



Engineering Science

N2

[*see terms and conditions](#)

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Electricity

Module 9

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3. Calculate the total resistance of resistors shown in the following circuits:

a)

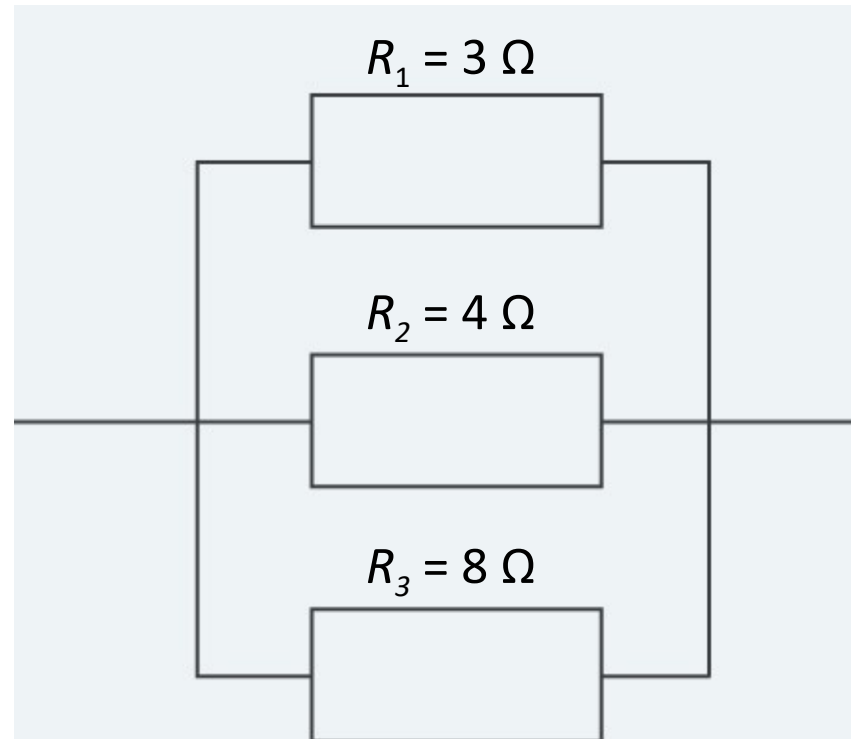


Figure: Three resistors in parallel

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3a) (Continued)

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$= \frac{1}{3} + \frac{1}{4} + \frac{1}{8}$$

$$= 0,333 + 0,25 + 0,125$$

$$= 0,708$$

$$\therefore R_T = \frac{1}{0,708}$$
$$= 1,412 \, \Omega$$

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3b)

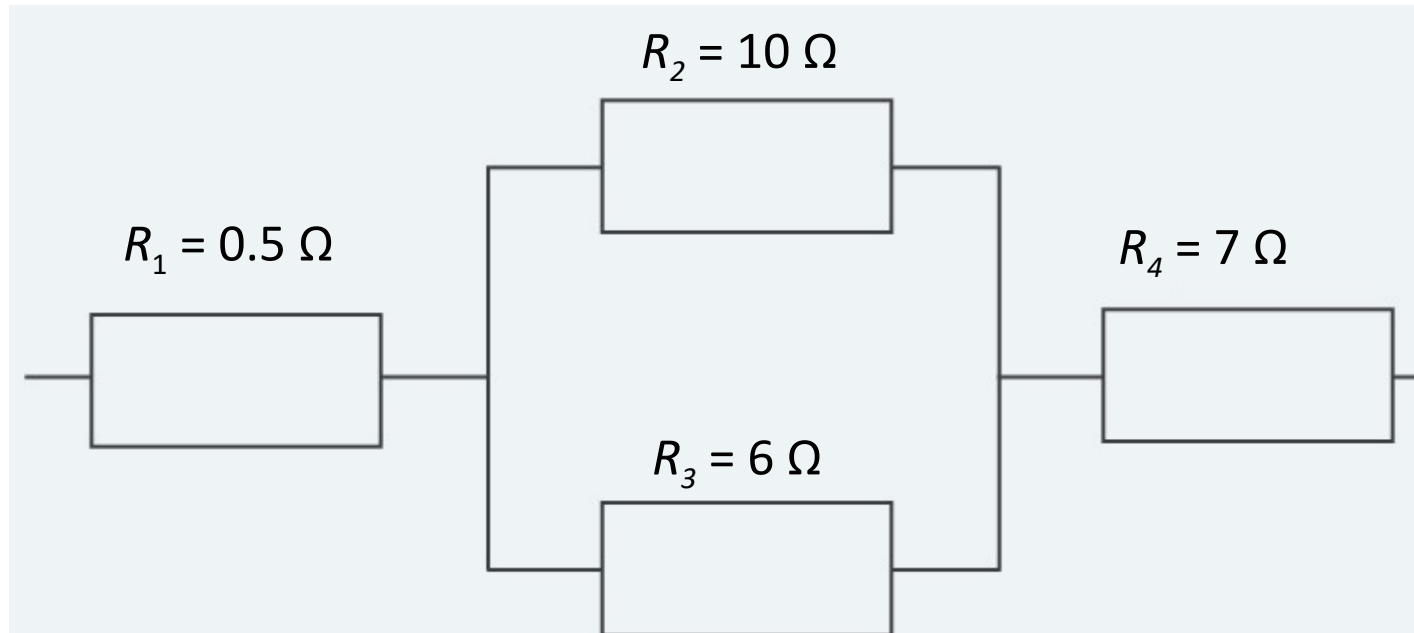


Figure: Resistors in series and in parallel

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3b) (Continued)

$$\begin{aligned}\frac{1}{R} &= \frac{1}{R_2} + \frac{1}{R_3} \\ &= \frac{1}{10} + \frac{1}{6} \\ &= 0,1 + 0,167\end{aligned}$$

$$= 0,267$$

$$\therefore R = \frac{1}{0,267}$$

$$= 3,745 \, \Omega$$

$$R_T = R_1 + R + R_4$$

$$= 0,5 + 3,745 + 7$$

$$= 11,245 \, \Omega$$

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5. Make a neat labelled sketch of the apparatus used to demonstrate self-induction.

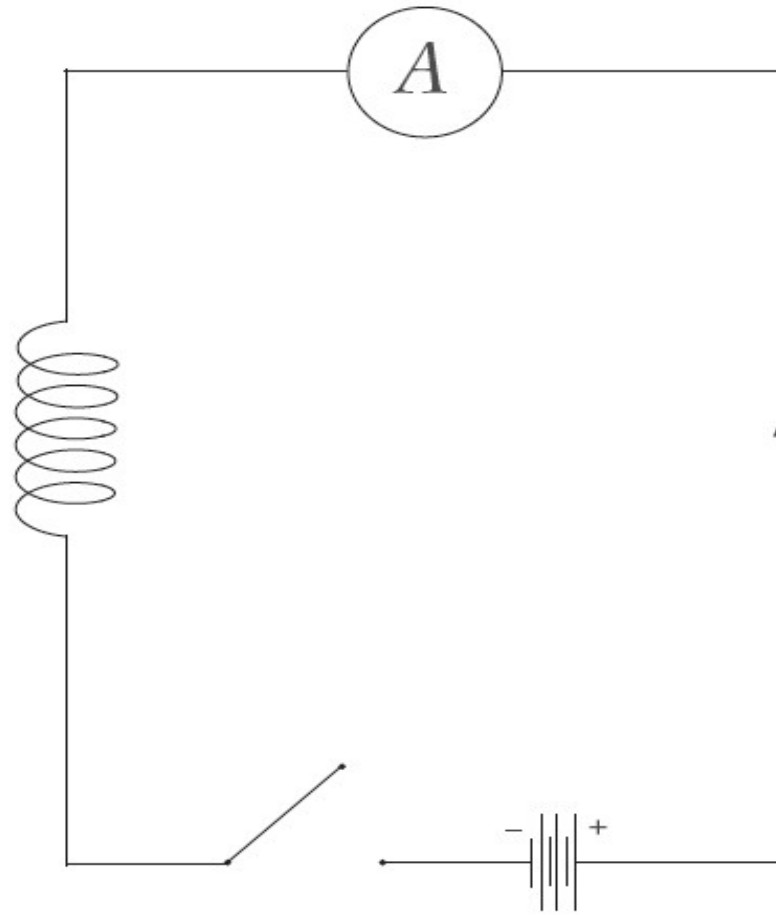


Figure: Apparatus to induce self-induction

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7. The figure below shows a circuit with three resistors connected in parallel.

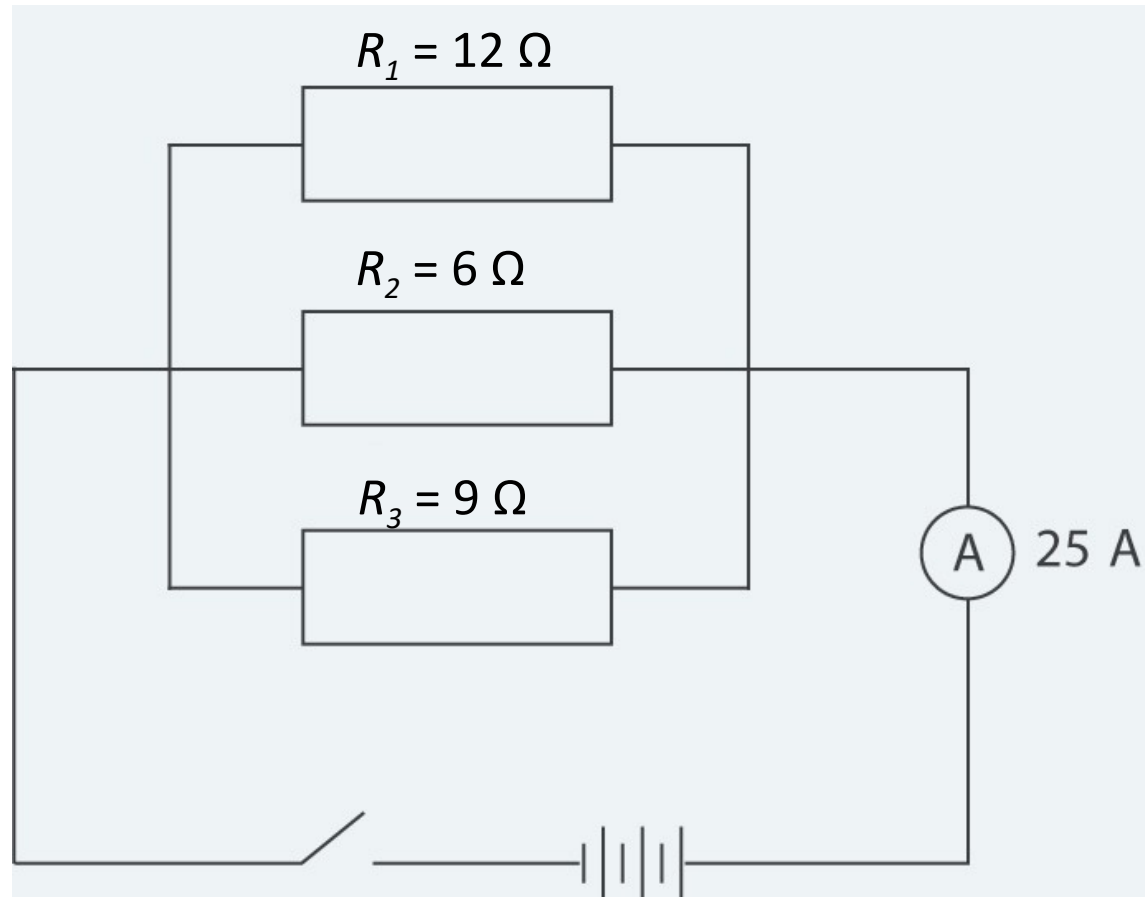


Figure: Circuit with three resistors connected in parallel

7. (Continued) Calculate the:

a) Total resistance

$$\begin{aligned}\frac{1}{R_T} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \\ &= \frac{1}{12} + \frac{1}{6} + \frac{1}{9} \\ &= 0,083 + 0,167 + 0,111 \\ &= 0,361 \\ \therefore R_T &= \frac{1}{0,361} \\ &= 2,770 \, \Omega\end{aligned}$$

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7. (Continued) Calculate the:

b) Current through the resistors

$$\begin{aligned} V &= IR \\ &= 25(2,770) \\ &= 69,25 \text{ V} \end{aligned}$$

Remember:

Resistors in parallel $\Rightarrow V = V_1 = V_2 = V_3$

(Continued)

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7b) (Continued)

$$\begin{aligned} I_1 &= \frac{V_1}{R_1} \\ &= \frac{69,25}{12} \\ &= 5,771 \text{ A} \end{aligned}$$

$$\begin{aligned} I_2 &= \frac{V_2}{R_2} \\ &= \frac{69,25}{6} \\ &= 11,542 \text{ A} \end{aligned}$$

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7b) (Continued)

$$\begin{aligned} I_3 &= \frac{V_1}{R_3} \\ &= \frac{69,25}{9} \\ &= 7,694 \text{ A} \end{aligned}$$

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8. A circuit consists of two parallel resistors of 4 ohms each, which in turn are connected in series with a resistor of 6 ohms. Calculate the total resistance of the circuit.

$$\begin{aligned}\frac{1}{R_{\text{parallel}}} &= \frac{1}{R_1} + \frac{1}{R_2} \\ &= \frac{1}{4} + \frac{1}{4} \\ &= 0,25 + 0,25 \\ &= 0,5\end{aligned}$$

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8. (Continued)

$$\begin{aligned}\therefore R_{\text{parallel}} &= \frac{1}{0,5} \\ &= 2 \, \Omega\end{aligned}$$

$$\begin{aligned}R_{\text{Total}} &= R_{\text{parallel}} + R_3 \\ &= 2 + 6 \\ &= 8 \, \Omega\end{aligned}$$

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9. Calculate the resistance of a copper conductor with a cross-sectional area of $2 \times 10^{-6} \text{ m}^2$. The length of the conductor is 105 m. The resistivity of the conductor is $0,02 \mu\Omega\cdot\text{m}$

$$\text{Given: } a = 2 \times 10^{-6} \text{ m}^2; l = 105 \text{ m}; \\ \rho = 0,02 \times 10^{-6} \Omega\cdot\text{m}$$

$$R = \frac{\rho l}{a} \\ = \frac{0,02 \times 10^{-6} \times 105}{2 \times 10^{-6}} \\ = 1,05 \Omega$$

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10. Calculate the diameter of a 5 km conductor with a resistance of 45Ω if its resistivity is $0,018 \times 10^{-6} \Omega.m$

Given: $l = 5000 \text{ m}$;

$R = 45 \Omega$;

$\rho = 0,018 \times 10^{-6} \Omega.m$

$$R = \frac{\rho l}{a}$$

$$\therefore a = \frac{\rho l}{R}$$

$$= \frac{0,018 \times 10^{-6} \times 5000}{45}$$

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10. (Continued)

$$= 2 \times 10^{-6} \text{ m}^2$$

$$= 2 \text{ mm}^2$$

$$\frac{\pi d^2}{4} = 2$$

$$= 2,546$$

$$\therefore d = \sqrt{2,546}$$

$$= 1,596 \text{ mm}$$

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11. Calculate the resistivity of a conductor with a length of 4 km, resistance of 4 Ω and diameter of 3 mm.

Given: $l = 4000 \text{ m}$;

$R = 4 \Omega$;

$d = 0,003 \text{ m}$

$$a = \frac{\pi d^2}{4}$$

$$= \frac{\pi(0,003)^2}{4}$$

$$= 7,069 \times 10^{-6} \text{ m}^2$$

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11. (Continued)

$$\frac{\rho l}{a} = R$$

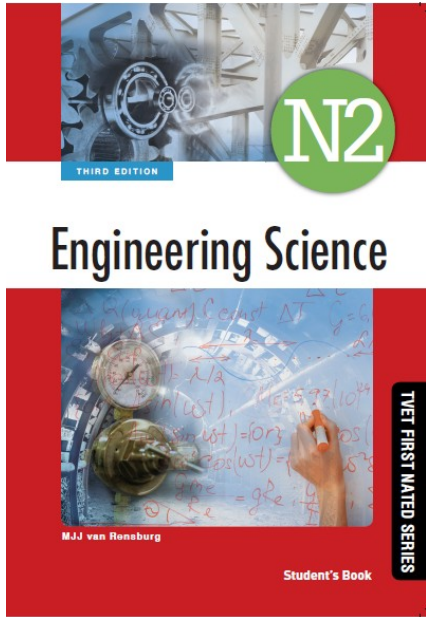
$$\therefore \rho = \frac{Ra}{l}$$

$$= \frac{4 \times 7,069 \times 10^{-6}}{4\,000}$$

$$= 7 \times 10^{-9} \, \Omega \cdot \text{m}$$

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Summative assessment

Test your knowledge of this module by completing the summative activity on page 225 of your Student's Book.

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