(1) i) $slope_{0,1} = \frac{-5}{1} = -5$

$slope_{1,2} = \frac{5}{1} = 5$

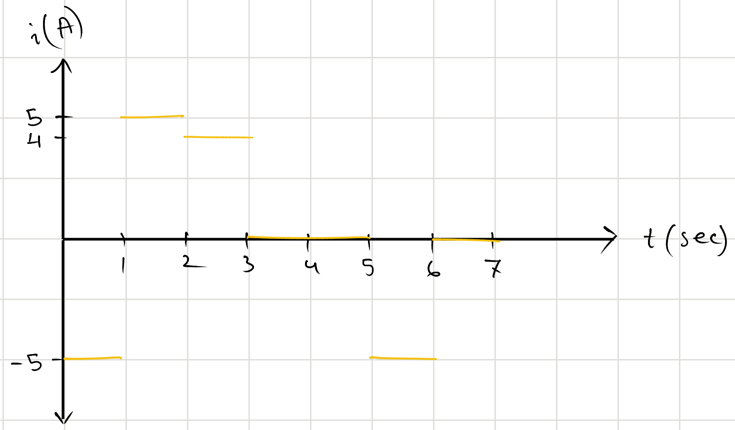
$slope_{2,3} = \frac{4}{1} = 4$

$slope_{3,4} = 0$

$slope_{4,5} = 0$

$slope_{5,6} = \frac{-5}{1} = -5$

$slope_{6,7} = 0$



$i(2.5) = 4\,A$

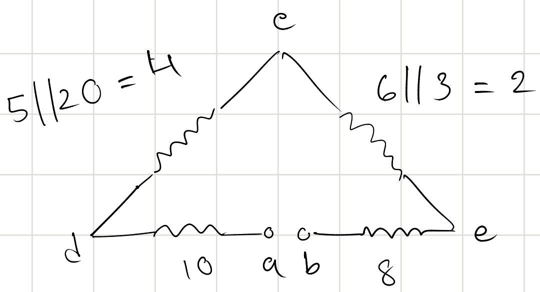
$i(5.5) = -5\,A$

ii) $p = i^2 R$ therefore p is maximum when i is maximum

In the graph $i_{max} = 5\,A$ from $t = 1s$ to $t = 2s$

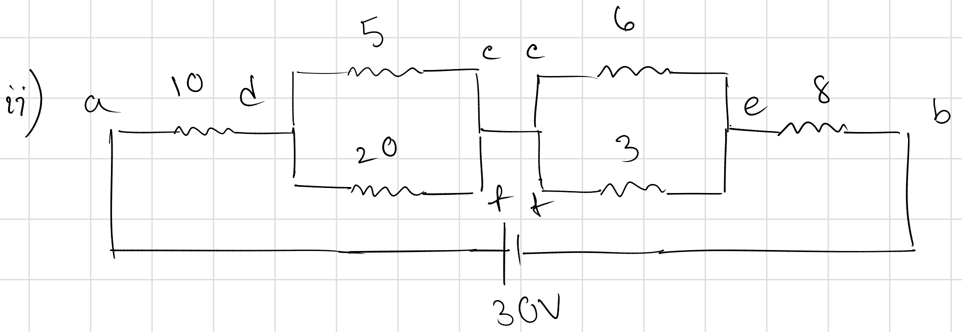
$\therefore p_{max} = 5^2 \times 20 = 500\,W$

(2) i) $eqv_{ab} = 24\,\Omega$



$4 + 10 + 8 + 2 = 24$

ii)

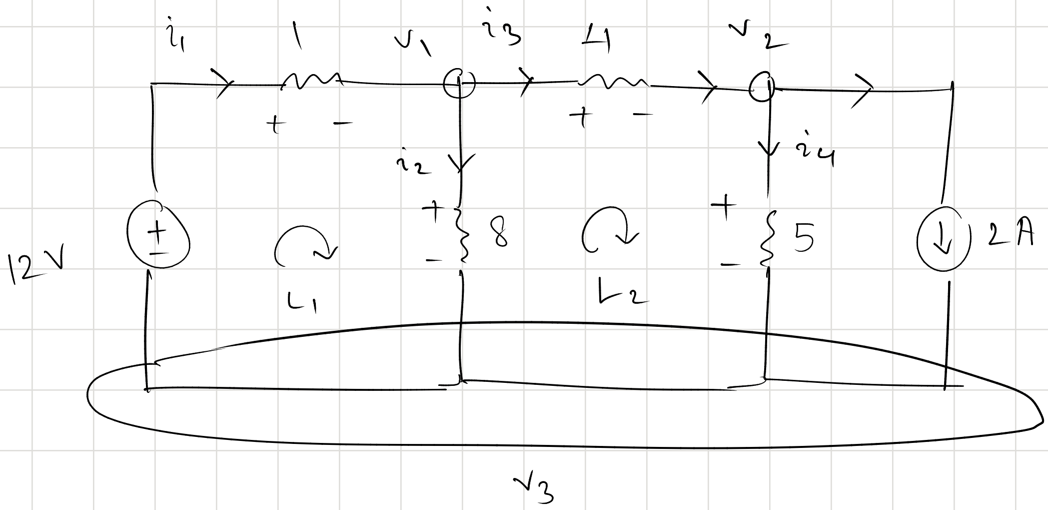


$i_{ab} = \frac{30}{24} = 1.25\,A$

$\therefore i_{eb} = 1.25\,A$

$i_{ce} = 1.25 \times \frac{3}{3+6} = 0.4167$

(3) **loop 1**



$i_1 + 8i_2 - 12 = 0$

$\Rightarrow i_2 + i_3 + 8i_2 - 12 = 0$

$\Rightarrow 9i_2 + i_3 - 12 = 0$

loop 2

$4i_3 + 5i_4 - 8i_2 = 0$

$\Rightarrow 4i_3 + 5i_3 - 10 - 8i_2 = 0 \quad [i_4 = i_3 - 2]$

$\Rightarrow -8i_2 + 9i_3 - 10 = 0$

$i_1 = \dfrac{12 - v_1}{1} \Rightarrow v_1 = 12 - 3.19 = 8.81\ V$

$i_2 = 1.1\ A \qquad i_3 = 2.09\ A$

$i_1 = 1.1 + 2.09 = 3.19\ A$

$i_4 = 2.09 - 2 = 0.09\ A$

$i_2 = \dfrac{v_1 - v_3}{8} \Rightarrow v_3 = v_1 - 8i_2$

$= 8.81 - 8 \times 1.1$

$= 0\ V$

$i_3 = \dfrac{V_1 - V_2}{4} \Rightarrow v_2 = v_1 - 4i_3$

$= 8.81 - 4 \times 2.09$

$= 0.45\ V$

(4)

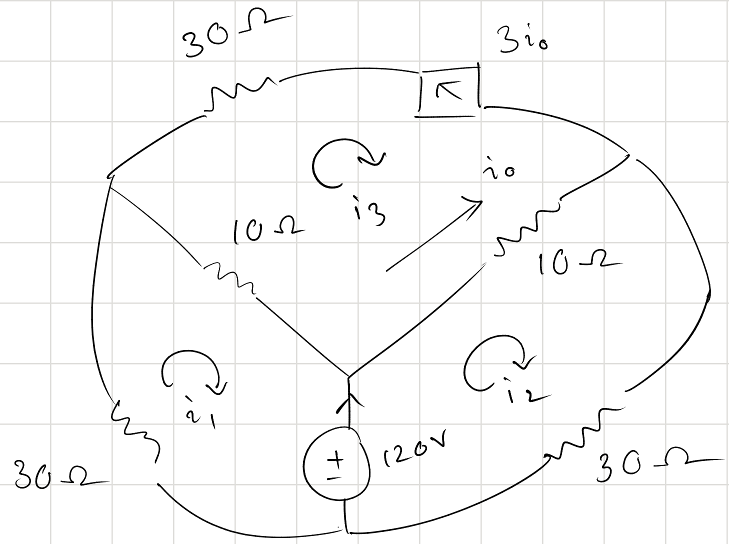
loop 1:

$$120 + 30i_1 + 10(i_1 - i_3) = 0$$

$$\Rightarrow 120 + 30i_1 + 10(i_1 + 3i_o) = 0$$

$$\Rightarrow 120 + 30i_1 + 10i_1 - 15i_2 = 0$$

$$\Rightarrow 40i_1 - 15i_2 = -120$$



loop 2:

$$-120 + 10(i_2 - i_3) + 30i_2 = 0$$

$$\Rightarrow 10(i_2 + 3i_o) + 30i_2 = 120$$

$$\Rightarrow 10\left(i_2 - \frac{3}{2}i_2\right) + 30i_2 = 120$$

$$\Rightarrow 10i_2 - 15i_2 + 30i_2 = 120$$

$$\Rightarrow \quad i_2 = \frac{120}{25} = 4.8\text{ A}$$

$$i_o = i_2 - i_3 = i_2 + 3i_o$$

$$\Rightarrow 2i_o = -i_2$$

$$\Rightarrow i_o = -\frac{i_2}{2}$$

$$i_o = -2.4\text{ A}$$

$$\therefore i_1 = \frac{-120 + 15i_2}{40}$$

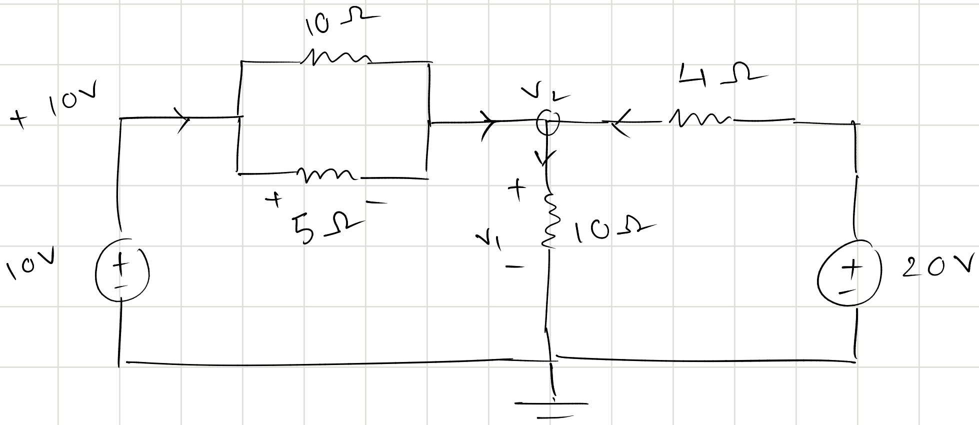
$$= \frac{-120 + 72}{40}$$

$$= -1.2\text{ A}$$

current through the battery

$$i_2 - i_1 = 4.8 + 1.2 = 6\text{ A}$$

(5) i) at the node with v_2 voltage



$$\frac{10-v_2}{10\|5} + \frac{20-v_2}{4} = \frac{v_2}{10}$$

$$\Rightarrow \frac{3}{10}(10-v_2) + \frac{20-v_2}{4} = \frac{v_2}{10}$$

$$\Rightarrow 6(10-v_2) + 5(20-v_2) = 2v_2$$

$$\Rightarrow 60 - 6v_2 + 100 - 5v_2 = 2v_2$$

$$\Rightarrow 13v_2 = 160$$

$$\Rightarrow v_2 = 12.308$$

$$v_1 = v_2 - 0 = 12.308\ \text{V}$$

current in 5Ω, $i = \dfrac{10-v_2}{5}$

$$= \frac{10-12.308}{5}$$

$$= -0.46\ \text{A}$$

ii) current through 4Ω resistor

$$i_1 = \frac{20-v_2}{4}$$

$$= \frac{20-12.308}{4}$$

$$= 1.923\ \text{A}$$

therefore 1.923 A current is flowing out of the positive terminal of 20V voltage source, meaning it is supplying power.

$$p = vi = 20 \times 1.923 = 38.46\ \text{W}$$