Electrical Engineering

Electronics and Communication Engineering

Instrumentation Engineering

Lecture No. 04

Basics of Network Theory

By- Pankaj Shukla sir

1. KVL & KCL.
2. Power & energy concept.
3.
4.
5.
6.

1. Question Discussion.
2.
3.
4.
5.
6.

How to Solve Numericals Based on Concepts we have studied.

We will apply in 95% of the cases, the (Inspection Method) to the Desired value.
—OR—

In this method:

(1) We will find the current in each branch of the circuit by using KCL.

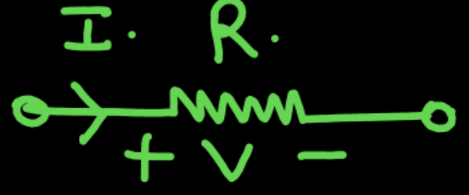
(2) Now we will apply KVL in the loops of circuit & Develope the equation in terms of Variables.

(3) Now solve the equations Developed & find the Desired response.

Note:

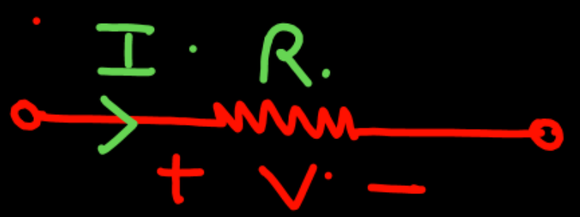
(1) While applying "Inspection Method" it is recommended that maintain number of variables in the circuit less than two are equal to two.

(2) Follow the sign conventions as given below.



Current Direction known.

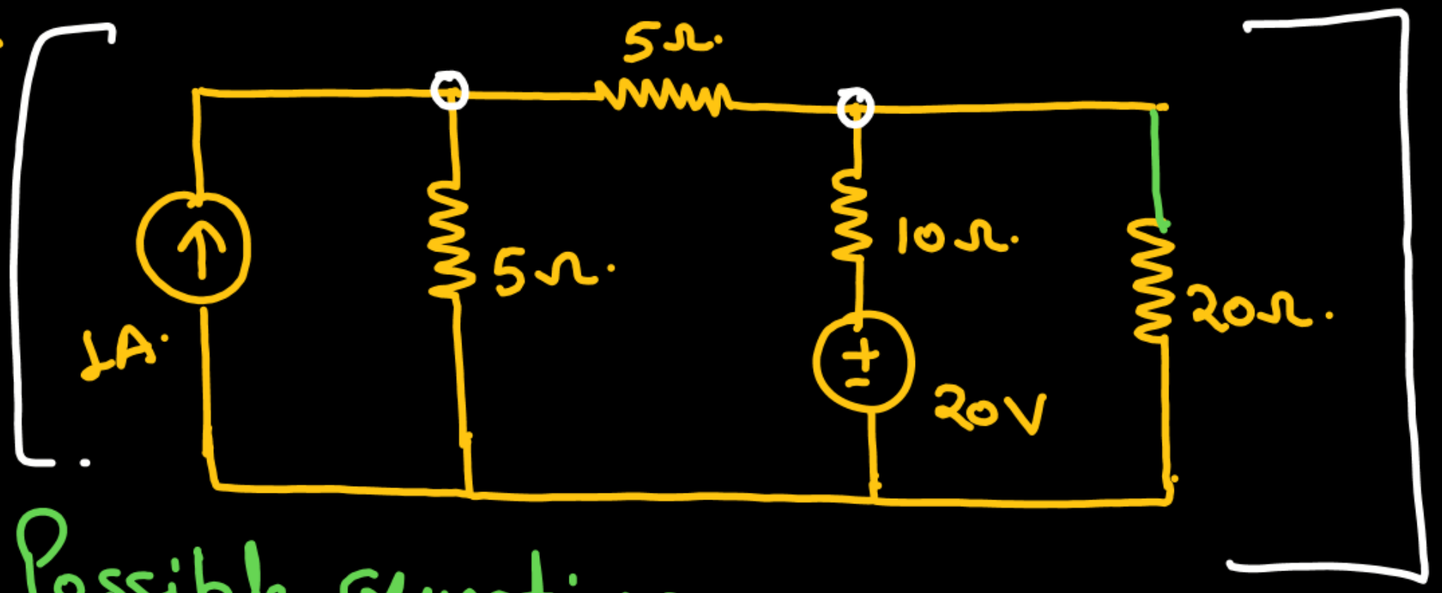
(Case - I)



Voltage Polarity is known.

(Case - II)

Q.



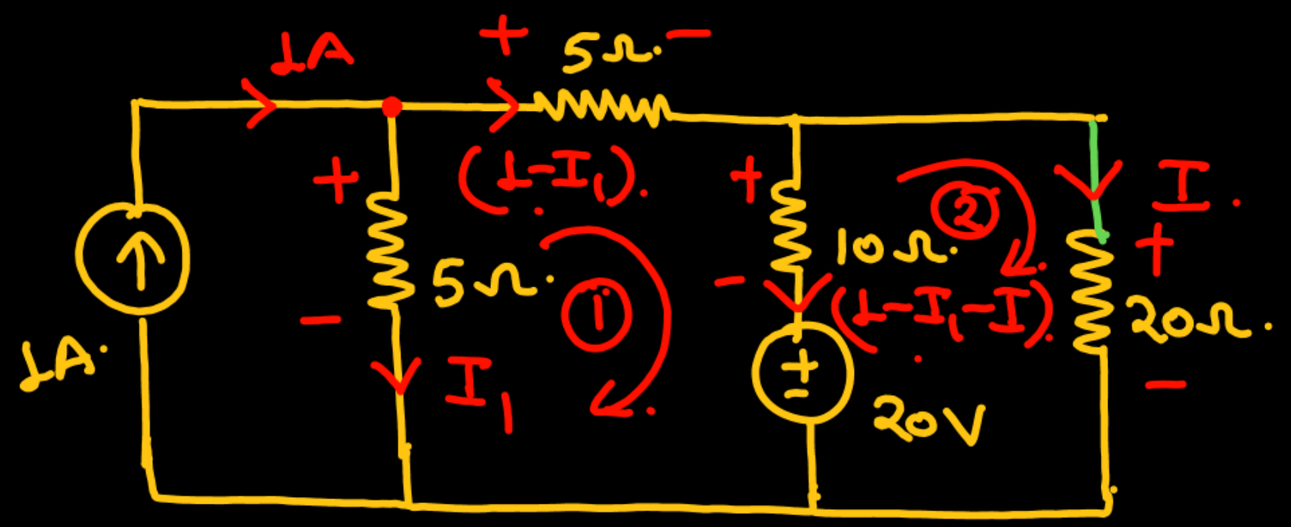
Possible Questions.

(1) Find the current in 20Ω.

(2) Find the Total Power Delived in the ckt.

(3) Find the total Powers Dissipated in the circuit.

(4) Find the total consumed Power in the circuit.



- (Inspection Method - 01)

KVL - 02.

$20 + 10 \times (1 - I_1 - I) = 20I$

$20 + 10 - 10I_1 - 10I = 20I$

$10I_1 + 30I = 30$

$[I_1 + 3I = 3] - ②$

- KVL → ①

$5I_1 = 5 \times (1 - I_1) + 10 \times (1 - I_1 - I) + 20$

$5I_1 = 5 - 5I_1 + 10 - 10I_1 - 10I + 20$

$20I_1 + 10I = 35$

$[4I_1 + 2I = 7] - ①$

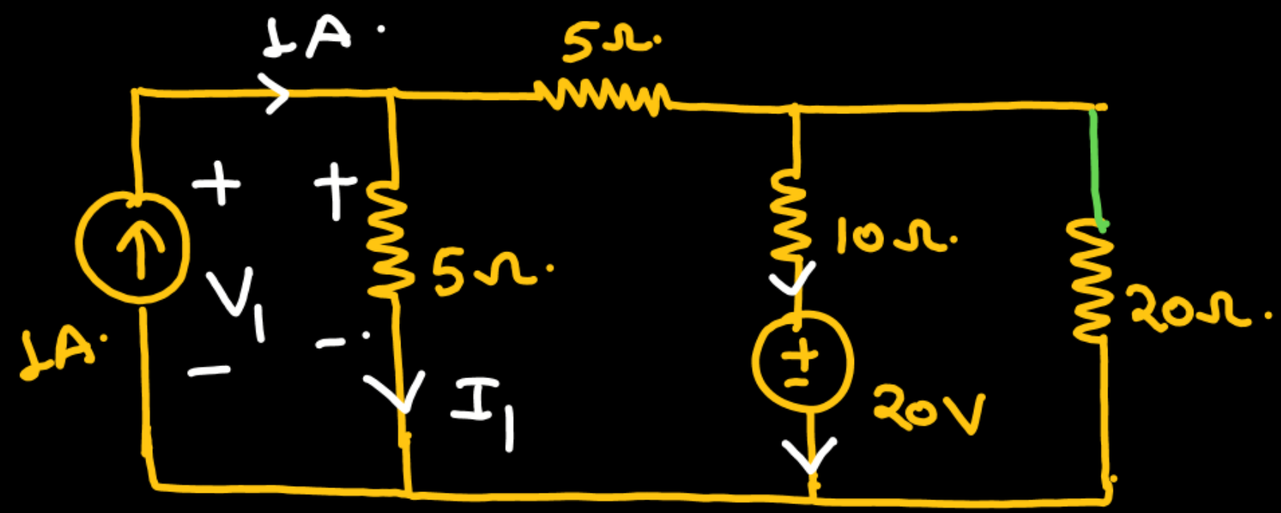
$4I_1 + 2I = 7$.

$4 \times [\; I_1 + 3I = 3 \;]$

$I(2 - 3\times4) = 7 - 3\times4$.

$$\left[I = \frac{-5}{-10} = +\frac{1}{2} = 0.5\,A \right]$$

- $\left[I_1 = 3 - 3I = 3 - 3\times\frac{1}{2} = 1.5 \right]$



$P_{T(delivered)} = ?$

$P_{20V} = 20 \times (1 - I_1 - I) = 20 \times (1 - 1.5 - 0.5) = -20\,W\,(A)$

or

$+20\,W\,(D)$

$P_{1A} = V_1 \times 1 = (5 \times I_1) \times 1 = 5 \times 1.5 \times 1 = 7.5\,W\,(D)$

or

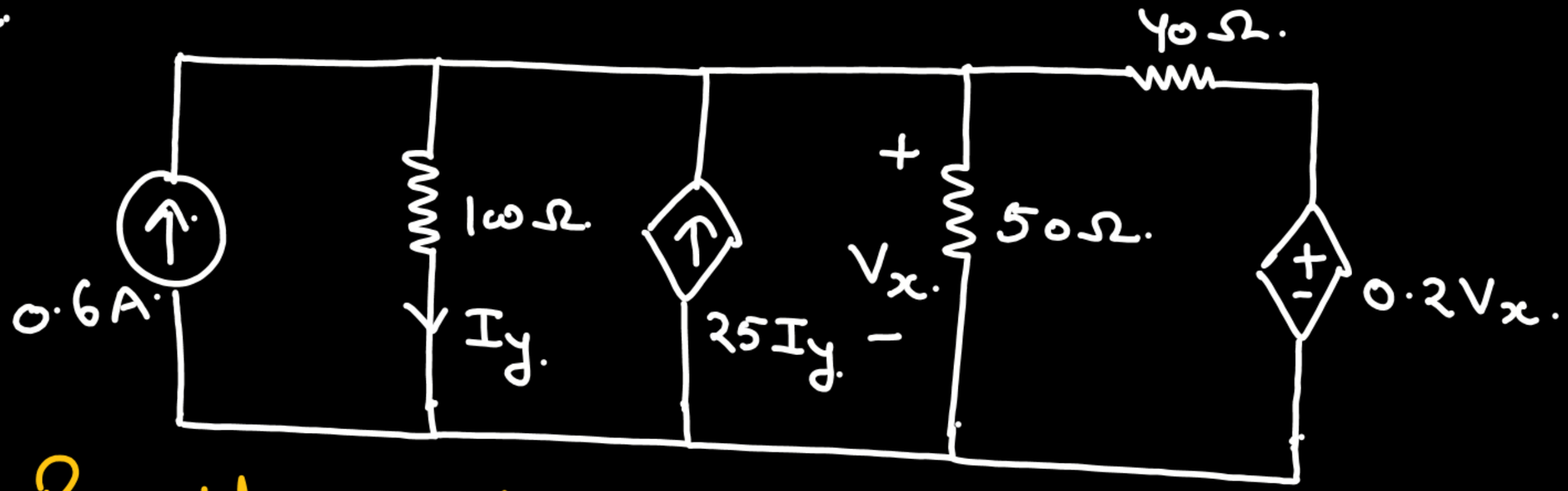
$-7.5\,W\,(A)$

$P_{T(delivered)} = 20 + 7.5 = 27.5\ watt$

$= P_{T(absumb)} = P_{T(consumed)}$

- $\left[P_T(\text{dissipated}) = P_T(\text{absorb}) - 0 = 27.5 \text{ watt}\right]$.

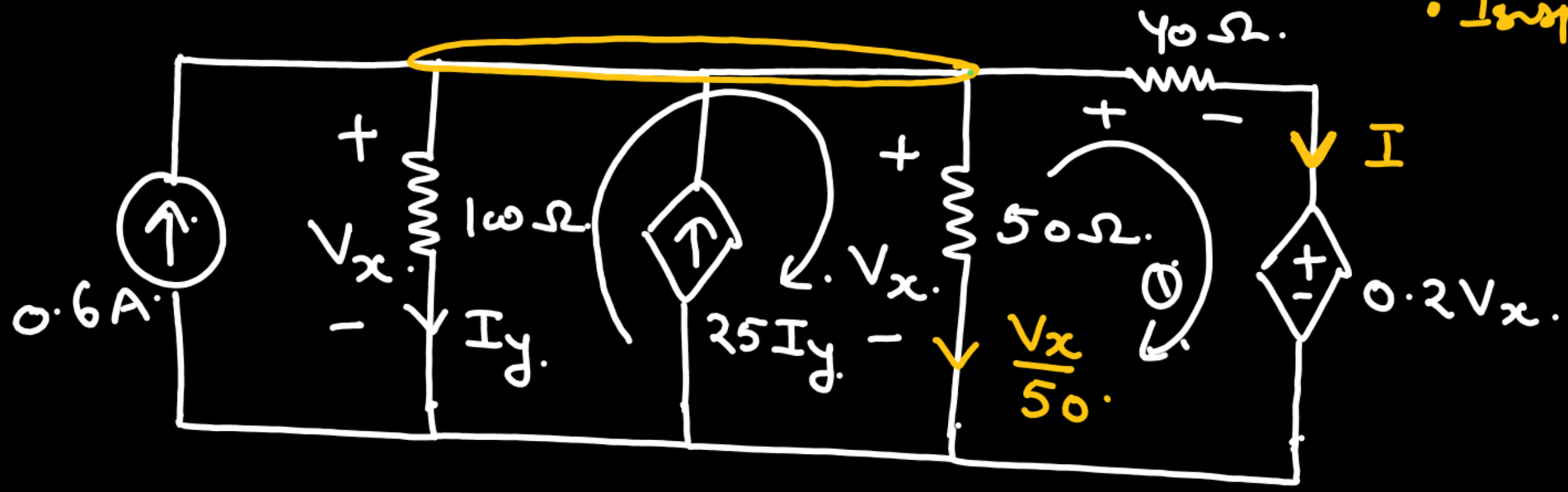
Q.



Possible Questions:

1. Find V_x & I_y.
3. Find the. P_T(delivered), P_T(absorb), P_T(dissipated)

• Inspection method — 01



$$I + \frac{V_x}{50} + I_y = 0.6 + 25I_y$$

$$I = \left(0.6 + 25I_y - I_y - \frac{V_x}{50}\right) = \left(0.6 + 24I_y - 0.02V_x\right)$$

• KVL → (01)

$$V_x = 0.2V_x + 40 \times (0.6 + 24I_y - 0.02V_x)$$

$$V_x(1 - 0.2 + 40 \times 0.02) - 40 \times 24I_y = 40 \times 0.6$$

$$1.6V_x - 960I_y = 24 \quad \text{——(1)}$$

- KVL-02.

$$V_x = I_y \times 1\omega$$

$$[V_x - 1\omega I_y = 0] \quad \text{——(2)}$$

- $1.6 \times [V_x - 1\omega I_y = 0]$

$$1.6V_x - 960I_y = 24$$

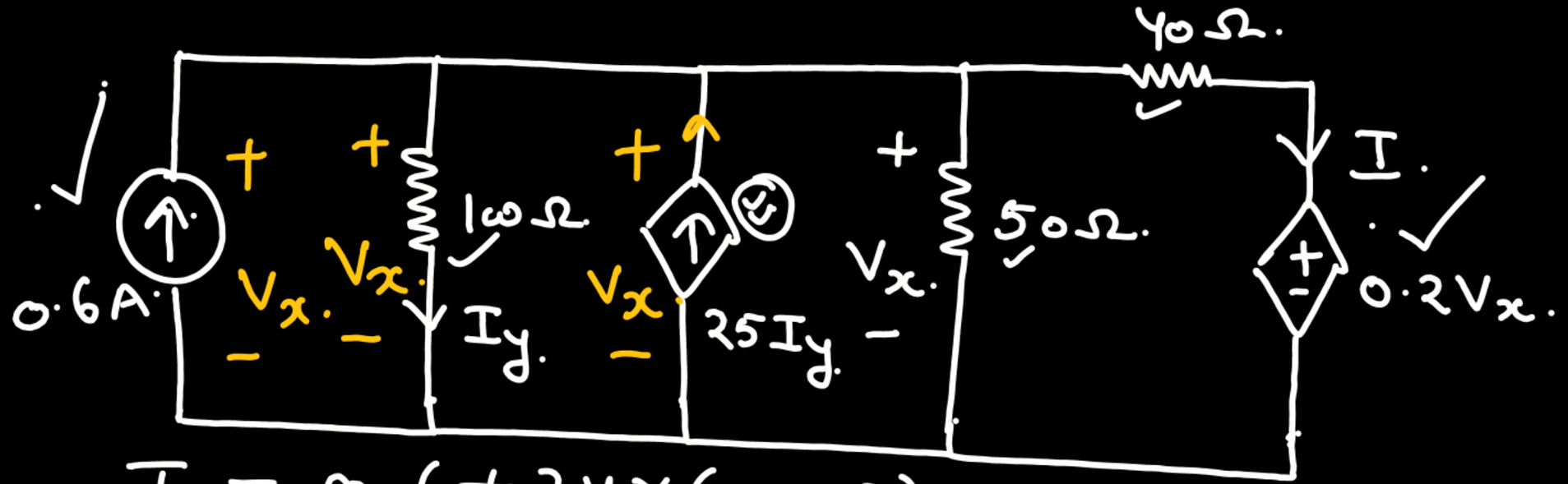
$$I_y(-1\omega \times 1.6 + 960) = 0 - 24$$

$$\left[I_y = \frac{-24}{8\omega} = -0.03\ A\right]$$

$V_x = 1\omega \times I_y$

$V_x = 1\omega \times (-0.03)$

$= (-3\ \text{Volt})$



$$I = 0.6 + 24 \times (-0.03) - 0.02 \times (-3).$$

$$[I = 0.6 - 0.72 + 0.06 = -0.06\,A]$$

- $P_{0.2V_x} = (0.2 \times V_x) \times I = 0.2 \times (-3) \times (-0.06) = 0.036$ watt (A).

  $P_{0.6A} = 0.6 \times V_x = 0.6 \times (-3) = -1.8$ W (D).

  on. $+1.8$ W (A).

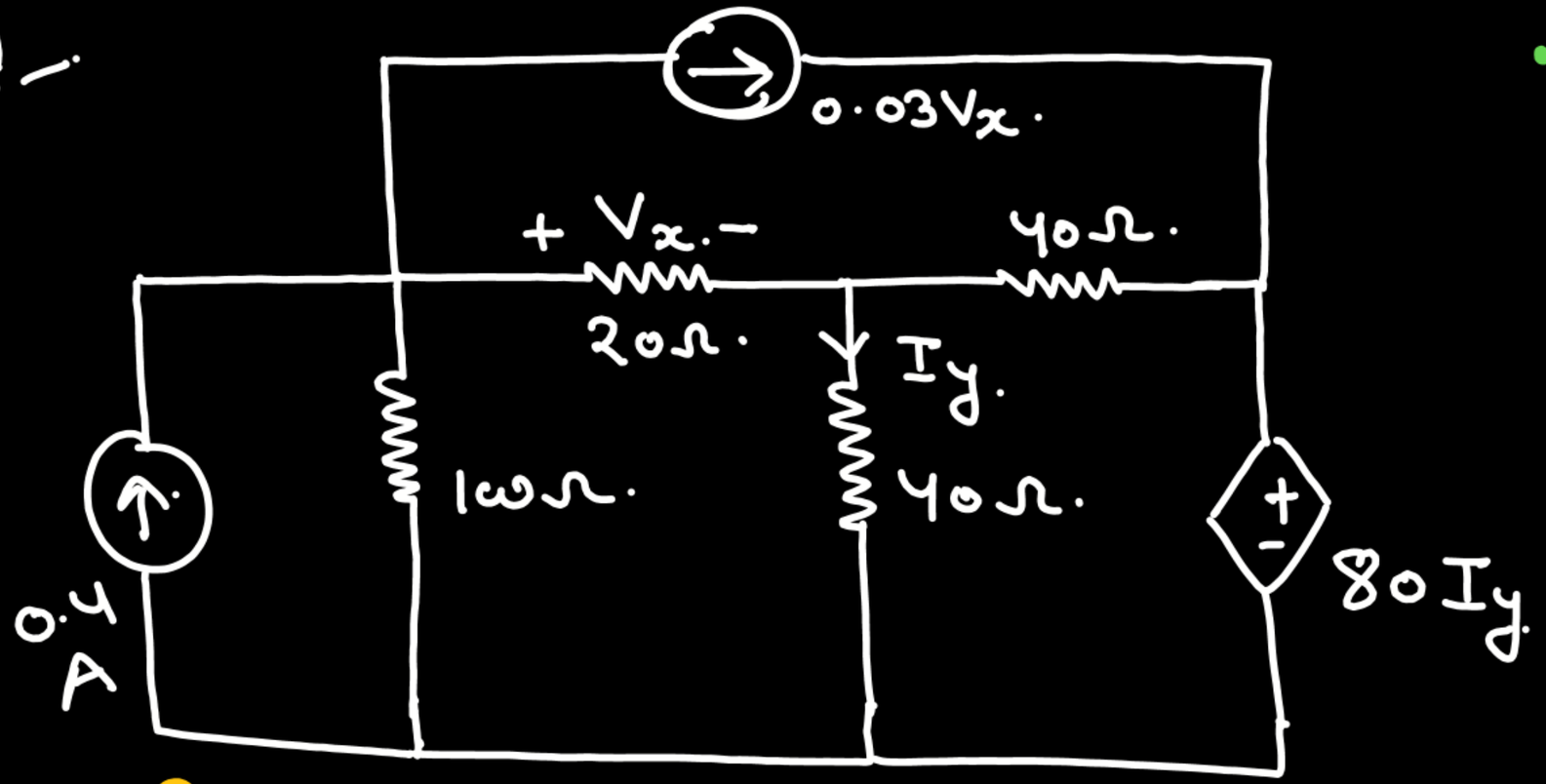
  on. -0.036 watt (D).

- $P_{25I_y} = (25I_y) \times V_x = 25 \times (-3) \times (-0.03)$
  $= 2.25\ W$ (D) or $-2.25\ W$ (A).

- $P_{T(delivered)} = P_{T(absorb)} = P_{T(consumed)}$.
  $= (2.25\ W)$

- $P_{T(dissipated)} = 2.25 - P_{0.6} - P_{0.2V_x}$.
  $= (2.25 - 1.8 - 0.036)$.
  $= (0.414\ W)$

Q. –

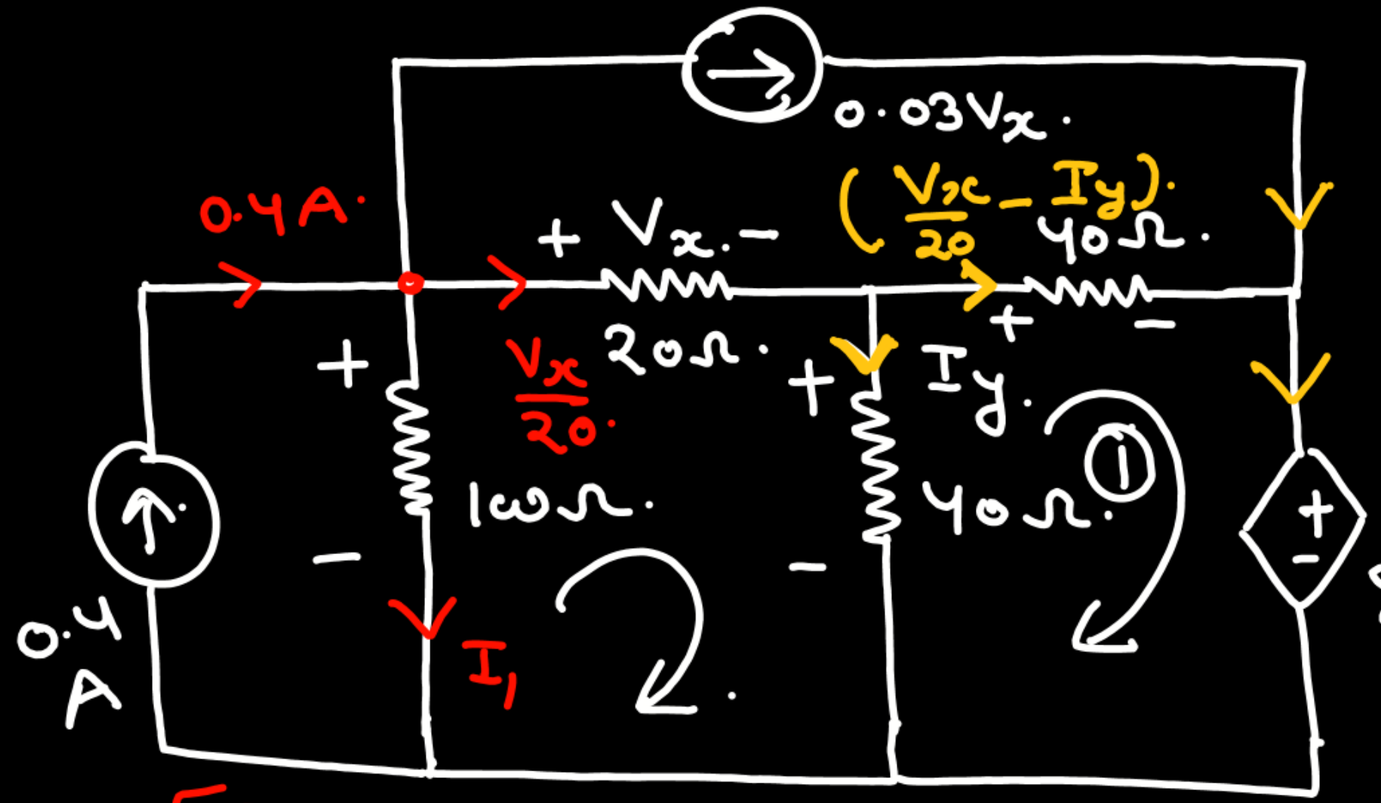


- Inspection Method.

Possible Question:

(1) Find V_x & I_y.

(2) Find P_T (delivered).



$$\frac{V_x}{20} - I_y + 0.03V_x = \left(0.08V_x - I_y\right)$$

$$\therefore$$

$$\left[I_1 = 0.4 - \frac{V_x}{20} - 0.03V_x = 0.4 - 0.08V_x\right]$$

KVL-OL.

$$40I_y = 40 \times (0.05V_x - I_y) + 80I_y$$

$$I_y(40 - 80 + 40) - 2V_x = 0$$

$$0 - 2V_x = 0$$

$$[V_x = 0V]$$

- KVL – 02 →

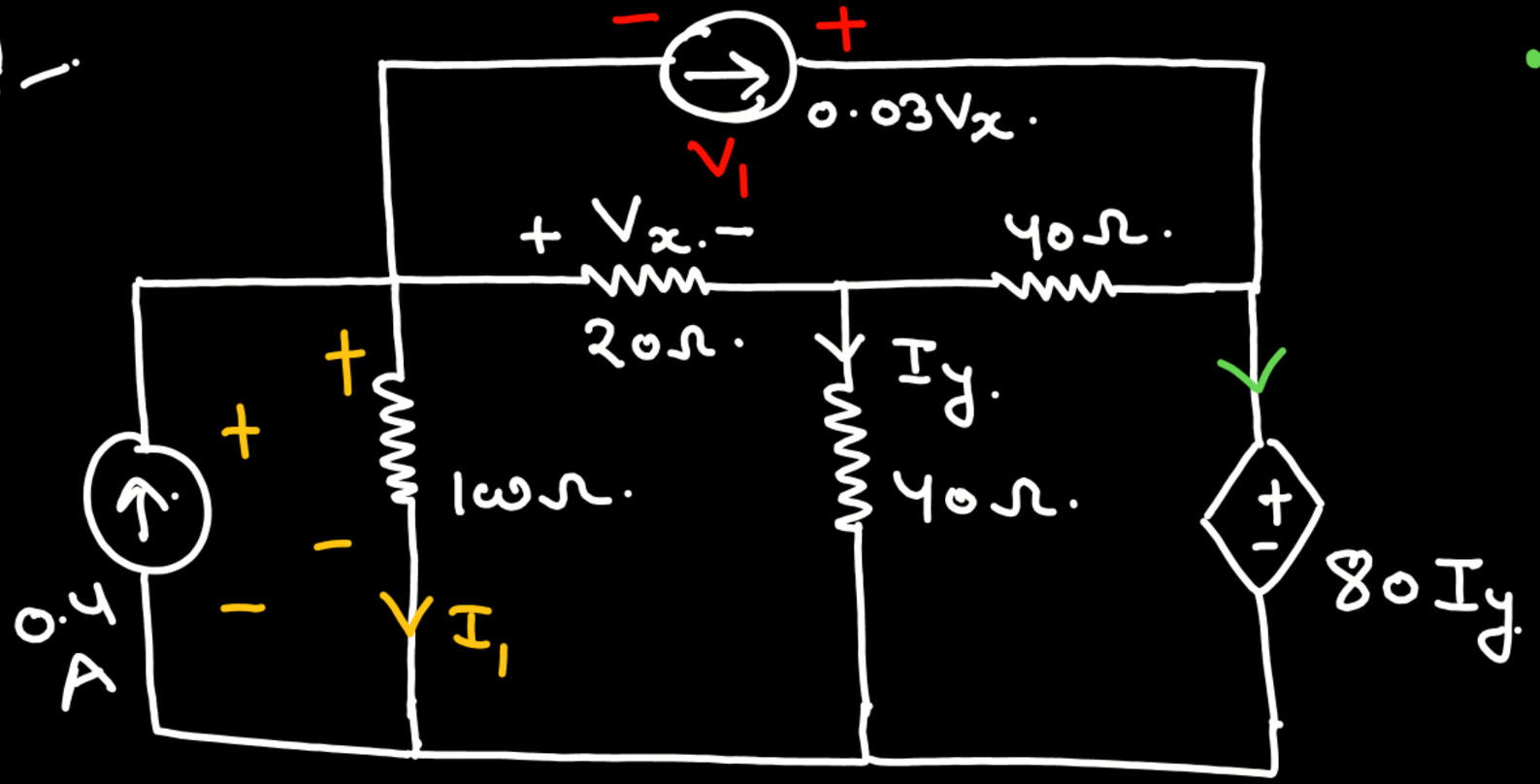
$$10\omega \times I_1 = V_x + 40 I_y$$

$$10\omega \times (0.4 - 0.08 V_x) = V_x + 40 I_y$$

$$40 I_y = 10\omega \times 0.4$$

$$\left[I_y = \frac{10\omega \times 0.4}{40} = 1\,A \right]$$

Q. –



- Inspection Method.

$$P_{80I_y} = 80 \times I_y \times (0.08V_x - I_y) = -80\,W\ (A) \text{ or } +80\,W\ (D)$$

$$P_{0.4A} = 0.4 \times (1\omega \times I_1) = 0.4 \times 1\omega \times (0.4 - 0.08V_x)$$

$$= 16\,W\ (D) \text{ or } -16\,W\ (A).$$

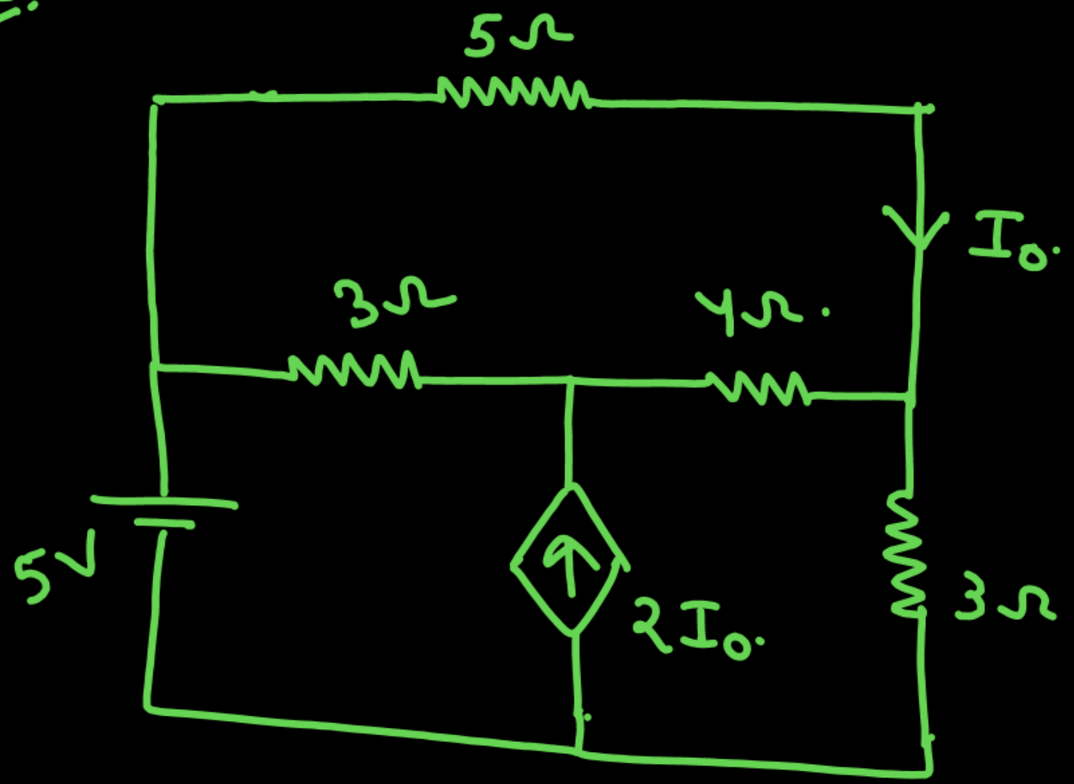
$P_{0.03V_x} = (0.03V_x) \times V_1 = 0\ W.$

- $P_T(\text{delivered}) = P_T(\text{absorb}) = P_T(\text{consumed}).$
  $= 80 + 16 = 96\ W.$

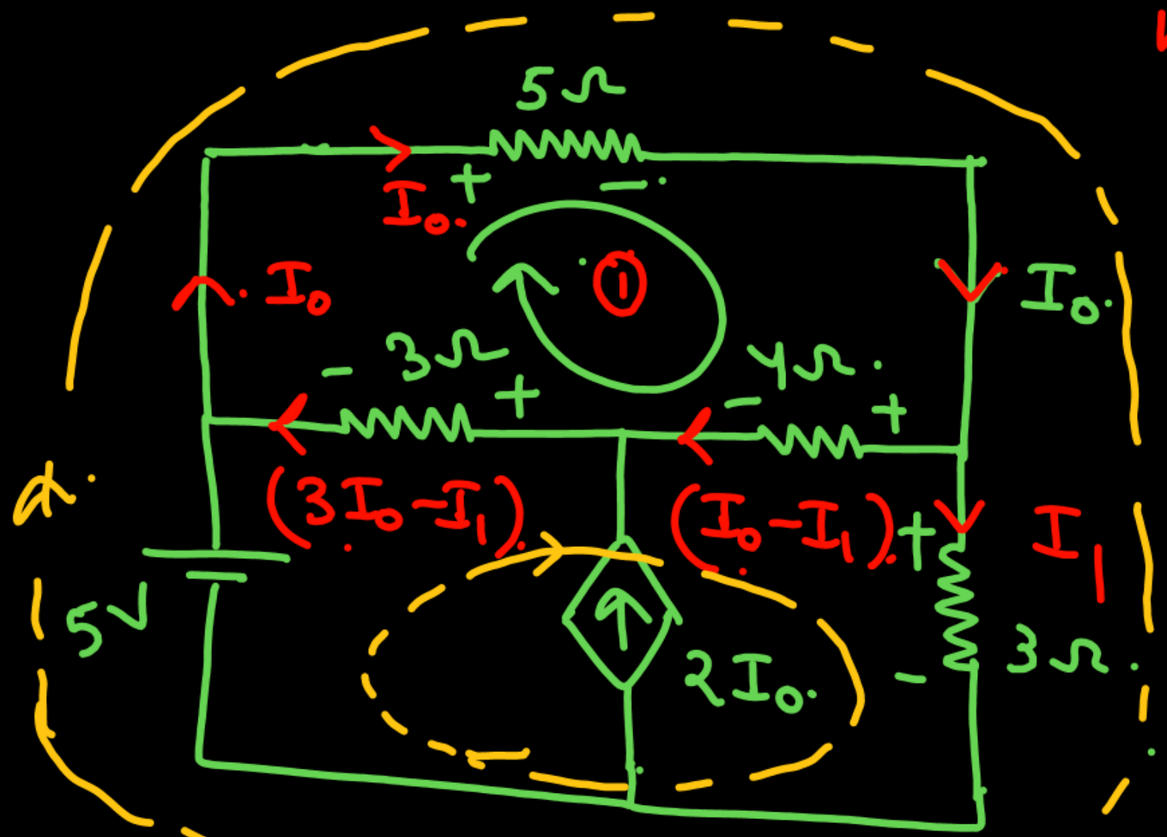
- $P_T(\text{dissipated}) = 96 - 0 = 96\ \text{watt}.$

Q.-

- Inspection method → 01



Find the current I_o = ?



KVL-01.

$5I_0 + 4\times(I_0-I_1) + 3\times(3I_0-I_1) = 0.$

$[18I_0 - 7I_1 = 0]$ —— ①

KVL-02

$5 + 3\times(3I_0-I_1) + 4\times(I_0-I_1) = 3I_1$

$13I_0 - 10I_1 = -5$ —— ②

$10\times[18I_0 - 7I_1 = 0]$

$7\times[13I_0 - 10I_1 = -5]$

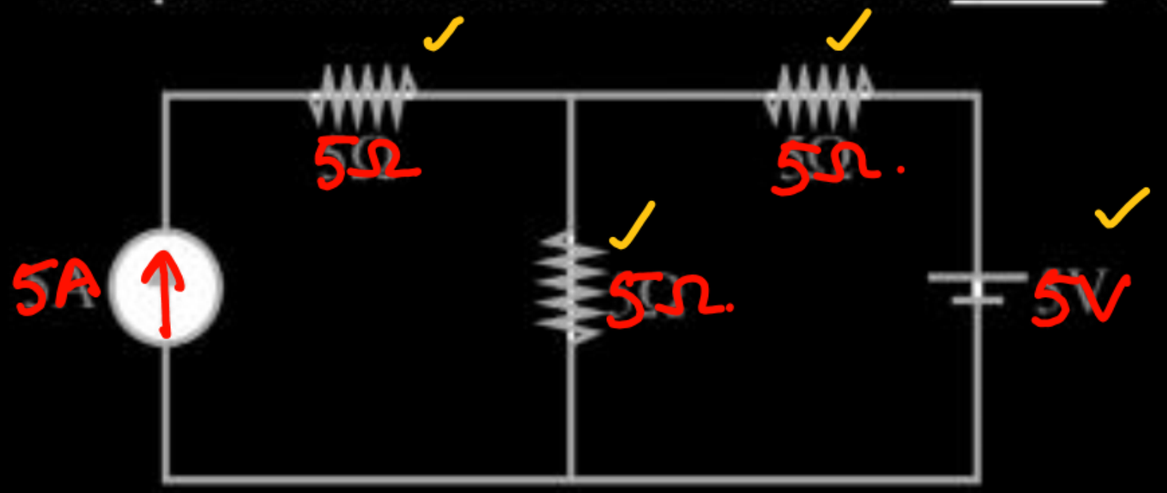
$I_0\times(180 - 13\times7) = +5\times7$

$I_0 = \frac{35}{89} = 0.3932 \simeq 0.4\ A$

"Inspection method"

Question

Total power consumed in the circuit below is _____ W.

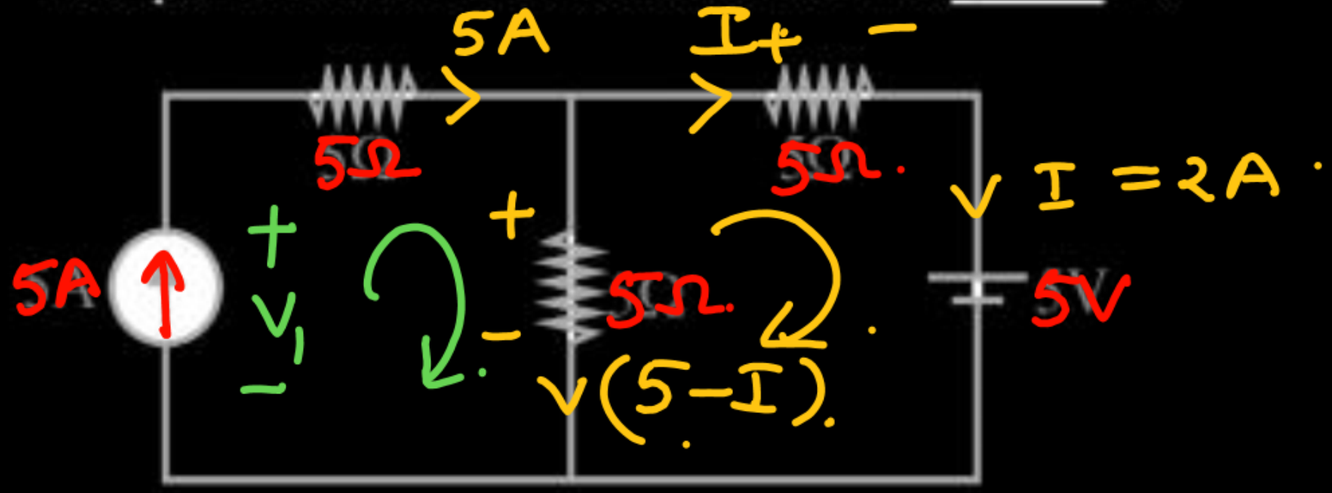


$P_{T(delivered)} = P_{T(absorbed)} = P_{T(consumed)}$

"Inspection Method".

Question

Total power consumed in the circuit below is _____ W.



$P_{5V} = 5 \times 2 = 10\,W\,(A)$.
or
$-10\,W\,(D)$.

$P_{5A} = V_1 \times 5 = 40 \times 5 = 200$
$= -200\,W\,(A).\ (D)$

$5 \times (5 - I) = 5 + 5I$.

$25 - 5I = 5 + 5I$.

$10I = 20$

$[I = 2A]$.

- $V_1 = 5 \times 5 + 5 \times (3)$.
  $= 25 + 15$.
  $= 40$ volt.

$P_T(del) = P_T(absub) = P_T(consumed) = 200\ Watt$

- $[P_T(dissipated) = 200 - 10 = 190\ W]$

@pankajshuklasirpw

telegram.

Thank you

GW

Soldiers !