

$$\text{slope}(0, 1) = 0$$

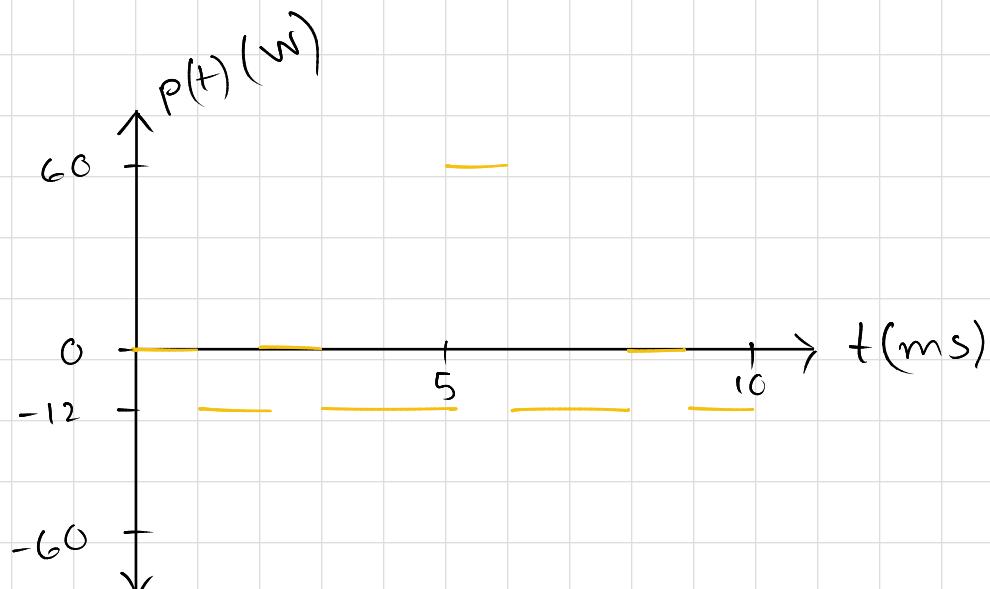
$$\text{slope}(1, 2) = \frac{-1}{1} = -1$$

$$\text{slope}(2, 3) = 0$$

$$\text{slope}(3, 5) = \frac{-2}{2} = -1$$

$$\text{slope}(5, 6) = \frac{5}{1} = 5$$

$$\text{ii) } P = Vi$$



$$\text{slope}(6, 8) = \frac{-2}{2} = -1$$

$$\text{slope}(8, 9) = 0$$

$$\text{slope}(9, 10) = \frac{-1}{1} = -1$$

$$P(0, 1) = 12 \times 0 = 0 \text{ W}$$

power is absorbed in the interval  $[5, 6]$

$$P(1, 2) = 12 \times (-1) = -12 \text{ W}$$

power is delivered in the

$$P(2, 3) = 0$$

following intervals

$$P(3, 5) = 12 \times (-1) = -12 \text{ W}$$

$$[1, 2], [3, 5], [6, 8], [9, 10]$$

$$P(5, 6) = 12 \times (5) = 60 \text{ W}$$

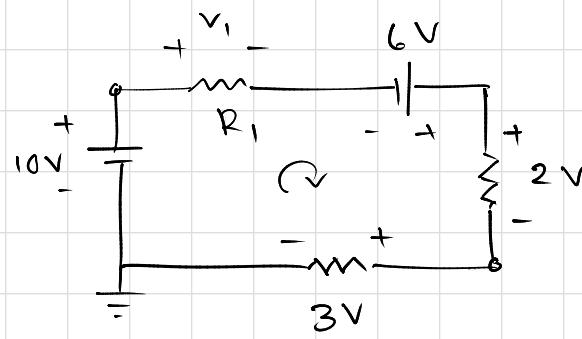
$$P(6, 8) = 12 \times (-1) = -12 \text{ W}$$

$$P(8, 9) = 0$$

$$P(9, 10) = 12 \times (-1) = -12 \text{ W}$$

(2) i) Applying KVL in the loop

$$-10 + v_1 - 6 + 2 + 3 = 0$$



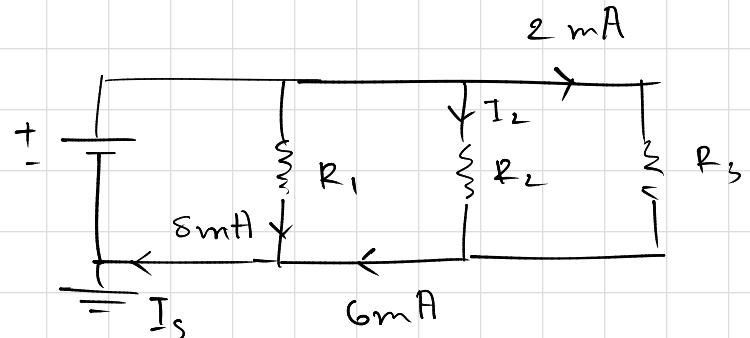
$$\Rightarrow v_1 = 11 \text{ V}$$

$$\therefore v_2 = v_1 - 6 + 2 = 7 \text{ V}$$

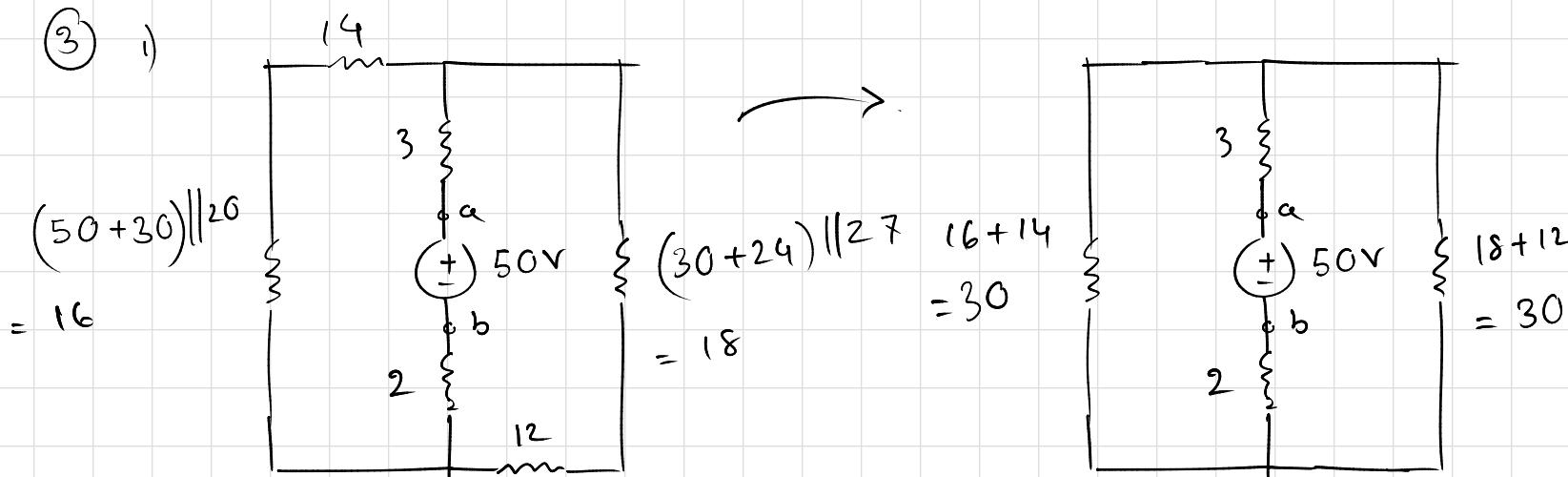
ii)  $I_s = 8 + 6 = 14 \text{ mA}$

$$I_s = 8 + I_2 + 2$$

$$\Rightarrow I_2 = 14 - 10 = 4 \text{ mA}$$

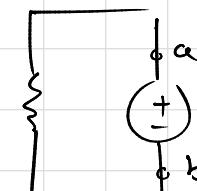


(3) i)



$$R_{ab} = 20 \Omega$$

$$(30||30)+2+3 = 20$$



$\rightarrow$

$$(30+24)||27 = 18$$

$$(16+14) = 30$$

$$18+12 = 30$$

$\rightarrow$

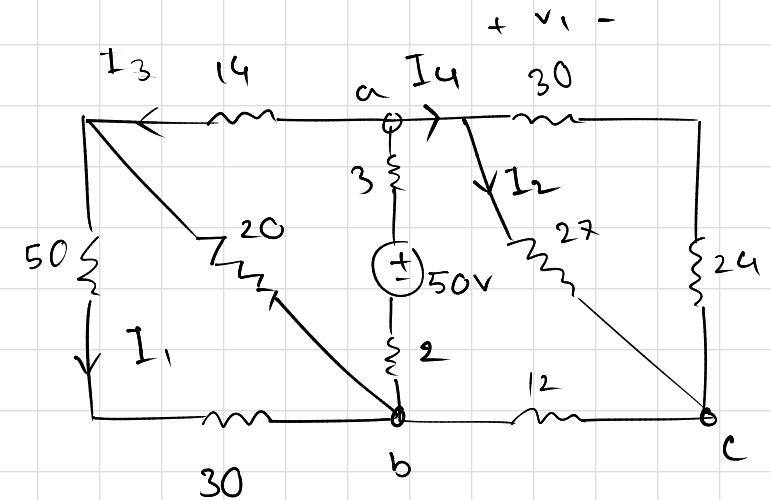
$$ii) I = \frac{50}{20} = 2.5 A$$

$$(i_2 + 27 || (30 + 24))$$

$$I_3 = 2.5 \times \frac{(14 + 20 || (50 + 30)) + (i_2 + 27 || (30 + 24))}{(14 + 20 || (50 + 30)) + (i_2 + 27 || (30 + 24))}$$

$$= 1.25 A$$

$$\therefore I_1 = 1.25 \times \frac{20}{(50 + 30) + 20} = 0.25 A$$



$$v_{ab} = 50 \times \frac{30 || 30}{3 + 2 + (30 || 30)}$$

$$= 37.5 V$$

$$v_{ac} = 37.5 \times \frac{27 || (30 + 24)}{12 + 27 || (30 + 24)}$$

$$= 22.5 V$$

$$v_c = 22.5 \times \frac{30}{30 + 24}$$

$$= 12.5 V$$

(4) i) loop 1:

$$-660 + 5i_1 + 15(i_1 - i_3) + 10(i_1 - i_2) = 0$$

$$\Rightarrow -660 + 5i_1 + 15i_1 - 15i_3 + 10i_1 - 10i_2 = 0$$

$$\Rightarrow 30i_1 - 10i_2 - 15i_3 = 660 \quad \text{--- (1)}$$

loop 2

$$-20i_\phi + 10(i_2 - i_1) + 50(i_2 - i_3) = 0$$

$$\Rightarrow -20(i_2 - i_3) + 10i_2 - 10i_1 + 50i_2 - 50i_3 = 0$$

$$\Rightarrow -10i_1 + 40i_2 - 30i_3 = 0 \quad \text{--- (2)}$$

solving (1), (2) and (3)

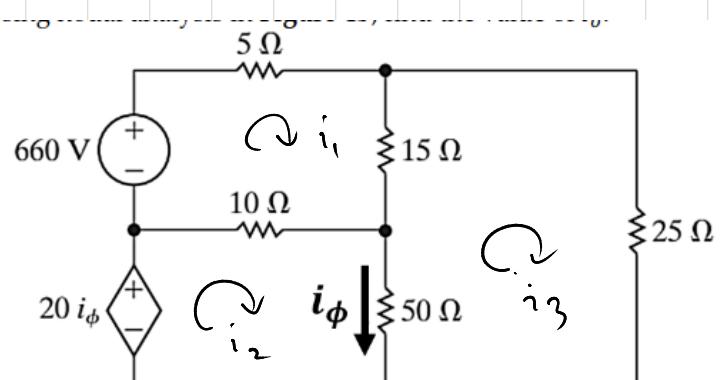


Figure 4a.

$$i_1 = 42 \quad i_2 = 27 \quad i_3 = 22$$

$$\therefore i_\phi = i_2 - i_3 = 5 A$$

loop 3

$$15(i_3 - i_1) + 25i_3 + 50(i_3 - i_2) = 0$$

$$\Rightarrow -15i_1 - 50i_2 + 90i_3 = 0 \quad \text{--- (3)}$$

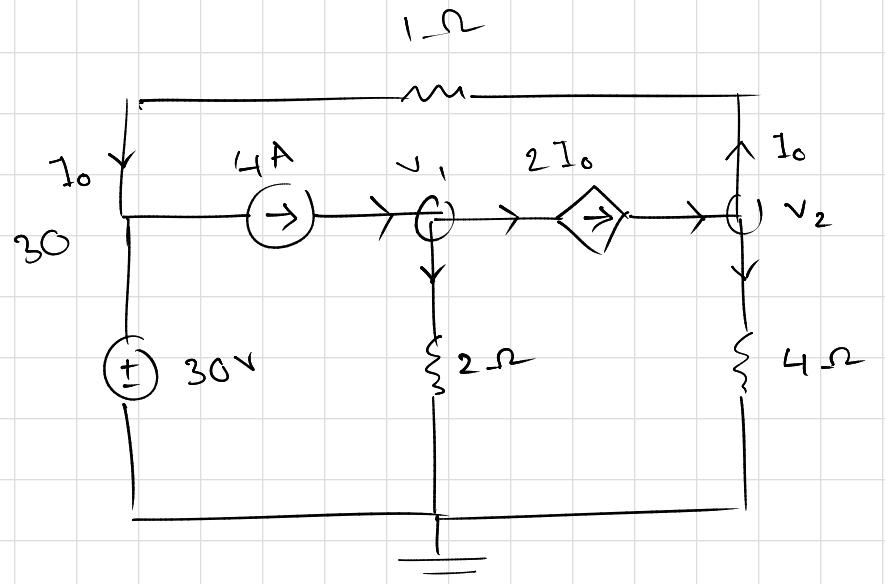
ii) node 1:

$$4 = \frac{v_1}{2} + 2I_o$$

$$\Rightarrow 4 = \frac{v_1}{2} + 2 \left( \frac{v_2 - 30}{1} \right)$$

$$\Rightarrow 4 = \frac{v_1}{2} + 2v_2 - 60$$

$$\Rightarrow \frac{1}{2}v_1 + 2v_2 = 64 \quad \text{--- (1)}$$



node 2:

$$2I_o = I_o + \frac{v_2}{4}$$

$$\therefore I_o = \frac{v_2 - 30}{1} = 10A$$

$$\Rightarrow \frac{v_2}{4} = I_o = \frac{v_2 - 30}{1}$$

$$\Rightarrow v_2 = 4v_2 - 120$$

$$\Rightarrow v_2 = \frac{120}{3} = 40$$