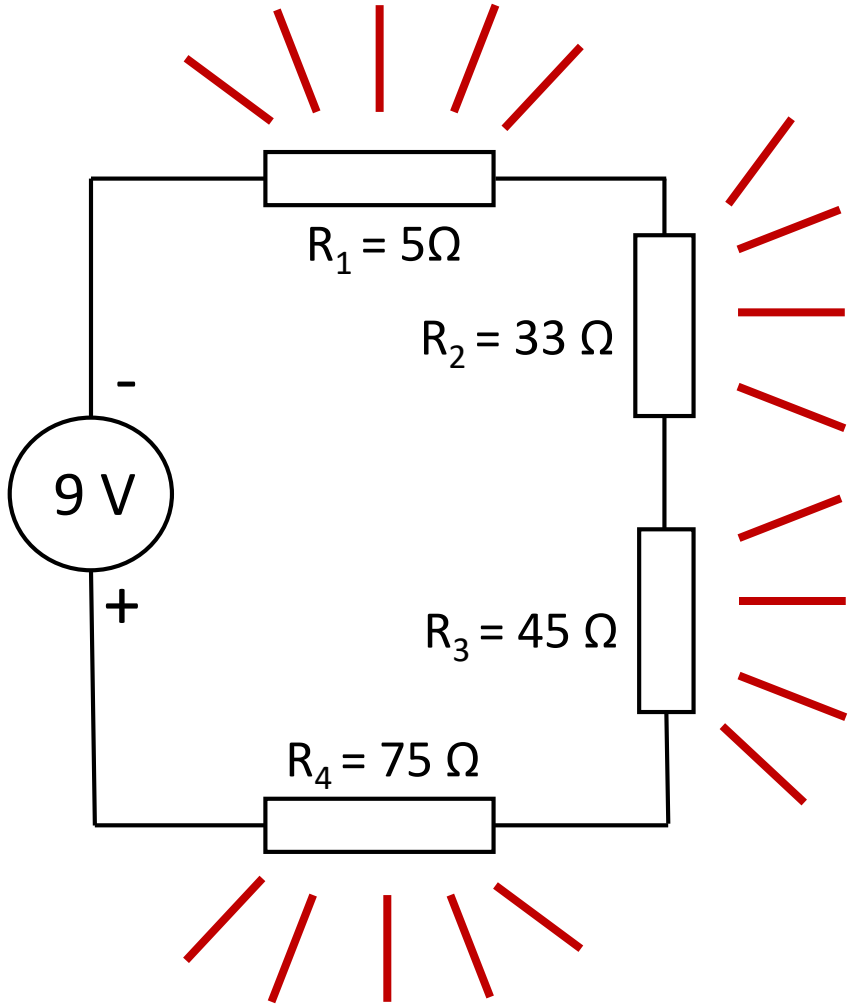
1.

Find electric power in all resistors in the circuit below.



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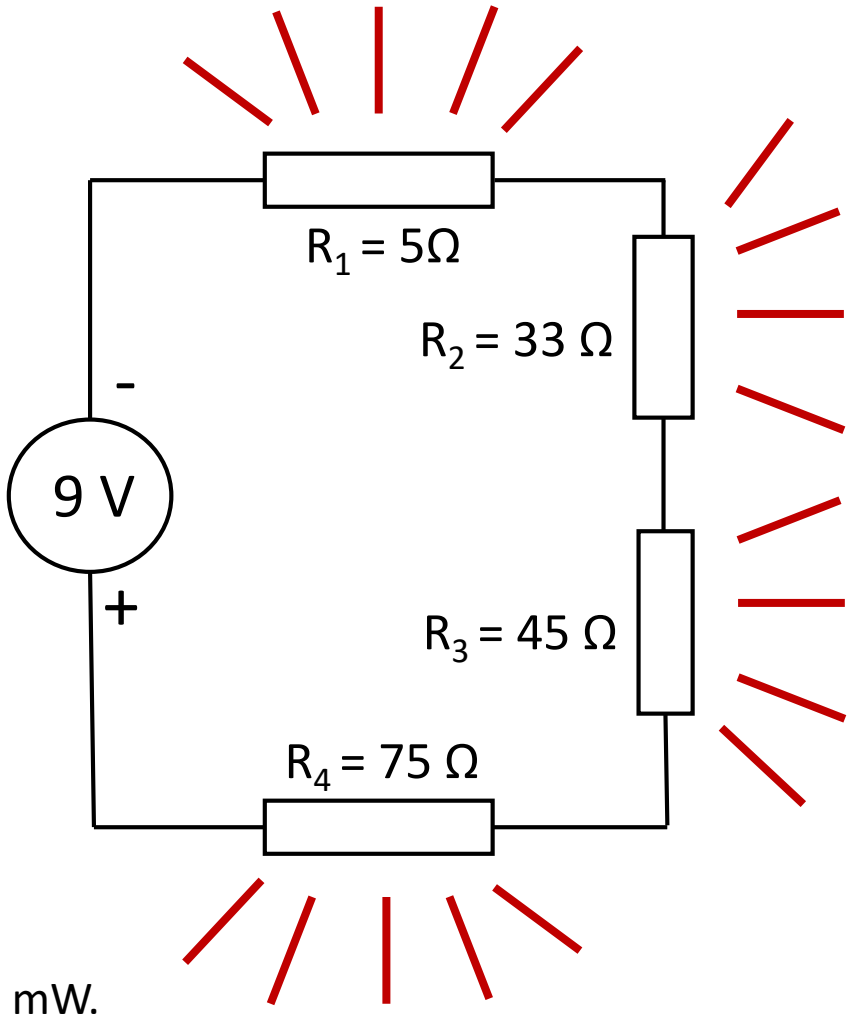


SOLUTION

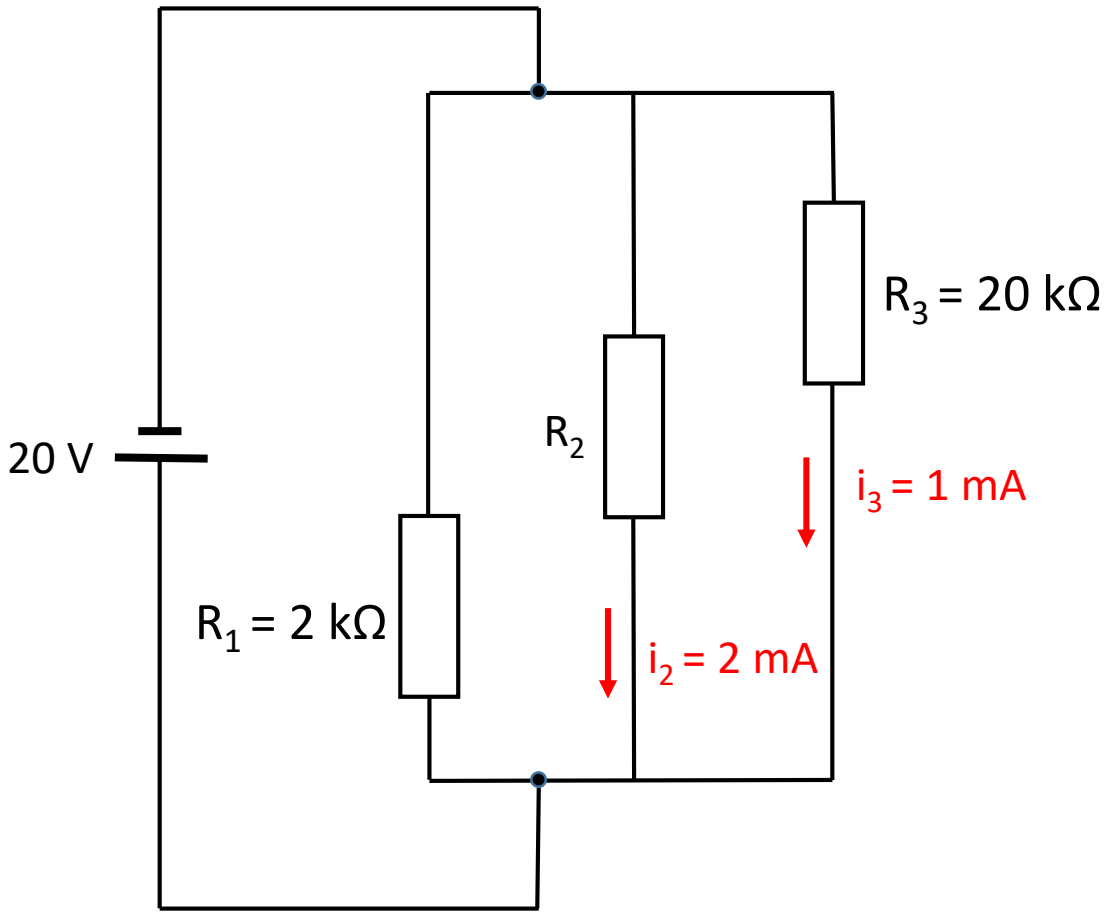
$$i = \frac{V}{R_1 + R_2 + R_3 + R_4} = 57\ mA$$ / Ohm's law, the current in the circuit

$$P = i \cdot V = i^2 R$$ /Electric power in the resistor

Answer: P_1 = 16 mW; P_2 = 107 mW; P_3 = 146 mW; P_4 = 243 mW.

2.

Find powers on all elements



2.

Find powers on all elements

SOLUTION

$$R_2 = \frac{V}{i_2} = 10\ k\Omega \quad \text{/ Ohm's law}$$

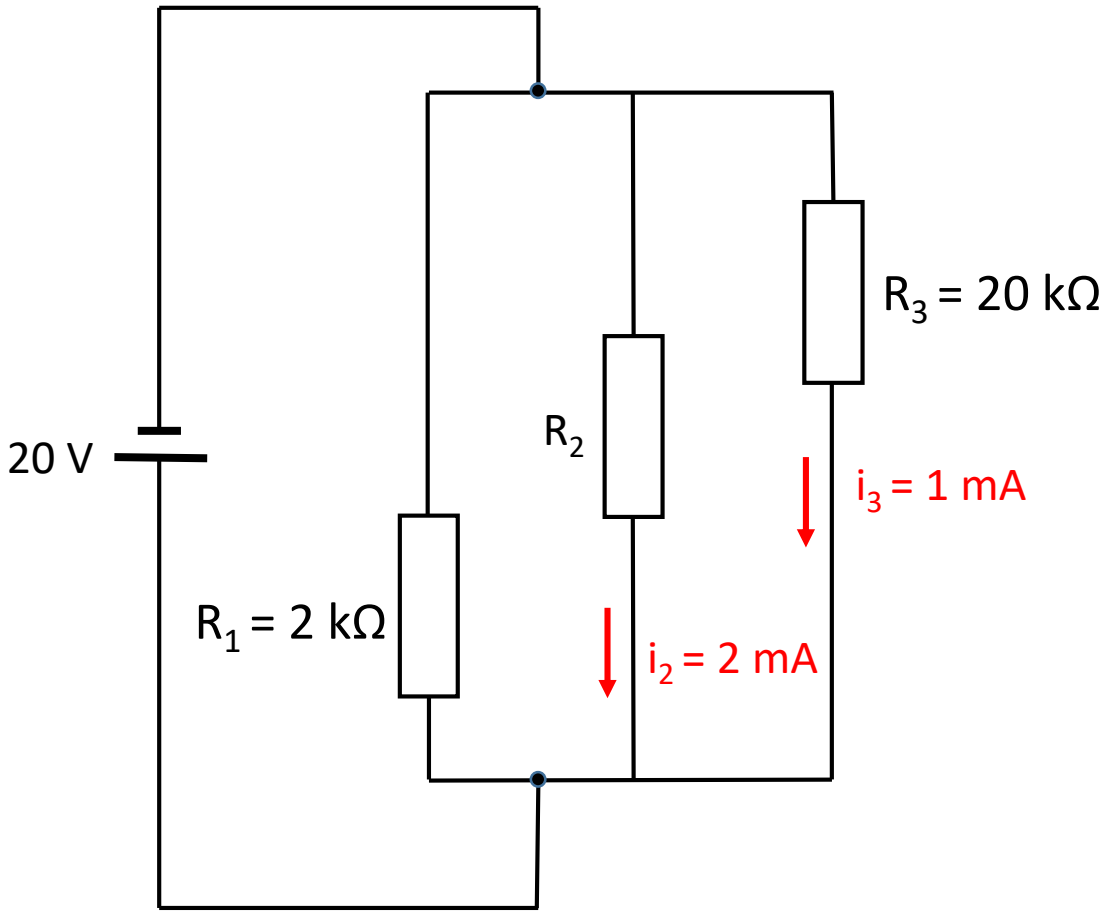
$$i_1 = \frac{V}{R_1} = 10\ mA$$

$$P_1 = \frac{V^2}{R_1} = 0.2\ \text{W}$$

$$P_2 = V \cdot i_2 = 0.04\ W$$

$$P_3 = V \cdot i_3 = 0.02\ W$$

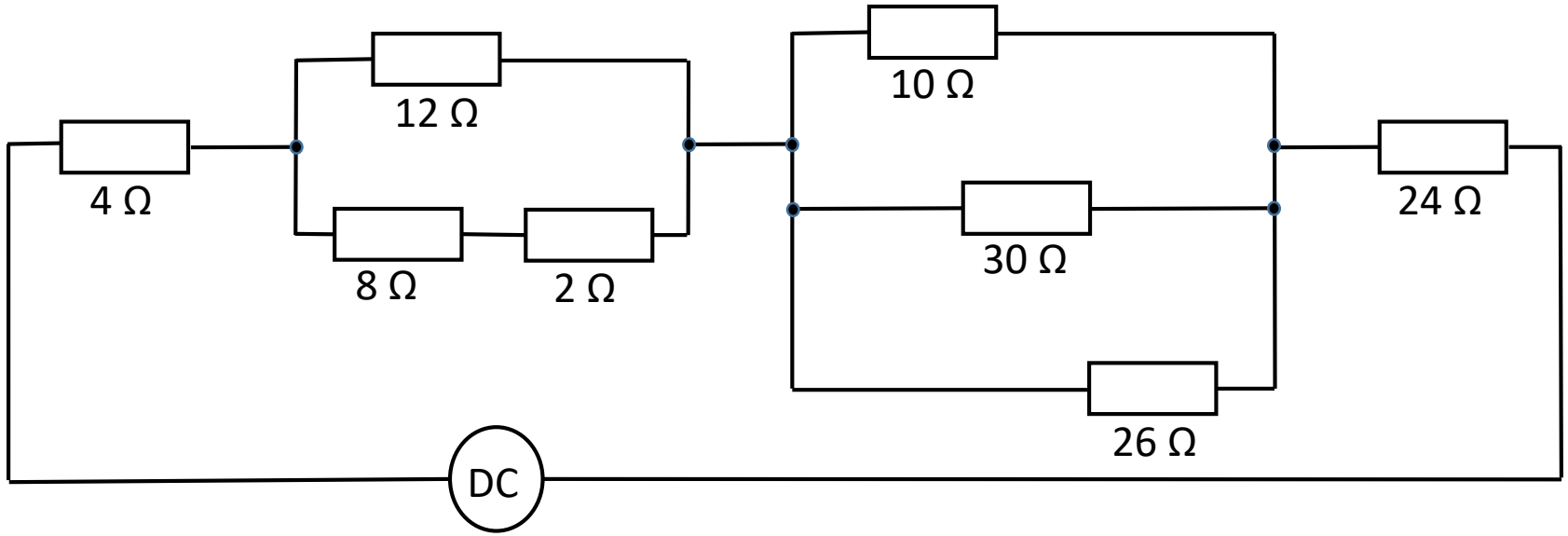
$$P = P_1 + P_2 + P_3 = 0.26\ W$$



Answer: P_1 = 0.2 W; P_2 = 0.04 W; P_3 = 0.01 W. Total power is 0.26 W

3.

Find the equivalent resistance



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Find the equivalent resistance

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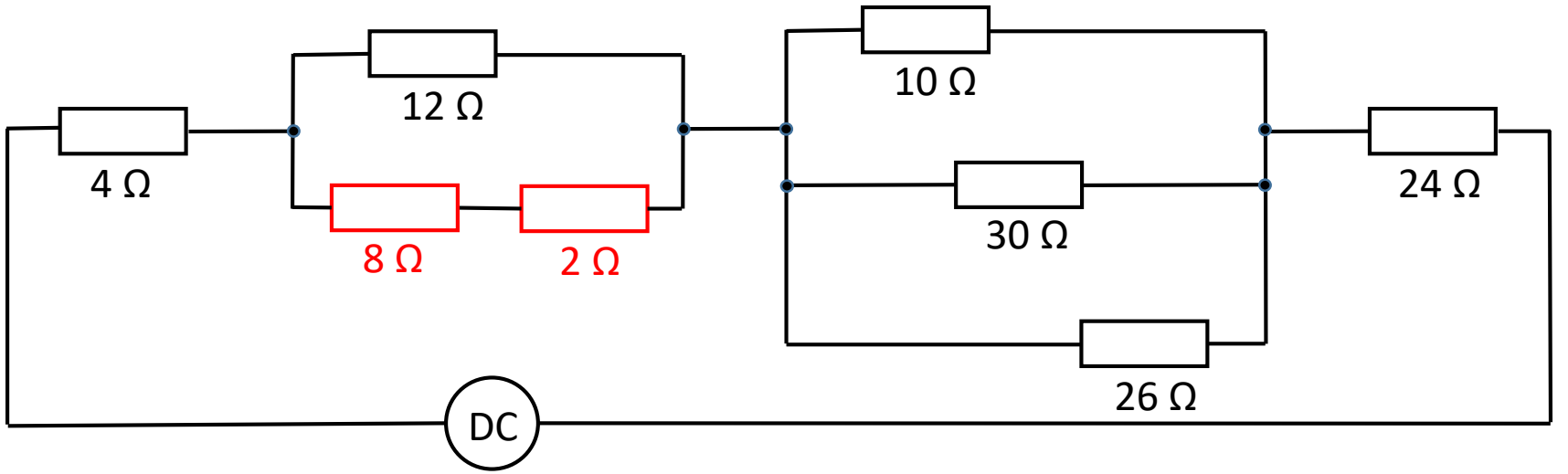

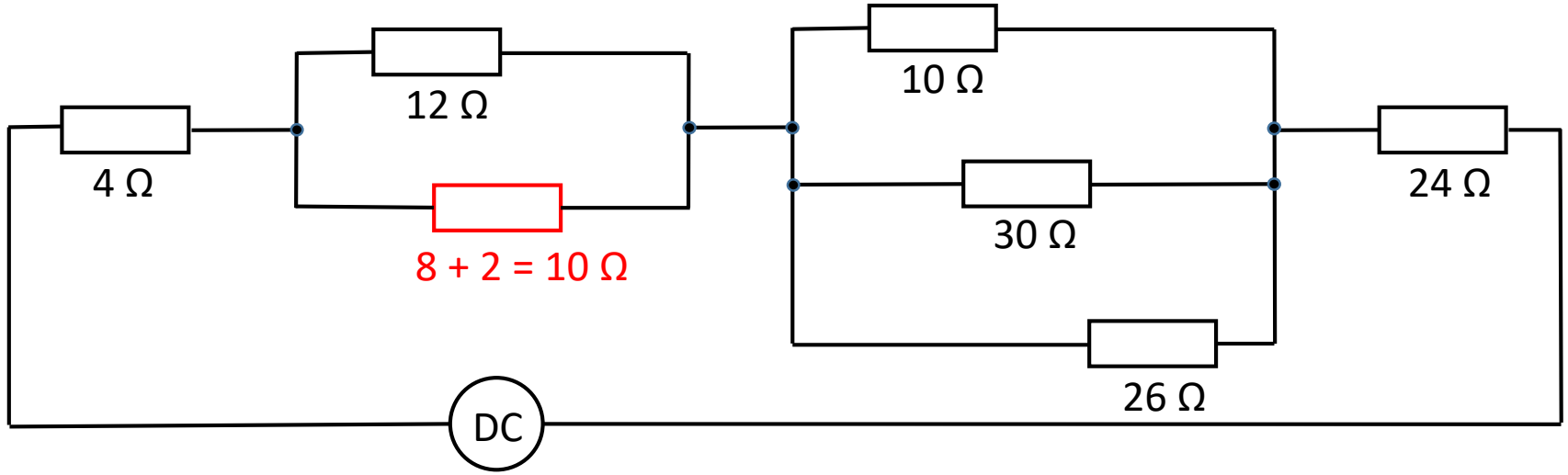

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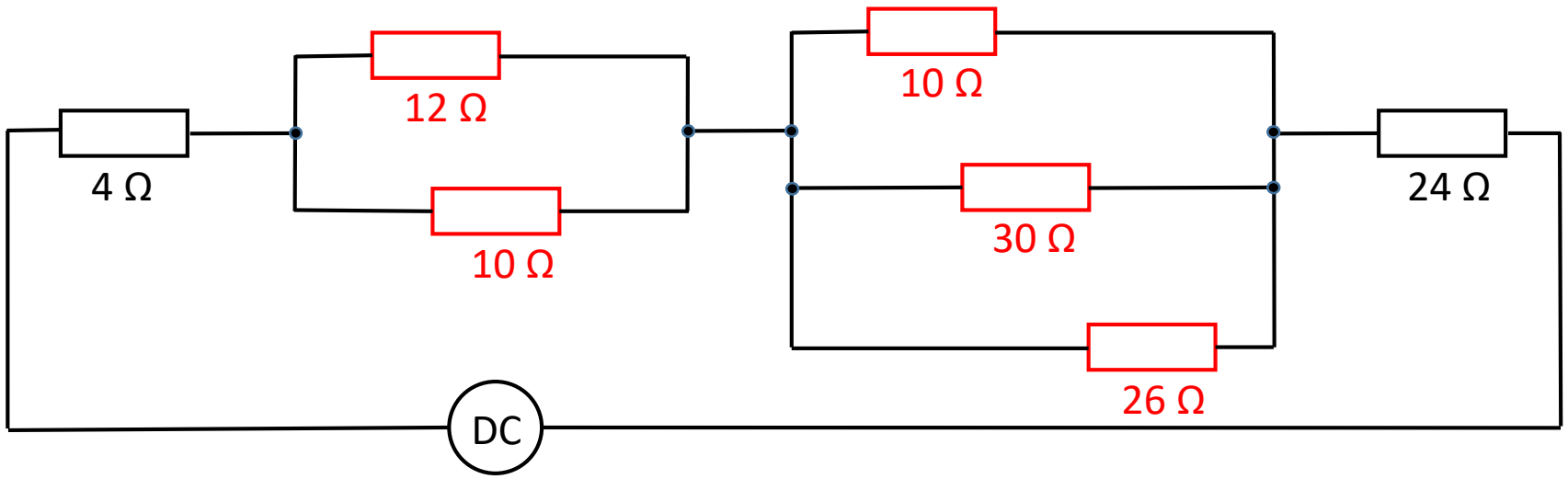
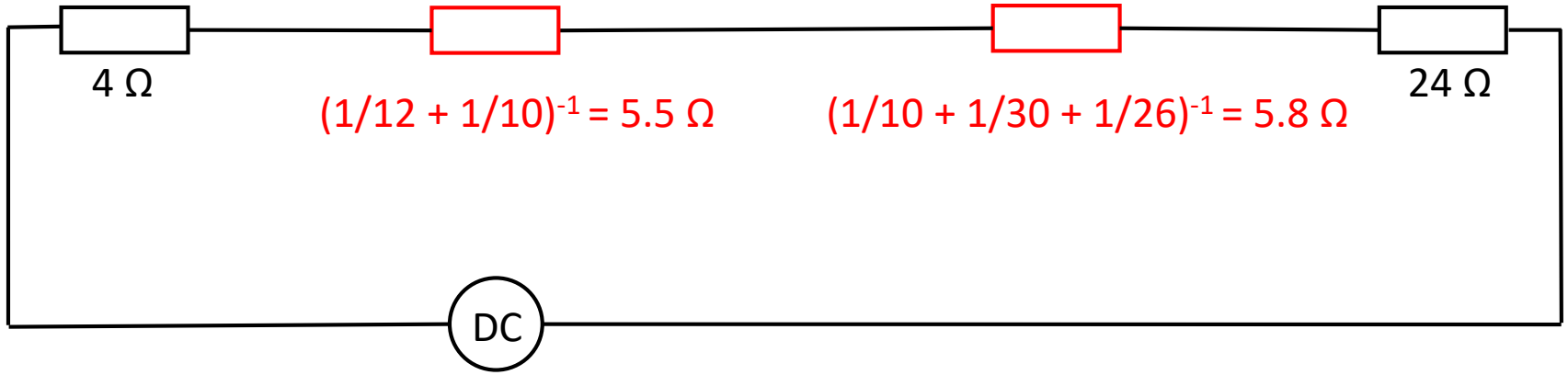


SOLUTION



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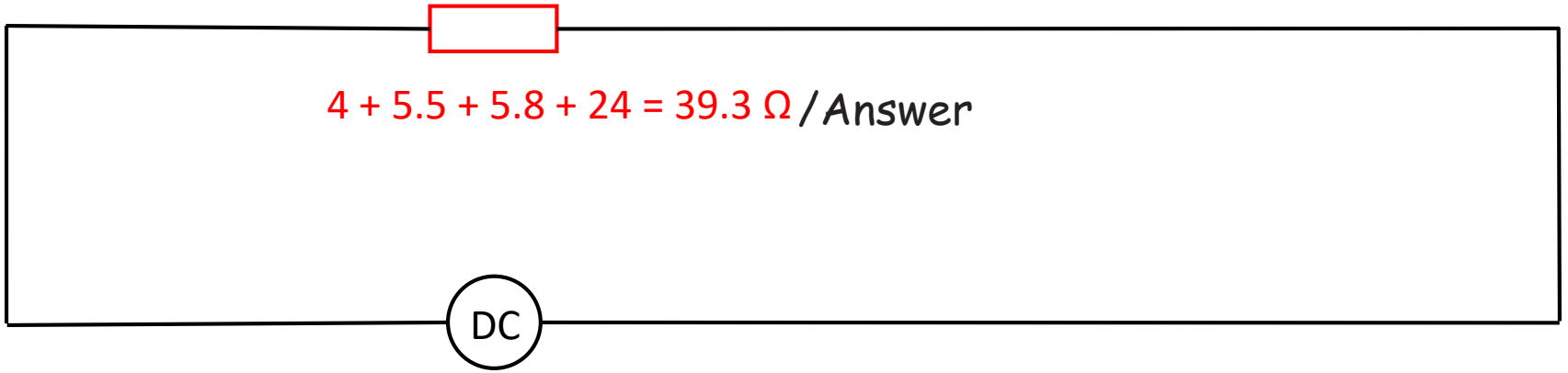
Find the equivalent resistance

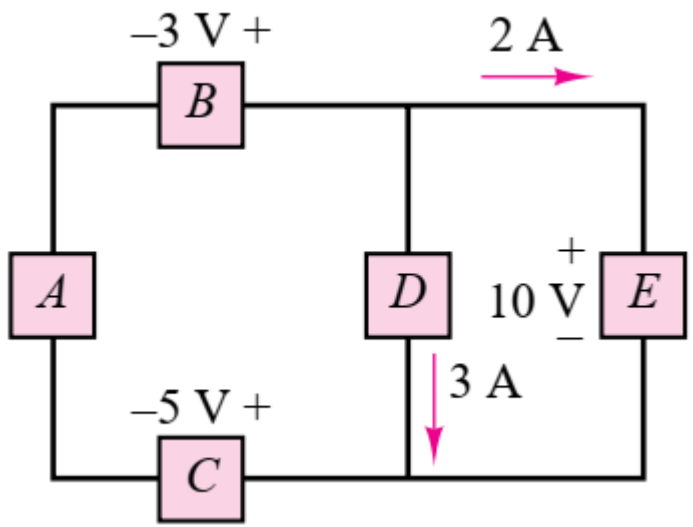
SOLUTION



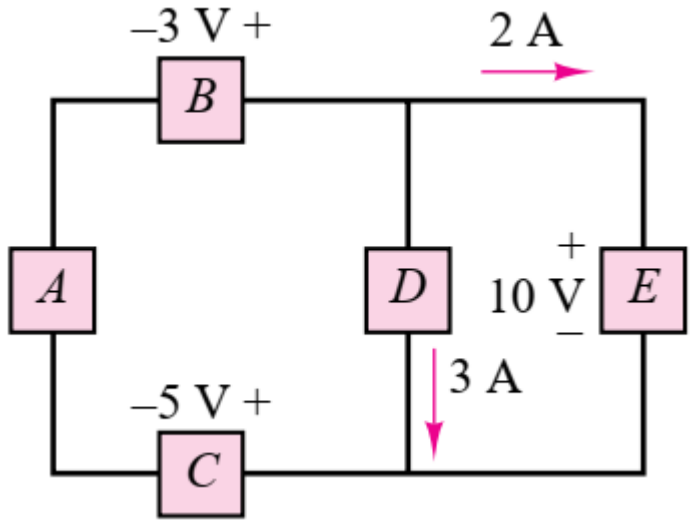
4 + 5.5 + 5.8 + 24 = 39.3 Ω /Answer

4.

Determine which components are absorbing power and which are delivering power



4.



By KCL, the current through element B is 5 A, to the right.

$$-v_a - 3 + 10 + 5 = 0 \quad / \text{By KVL}$$

$$v_a = 12 \text{ V}$$

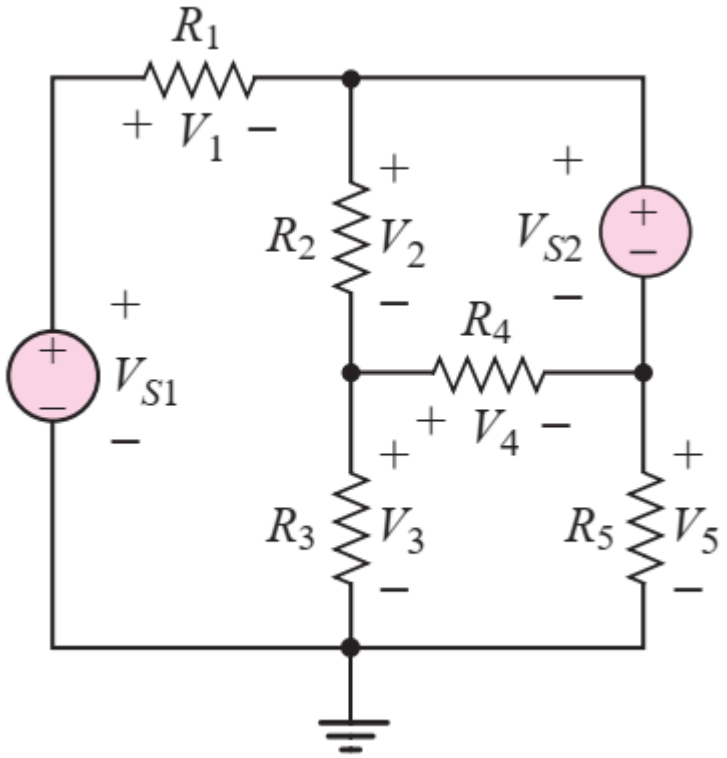
SOLUTION

Answer:

A supplies $(12 \text{ V})(5 \text{ A}) = 60 \text{ W}$
B supplies $(3 \text{ V})(5 \text{ A}) = 15 \text{ W}$
C absorbs $(5 \text{ V})(5 \text{ A}) = 25 \text{ W}$
D absorbs $(10 \text{ V})(3 \text{ A}) = 30 \text{ W}$
E absorbs $(10 \text{ V})(2 \text{ A}) = 20 \text{ W}$
Total power supplied $= 60 \text{ W} + 15 \text{ W} = 75 \text{ W}$
Total power absorbed $= 25 \text{ W} + 30 \text{ W} + 20 \text{ W} = 75 \text{ W}$
Total power supplied = Total power absorbed, so conservation of power is satisfied

5.

Use KVL to determine the unknown voltages V_1 and V_4 in the circuit.



Given:

$V_{S1} = 12\ \text{V}$

$V_{S2} = -4\ \text{V}$

$V_2 = 2\ \text{V}$

$V_3 = 6\ \text{V}$

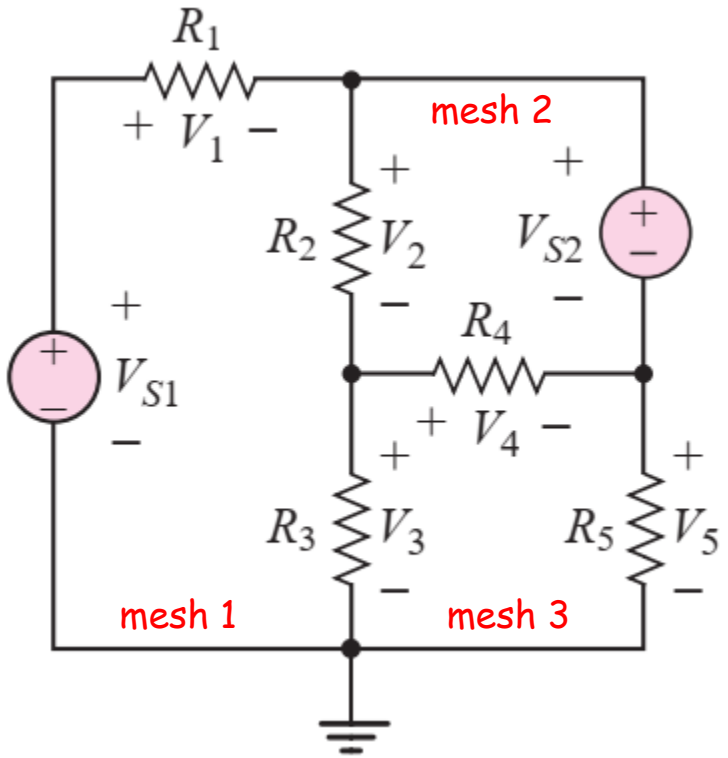
$V_5 = 12\ \text{V}$

5.

SOLUTION

Application of KVL clockwise around each of the three meshes:

$$V_{S1} - V_1 - V_2 - V_3 = 0 \quad \text{/mesh 1}$$
$$V_2 - V_{S2} + V_4 = 0 \quad \text{/mesh 2}$$
$$V_3 - V_4 - V_5 = 0 \quad \text{/mesh 3}$$



Given:

$V_{S1} = 12\ \text{V}$

$V_{S2} = -4\ \text{V}$

$V_2 = 2\ \text{V}$

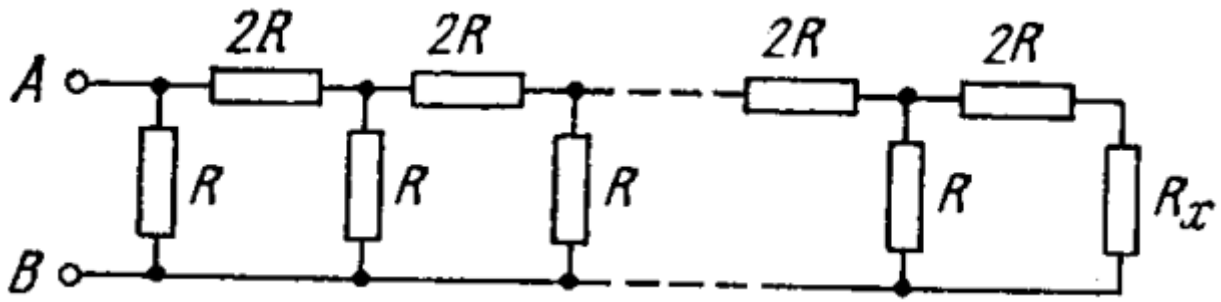
$V_3 = 6\ \text{V}$

$V_5 = 12\ \text{V}$

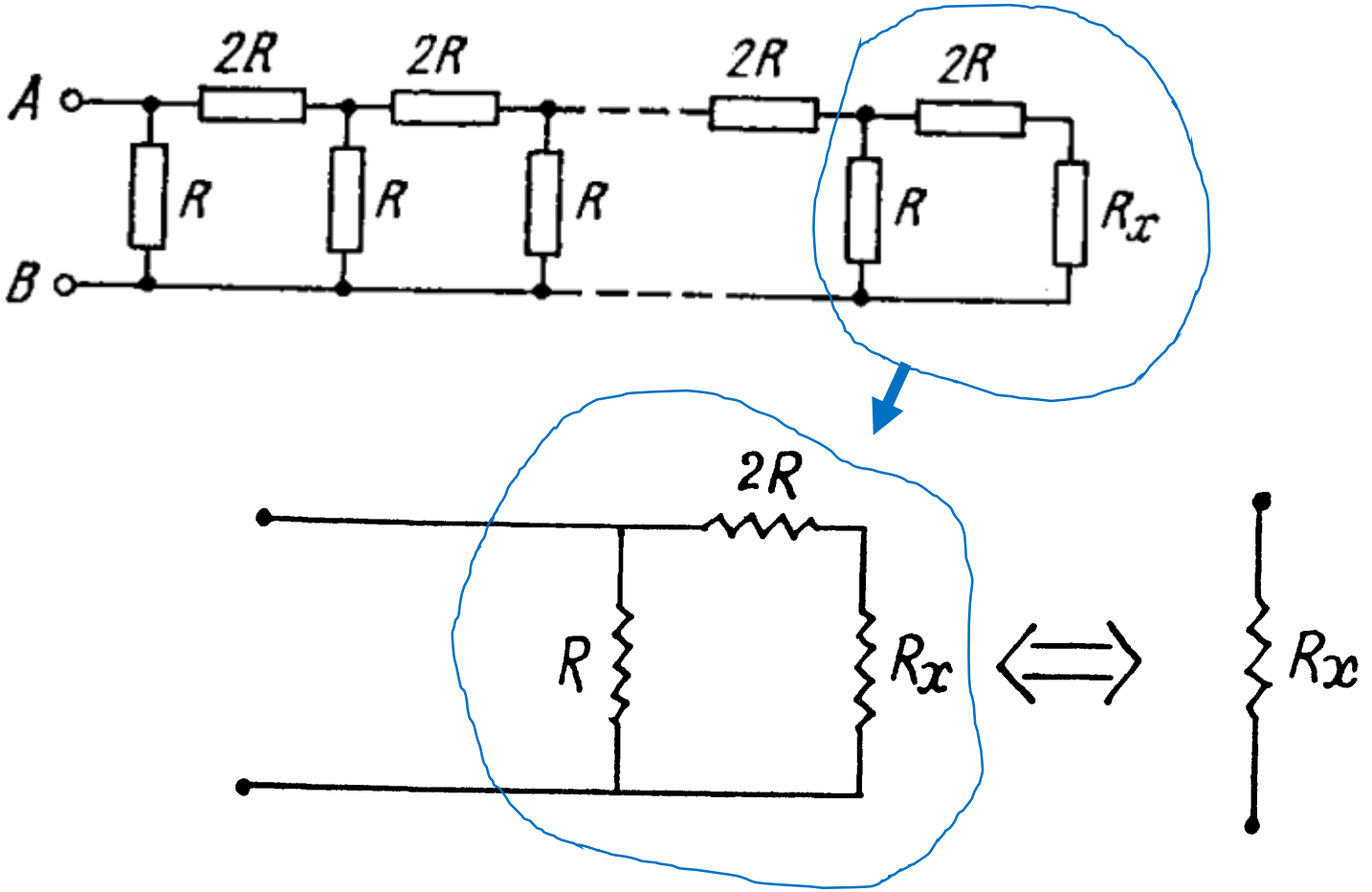
$$12 - V_1 - 2 - 6 = 0$$
$$V_1 = 4\ \text{V} \quad \text{/Answer}$$
$$2 - (-4) + V_4 = 0$$
$$V_4 = -6\ \text{V} \quad \text{/Answer}$$
$$6 - (-6) - V_5 = 0$$
$$V_5 = 12\ \text{V}$$

6.

At what size of the resistor R_x the equivalent resistance between points *A* and *B* is independent on the number of meshes?



6.



$$R_x = \frac{(R_x + 2R)\,R}{R_x + 2R + R}$$

$$R_x^2 + 2R\,R_x - 2\,R^2 = 0$$

On solving and rejecting the negative root of the quadratic equation, we have,

$$R_x = R\,(\sqrt{3} - 1)$$ /Answer