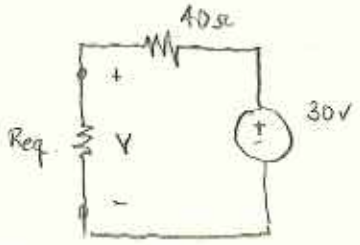
Redrawing ...



$R_{eq} = 13 + 4 + 4 + 7$

$\boxed{R_{eq} = 28\,\Omega}$

Question 2



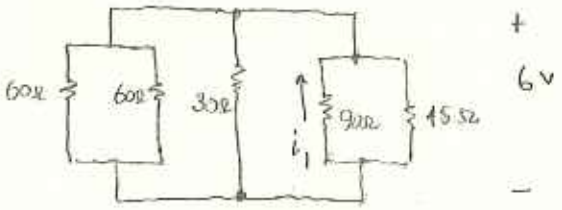
$R_{eq} = \left(\frac{1}{60}+\frac{1}{60}+\frac{1}{30}+\frac{1}{90}+\frac{1}{45}\right)^{-1}$

$= 10\,\Omega$

By voltage division, $V = \frac{R_{eq}}{R_{eq}+40} \times 30 = \frac{10}{10+40} \times 30$

$V = 6\,V$

Reconstructing the parallel resistor circuit



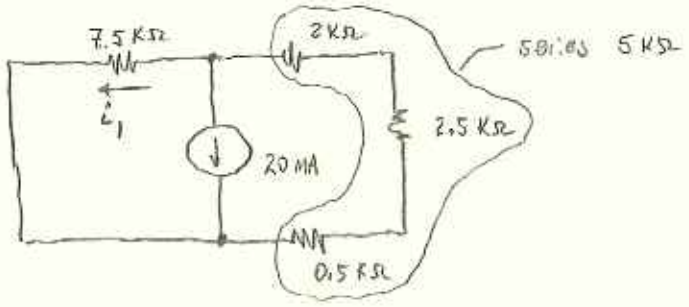
Then, by Ohm's Law

$i_1 = -\frac{V}{R} = \frac{-6}{90}$

$\boxed{i_1 = -66.67\ mA}$

Question 3

The two 1 kΩ resistors at the bottom of the circuit are in parallel, so redrawing ...

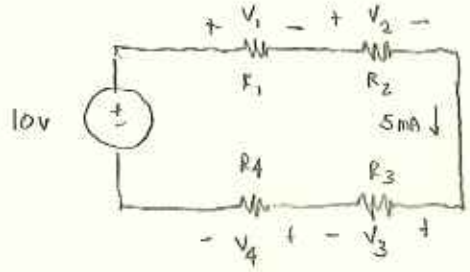


Note that i_1 is opposite to the direction of current flow, and then by current division,

$$i_1 = -\frac{5K}{5K + 7.5K} \times 20\ mA$$

$$\boxed{i_1 = -8\ mA}$$

Question 4



By KVL, we have $V_1 + V_2 + V_3 + V_4 = 10\ v.$

From the design criteria, we know $V_3 = 3V_4$

$V_2 = 2V_3 = 6V_4$

$V_1 = 5V_2 = 30\ V_4$

Substituting into the KVL equation,

$$30V_4 + 6V_4 + 3V_4 + V_4 = 10$$

$$40\ V_4 = 10$$

$$\text{so } V_4 = 0.25\ v$$

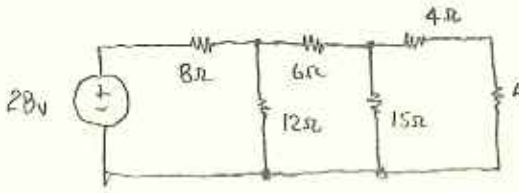
And therefore, $V_1 = 30\ V_4 = 7.5\ v$

Finally, $R_1 = \frac{V_1}{i} = \frac{7.5}{0.005} = 1500\Omega$

$$\boxed{R_1 = 1500\Omega}$$

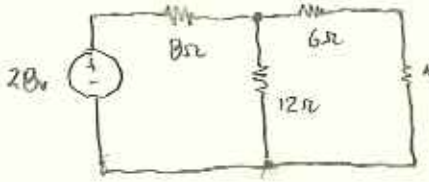
Question 5

By combining resistors in series and parallel, we may first simplify the circuit, and then reconstruct it.



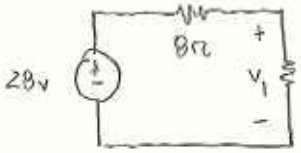
$(2+13)\,//\,10\Omega$ ← "in parallel with"

$= 6\Omega$



$(6+4)\,//\,15\Omega$

$= 6\Omega$

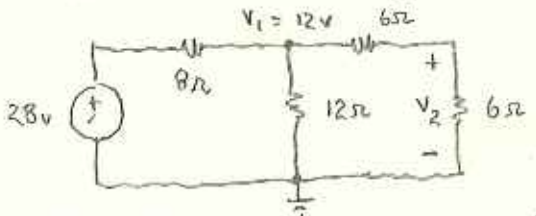


$(6+6)\,//\,12 = 6\Omega$

and by voltage division $V_1 = \frac{6}{6+8} \times 28$

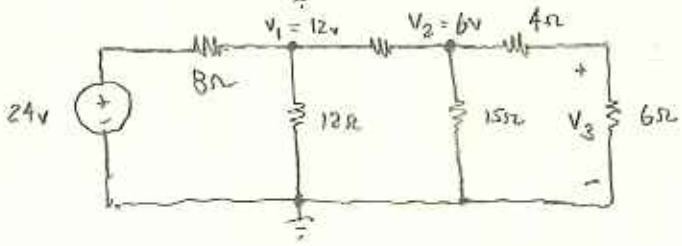
$V_1 = 12\,V$

Now reconstruct the circuit ...



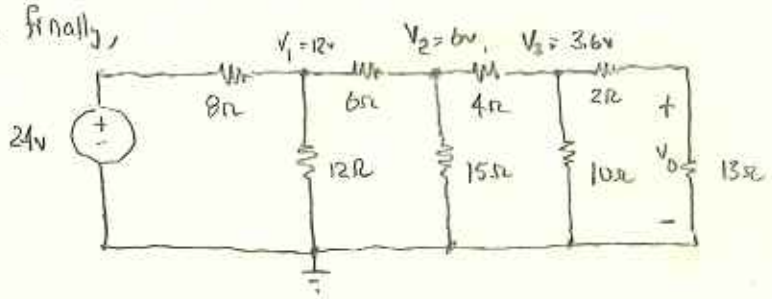
Again by voltage division

$V_2 = \frac{6}{6+6} \times V_1 = 6\,V$



$V_3 = \frac{6}{6+4} \times V_2 = 3.6\,V$

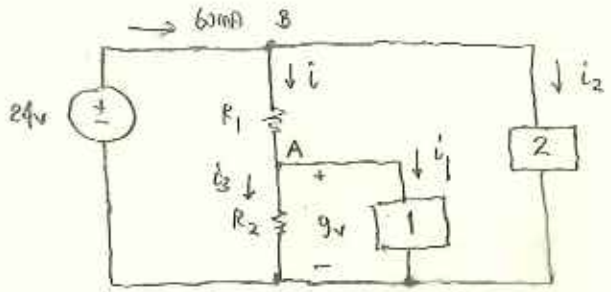
And finally,



$$V_o = \frac{13}{13+2} \times 3.6$$

$$\boxed{V_o = 3.12v}$$

Question 6



From the specifications given for device 2,

$p = i_2 V$, where $p = 480\,mW$ and $V = 24\,V$

therefore, $i_2 = \frac{480\,mW}{24\,V} = 20\,mA$

By KCL at node B, $i = 60\,mA - i_2$

$= 40\,mA.$

Then, from the specifications given for device 1,

$$i_1 = \frac{45\,mW}{9\,V} = 5\,mA$$

KCL at node A therefore gives $i_3 = i - 5\,mA$

$i_3 = 35\,mA$

We now know that R_2 must support 35 mA of current at 9 V.

$$R_2 = \frac{V}{i_3} = \frac{9}{0.035} = 257.14\ \Omega$$

$R_2 = 257.14\ \Omega$