① ⓐ

$$P = -IV$$

$$\Rightarrow -12 = -I \times 3$$

$$\boxed{I = 4\,A}$$

ⓑ

$$4 + I_x = 2$$

$$\boxed{I_x = -2\,A}$$

ⓒ $+V_x - (2\times 2) + 9 + 3 = 0$

$$\boxed{V_x = -8\,V}$$

② ⓐ Using nodal,

$$\cancel{V_1} \; \cancel{X_1/20} \over 10$$

V_1, V_2 : $\dfrac{V_1 - 20}{10} + \dfrac{V_1 - V_3 - 20}{5} + 3 = V_y$

$(V_y = V_3)$ $\Rightarrow \boxed{\dfrac{3}{10}V_1 \cancel{-\dfrac{V}{2}} - \dfrac{6}{5}V_3 = 3 \; - ①}$

V_3 : $\dfrac{V_3}{10} + \dfrac{V_3 - V_1 + 20}{5} = 3$

$$\Rightarrow \boxed{-\dfrac{1}{5}V_1 + \dfrac{3}{10}V_3 = -1 \; - ②}$$
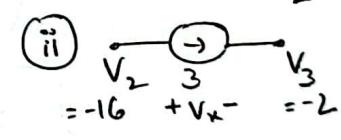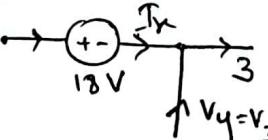
$$\boxed{V_1 - V_2 = 18 \; - ③}$$

solving ①, ②, ③

$$\boxed{\begin{array}{l} V_1 = \dfrac{94}{5} = \cancel{18.8} \quad 2 \\[2mm] V_2 = \dfrac{4}{5} = \cancel{0.8} \quad -16 \\[2mm] V_3 = \dfrac{46}{5} = \cancel{9.2} = V_y - 2 = V_y \end{array}}$$

ⓘ

$$I_x + V_y = 3$$

$$I_x = \cancel{3-9.2 = 6.25}$$

$$P = +IV$$

$$= +\left(\cancel{+6.2}\right) \times 18$$

$$= \cancel{111.6\,W}$$

$$\boxed{= +90\,W\ (\text{absorbing})}$$

ⓘⓘ

$$V_x = -16 + 2$$
$$= -14$$

$$P = +IV$$
$$= 3 \times -14$$

$$\boxed{= -42\,W}$$
$$\boxed{(\text{supplying})}$$

② ⓐ Using mesh,

1,2,3 : $-20 + 10i_1 + 5i_2 + 20 + 10i_3 = 0$

$$\boxed{10i_1 + 5i_2 + 10i_3 = 0 - ①}$$

$$\boxed{i_3 - i_2 = 2 - ②}$$

$i_3 - i_1 = V_y$ $\left[V_y = 10i_3\right]$

$$\boxed{i_1 + 9i_3 = 0 - ③}$$

solving,
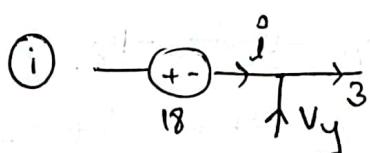
$$\boxed{\begin{array}{l} i_1 = 1.8 \\ i_2 = -3.2 \\ i_3 = -0.2 \end{array}} \; mA$$

$V_y = -2 \; (= V_3)$

ⓘ

$i + V_y = 3$

$i = 5$

$P = +IV$

$= +5 \times 18$
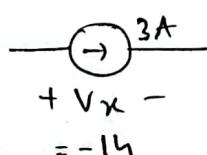
$$\boxed{= 90W \; (absorbing)}$$

ⓘⓘ consider mesh 1, 3 –

$-20 + 10i_1 + 18 + V_x + V_y = 0$

$V_x = 20 - 10(1.8) - 18 - (-2)$

$\qquad = -14V$

$+ V_x -$
$= -14$

$P = +IV$

$= + 3 \times -14$

$$\boxed{= -42 \; W \; (supplying)}$$

②ⓑ $\underline{\text{mesh}}$: $10i_1 + 5i_2 + 10i_3 = 0$ — ①

$$i_3 - i_2 = 5 — ②$$

$$i_1 + 9i_3 = 0 — ③$$

$$\left(V_y = i_3 - i_1 \right)$$
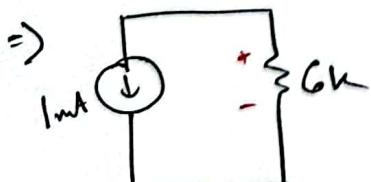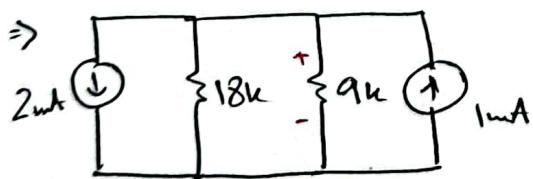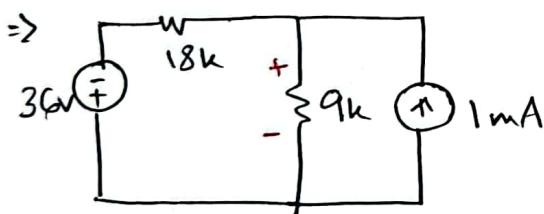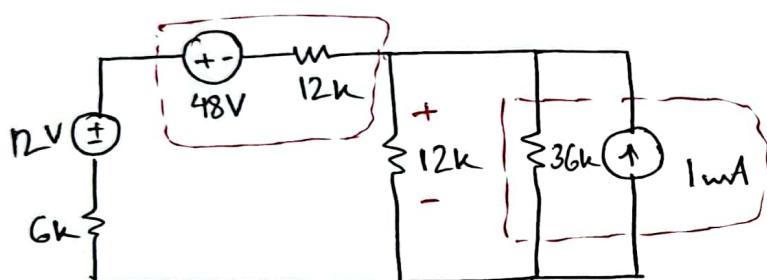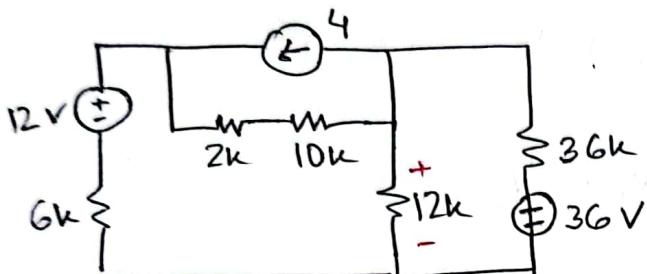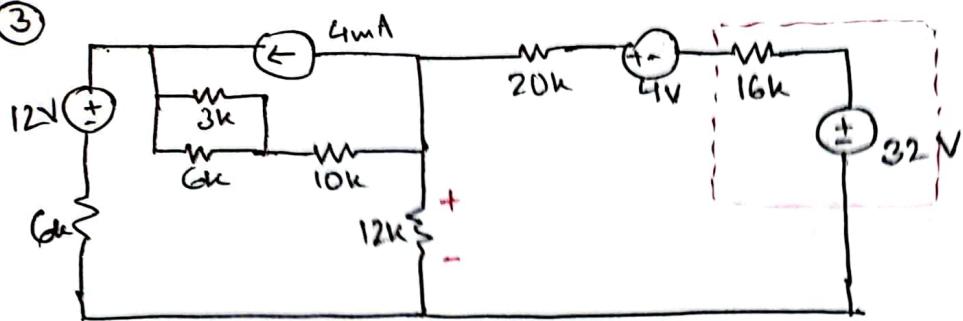
$\underline{\text{nodal}}$: $\dfrac{3}{10} V_1 - \dfrac{6}{5} V_3 = 3$ $\Big/$ $3V_1 - 12V_3 = 30$ — ①

$-\dfrac{1}{5} V_1 + \dfrac{3}{10} V_3 = -1$ $\Big/$ $-2V_1 + 3V_3 = -10$ — ②

$$V_1 - V_2 = 18 — ③$$

$$\left(V_y = V_3 \right)$$

③

4mA
12V
3k
6k
10k
20k
4V
16k
12k
6k
32 V

4
12v
2k   10k
6k
36k
12k
36 V

48V
12k
12v
12k   36k   1mA
6k

=>

18k
36v
9k   1mA

=>

2mA
18k   9k   1mA

=>

1mA
6k

$$V_x = -1 \times 6$$
$$= -6 V$$

(4)

shorted 4k

6k   6k

3k   3k

24k

24k

12k

6k   6k

3k   6k   3k

12k

12k

$R_{eq} = 12k \parallel 12k$

$= 6k$