Quiz 5 Solution (mesh and supermesh)

Electrical Circuits 1

TE1002

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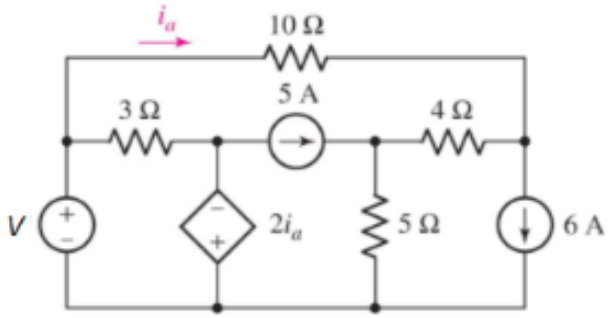
Consider the circuit given below.



If V = 4 V, determine the power absorbed by the 10-Ω resistor.

The value of the power absorbed by the 10-Ω resistor is 30.1662 ± 2% W.

Explanation:

With the top node naturally associated with a clockwise mesh current i_a, we name (left to right) the remaining mesh currents (all defined flowing clockwise) as i_1, i_2 and i_3, respectively.

We create a supermesh from meshes "a" and "2", noting that i_3 = 6 A based on inspection.

The mesh equations are

$$-4 + 3i_1 - 2i_a - 3i_a = 0$$

$$2i_a + 3i_a - 3i_1 + 10i_a + 4i_a - (4 \times 6) + 5i_2 - (5 \times 6) = 0$$

$$i_2 - i_a = 5$$

On solving the simultaneous equations, we get

i_a = 1.7368 A

i_1 = 4.2281 A

i_2 = 6.7368 A

$$P_{10\Omega} = 10 \times i_a{}^2 = 30.1662 \text{ W}$$

The value of the power absorbed by the 10-Ω resistor is 30.1662 W.