Paper 1, TDC Part-1
Chapter– 3, Mesh and Node Analysis
Solution of problems

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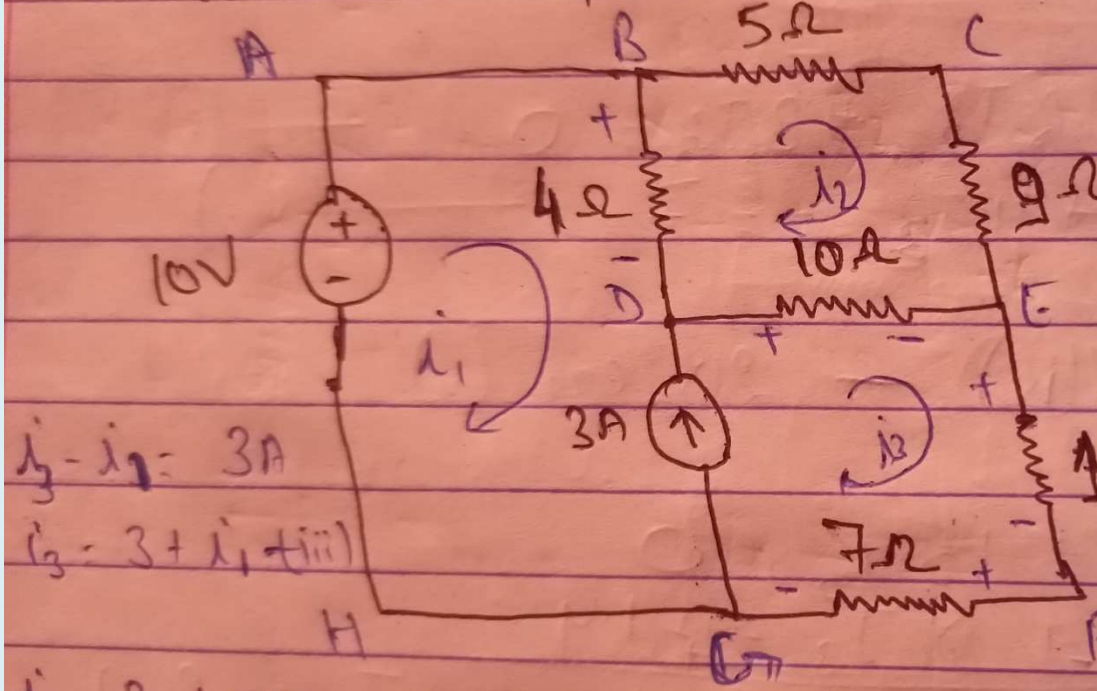
Mesh and Nodal Analysis in Passive Circuits

Question for practice

Determine the current i_1 in the circuit shown below.



In supermesh ABDEFGHA

$4i_1 - 14i_2 + 18i_3 = 10$ ...(i)

In mesh BCEDB

$+4i_1 - 28i_2 + 10i_3 = 0$ ...(ii)

$i_3 - i_2 = 3A$

$i_3 = 3 + i_2$ ...(iii)

$22i_1 - 14i_2 = -44$ ×2

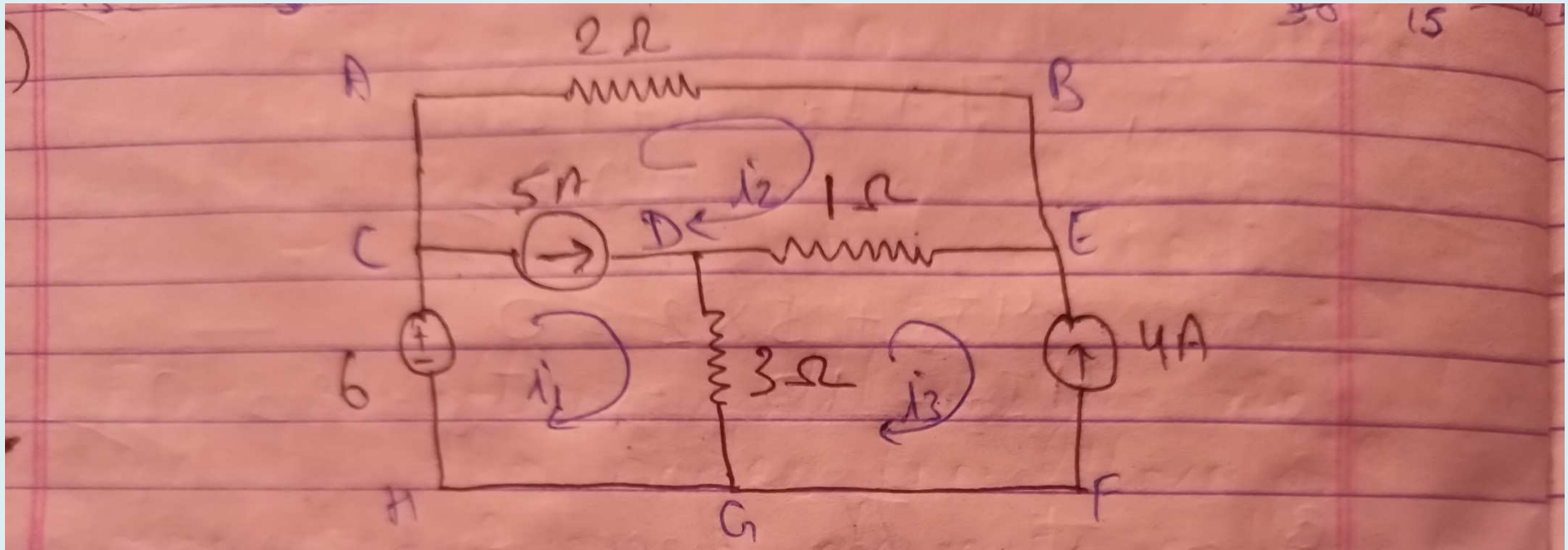
$14i_1 - 28i_2 = -30$

$30i_1 = -58$

$i_1 = \frac{-58}{30} = \frac{-29}{15} = -1.93A$

$i_3 = 3 - 1.93A = 1.07A$, $i_2 = 0.11A$

Mesh and Nodal Analysis in Passive Circuits



Determine current through all resistors of circuit shown above.

$i_3 = -4A$,

$i_1 - i_2 = 5A$

$i_1 = 5 + i_2$

In supermesh ABEDGHA

$3i_1 + 3i_2 - 4i_3 = 6$

$3(5 + i_2) + 3i_2 - 4(-4) = 6$

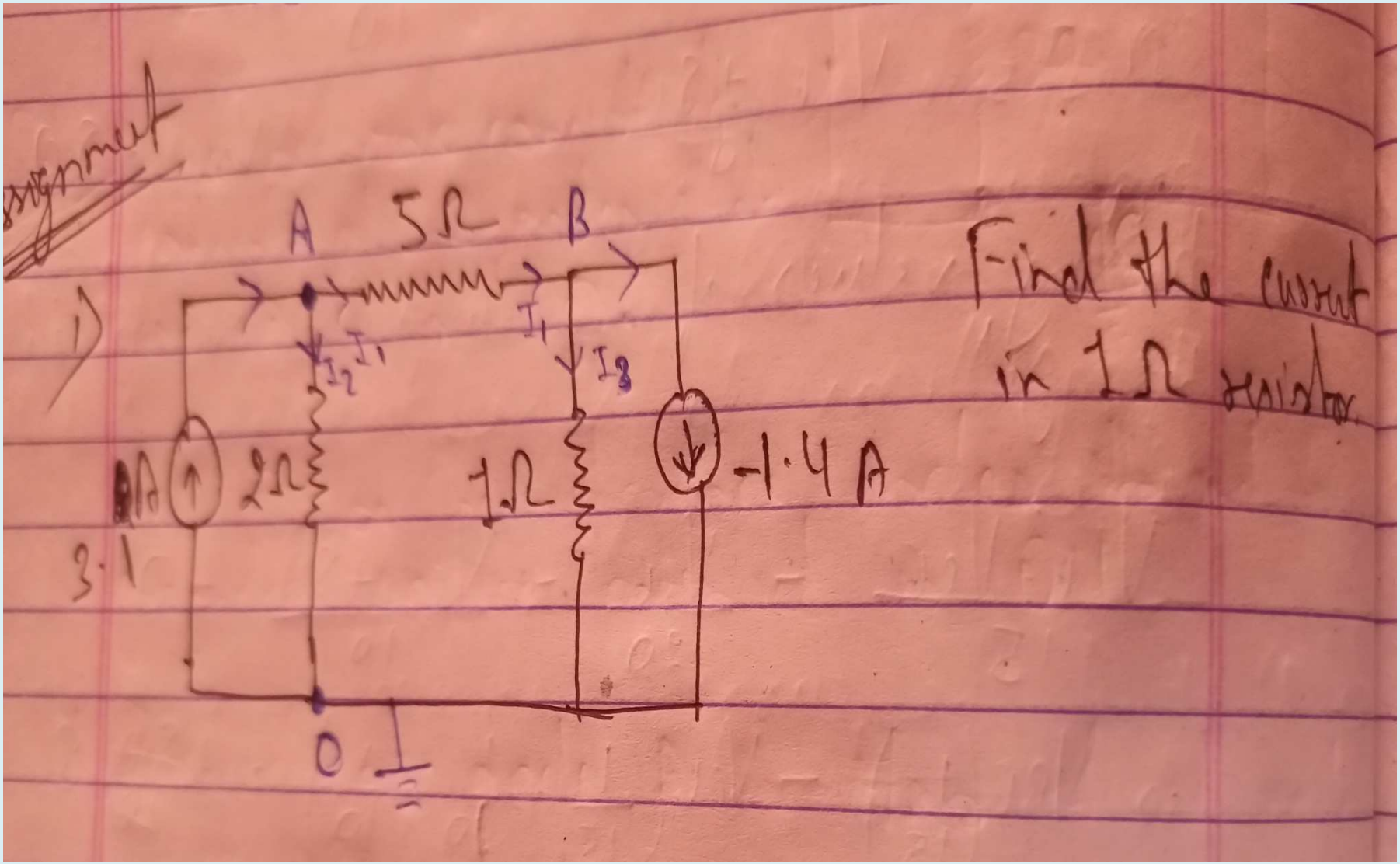
$6i_2 + 31 = 6$

$i_2 = \frac{-25}{6} = -4.17A$

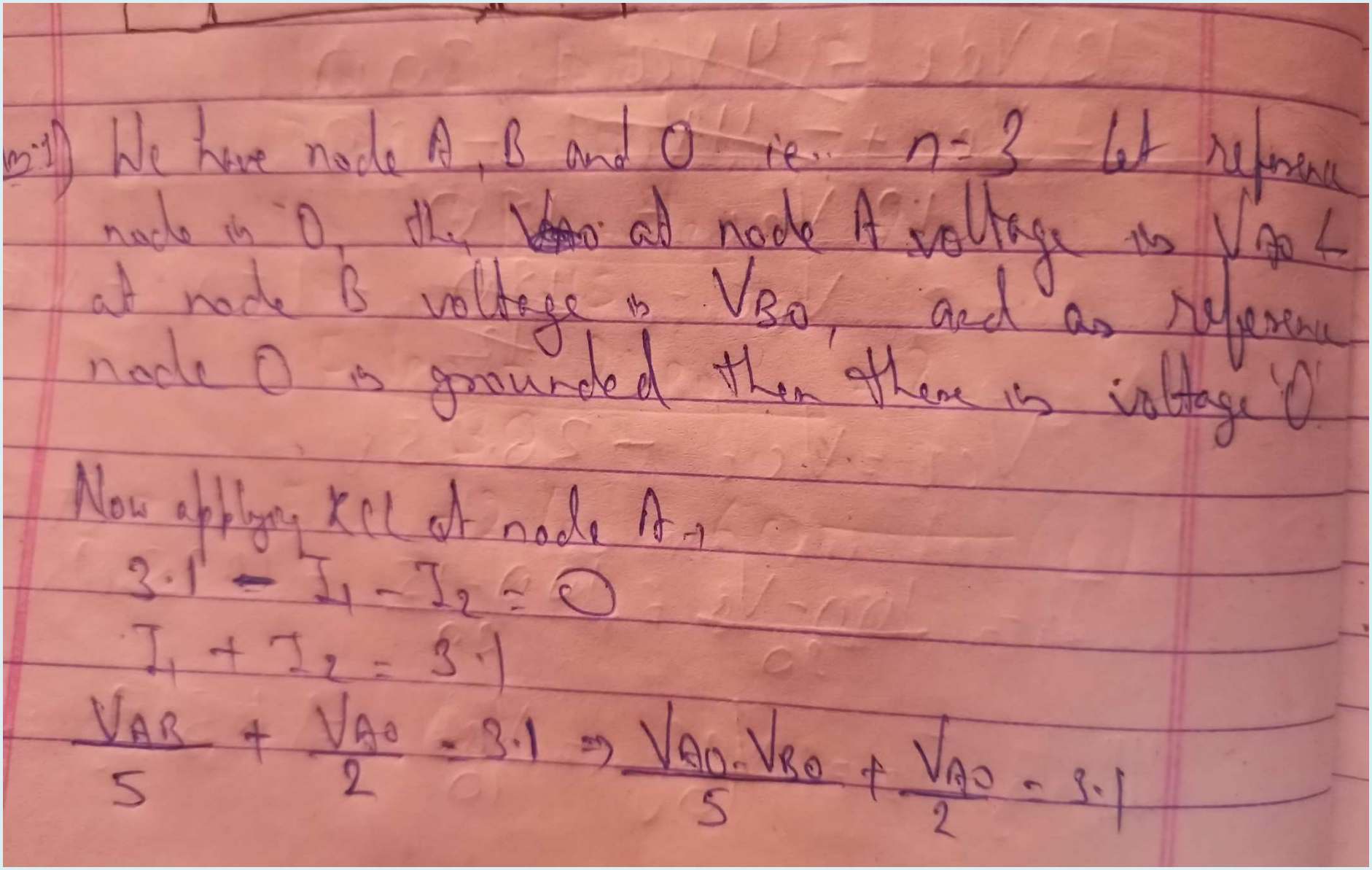
$i_1 = 5 - 4.17$

$= .83\ A$

Mesh and Nodal Analysis in Passive Circuits



Mesh and Nodal Analysis in Passive Circuits



Mesh and Nodal Analysis in Passive Circuits

$$\frac{7V_{AO}}{10} - \frac{V_{BO}}{5} = 3.1 \Rightarrow 7V_{AO} - 2V_{BO} = \ldots \quad (i)$$

KCL at node B, $I_1 + I_3 - (-1.4A) = 0$

$$I_1 - I_3 + 1.4 = 0$$

$$\Rightarrow \frac{V_{AB}}{5} - \frac{V_{BO}}{1} = -1.4$$

$$\Rightarrow \frac{V_{AO}}{5} - \frac{6V_{BO}}{5} = -1.4 \Rightarrow V_{AO} - 6V_{BO} = -7 \quad \ldots (ii)$$

eqn(i)×3 − eqn. (ii) results

$$21V_{AO} - 6V_{BO} = 93$$

$$-V_{AO} + 6V_{BO} = +7$$

$$20V_{AO} = 100 \Rightarrow V_{AO} = \frac{100}{20} = 5V$$

Mesh and Nodal Analysis in Passive Circuits

$$V_{BO} = \frac{31-35}{-2} = \frac{+4}{+2} = 2V$$

Current flowing ~~left to right~~ through the 1 Ω resistor is

$$I_{1\Omega} = \frac{V_{BO}}{1\Omega} = \frac{2V}{1\Omega} = 2A$$

Or, $I_1 = I_3 + (-1.4)$

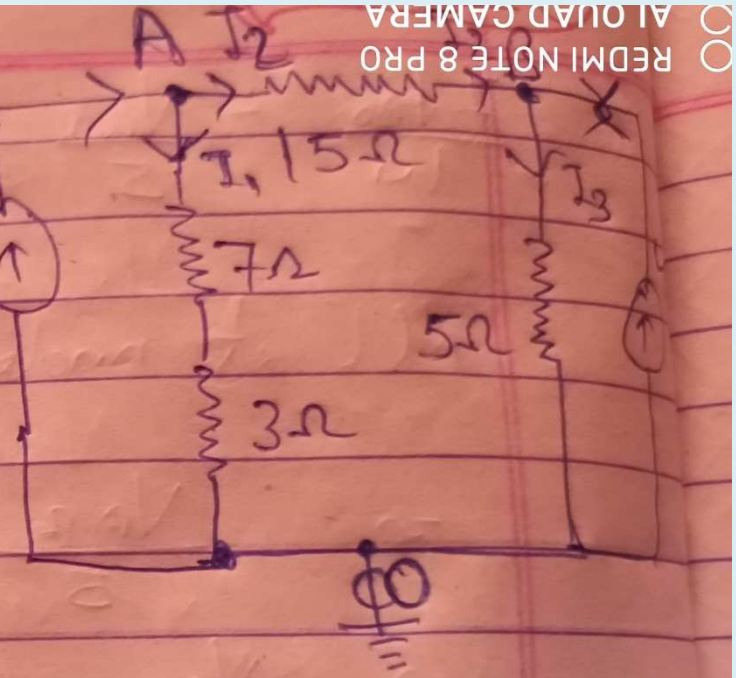
or, $I_3 = I_1 + 1.4$

$$= \frac{V_{AO} - V_{BO}}{5} + 1.4$$

$$= \frac{5-2}{5} + 1.4 = \frac{3}{5} + 1.4 = 0.6 + 1.4 = 2A$$

Mesh and Nodal Analysis in Passive Circuits

(2) To find current through 15 Ω resistor from left to right.



Sol: The network consist of consist of 3 nodes that are A, B and O.

Let O be the reference nodes and is grounded so its potential is 0 V.

Let Potential at node A is V_{AO} & at node B is V_{BO},

Mesh and Nodal Analysis in Passive Circuits

Applying KCL at node A

$2A \rightarrow I_1 - I_2 = 0$

$\Rightarrow I_1 + I_2 = 2$

$$\frac{V_{AO}}{(7+3)} + \frac{V_{AB}}{15} = 2$$

$$\Rightarrow \frac{V_{AO}}{10} + \frac{V_{AO} - V_{BO}}{15} = 2$$

$$\Rightarrow \frac{5V_{AO} - 2V_{BO}}{30} = 2$$

$\Rightarrow 5V_{AO} - 2V_{BO} = 60$ ——— (i)

Mesh and Nodal Analysis in Passive Circuits

KCL at node B,

$I_2 + 4A = I_3$

$I_3 - I_2 = 4A$

$\frac{V_{BO}}{5} + \frac{V_{AO} - V_{BO}}{15} = 4$

$\Rightarrow V_{AO} + 2V_{BO} = 60$ ——— (ii)

Adding eqn. (i) & (ii) results

$6V_{AO} = 120 \Rightarrow V_{AO} = 20\,V$

$V_{BO} = 20V$

Current in 15Ω resistor is $I_{15\Omega} = \frac{V_{AB}}{15}$

$= \frac{V_{AO} - V_{BO}}{15} = \frac{20 - 20}{15} = 0$

So current through 15Ω resistor is 0A.

Mesh and Nodal Analysis in Passive Circuits

For any query contact- 9771474020

Thank You