

ELECTROTECHNICS

MAGNETIC FIELD

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MAGNETIC FIELD

Example 1

Assignment

Calculate magnetic field intensity in a point A between two parallel wires which axial distance is 1,2 m. The current of the first wire is $I_1 = 20$ A, of the second one $I_2 = 15$ A. The magnetic field intensity calculate for the case if:

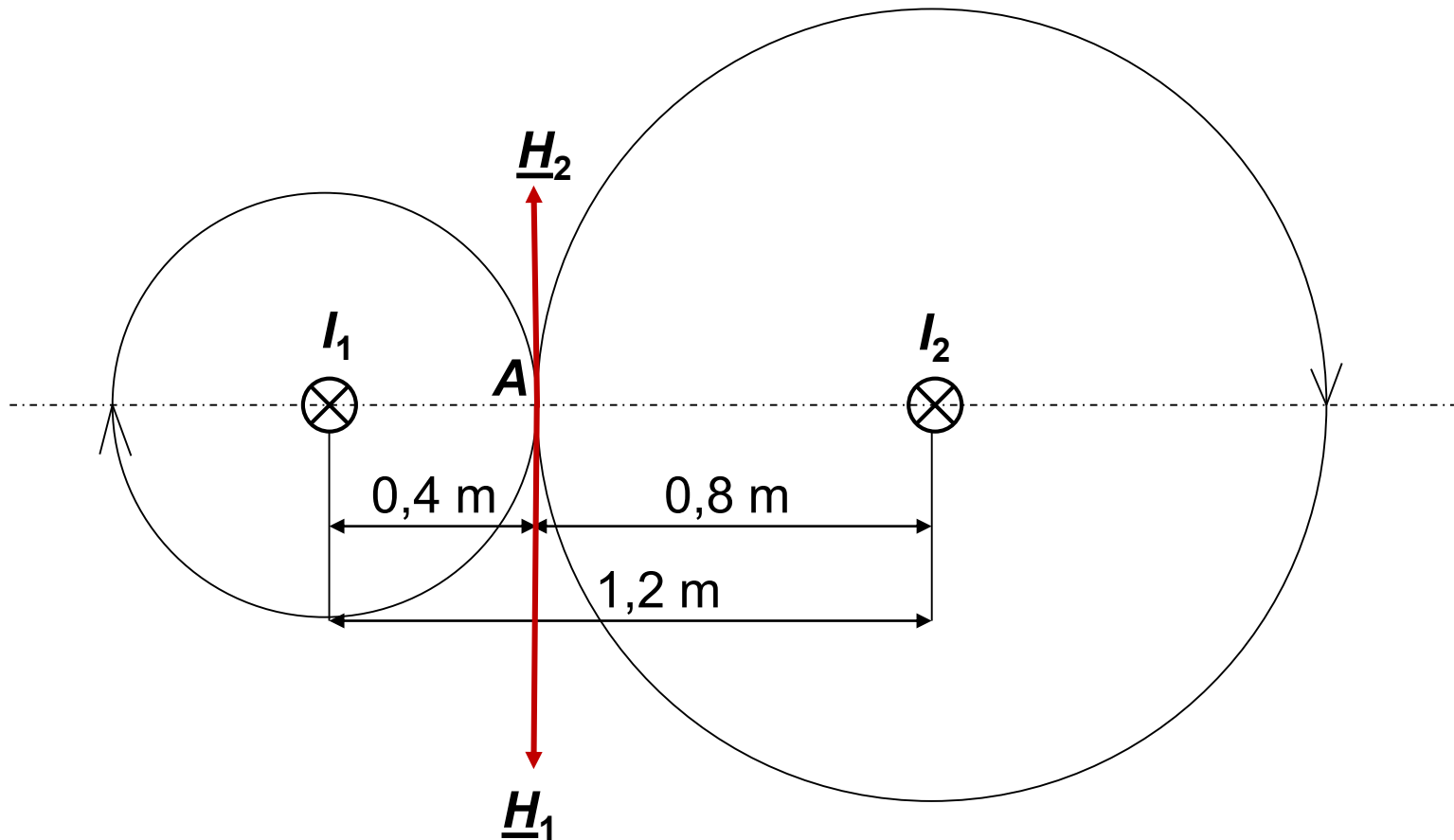
- a) The currents in both wires have the same direction**
- b) The currents in both wires have the opposite direction**

MAGNETIC FIELD

Example 1

Solution

a) The currents in both wires have the same direction



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Solution

a) The currents in both wires have the same direction

- Direction and orientation of the field is given by Ampere's Law
- For the magnetic field intensity created by the current I_1 in the long straight wire is valid the formula in the point A :

- $$H_1 = \frac{I_1}{2\pi r_1} = \frac{20}{2\pi \cdot 0,4} = 8 \text{ Am}^{-1}$$

- For the magnetic field intensity created by the current I_2 in the long straight wire is valid the formula in the point A :

- $$H_2 = \frac{I_2}{2\pi r_2} = \frac{15}{2\pi \cdot 0,8} = 3 \text{ Am}^{-1}$$

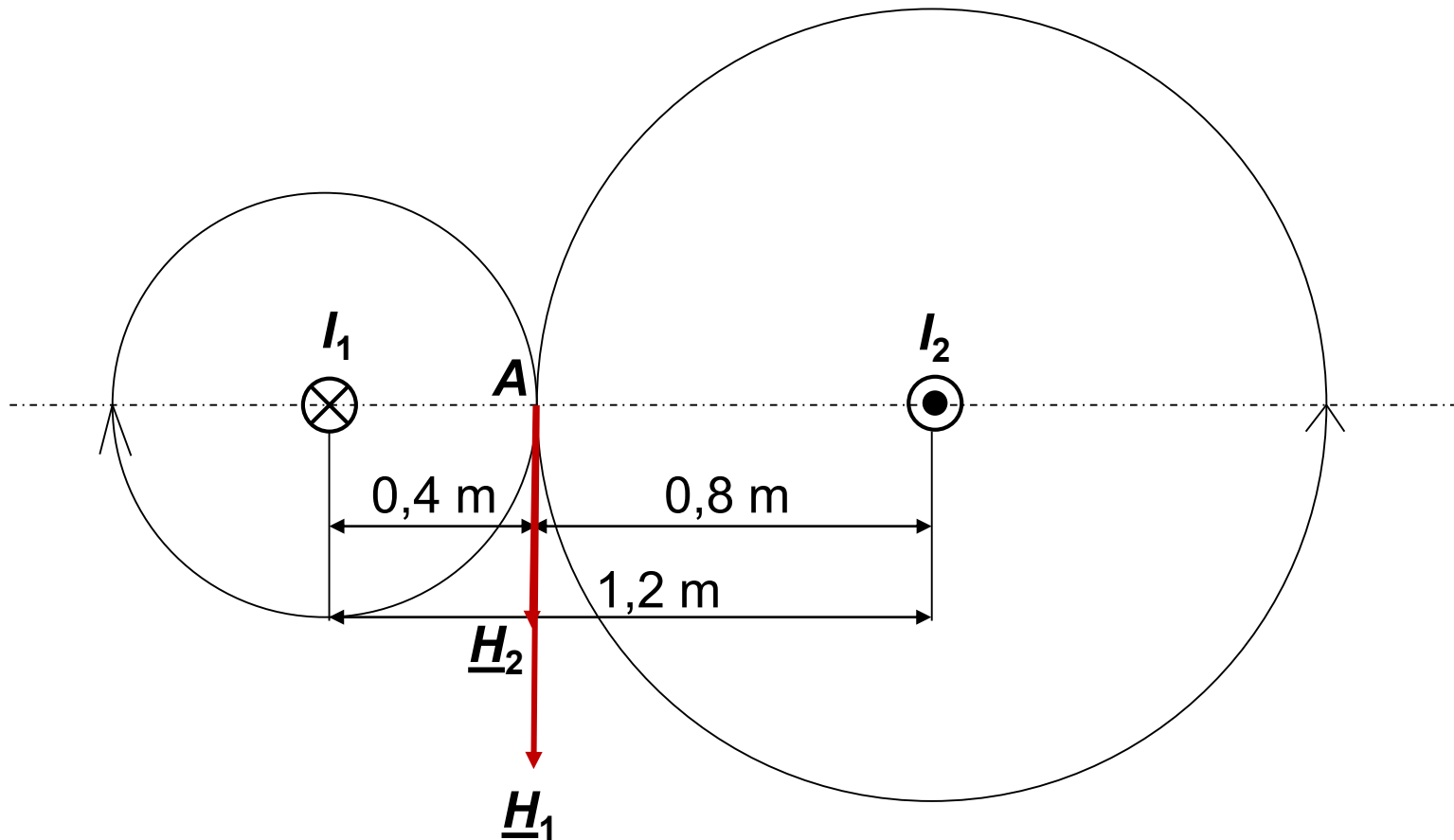
- The field intensities have the same direction, but the opposite orientation:
- $$H = H_1 - H_2 = 8 - 3 = 5 \text{ Am}^{-1}$$

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Example 1

Solution

b) The currents in both wires have the opposite direction



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Example 1

Solution

b) The currents in both wires have the opposite direction

- The field intensities have the same direction and orientation:
- $H = H_1 + H_2 = 8 + 3 = 11 \text{ Am}^{-1}$

MAGNETIC FIELD

Example 2

Assignment

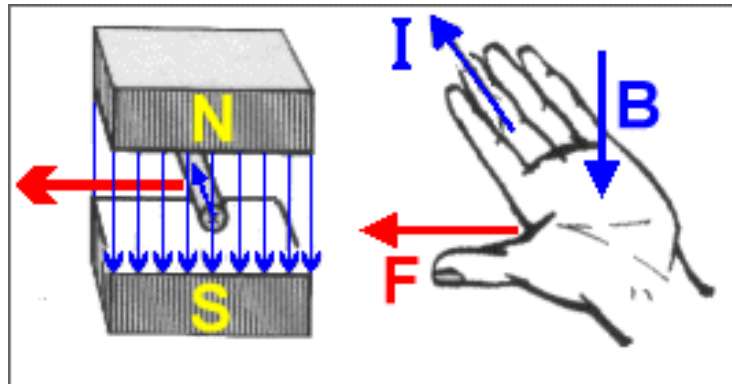
Calculate the force on a wire in the magnetic field with magnetic flux density $B=0,8$ T. A current of $I=125$ A is flowing across the wire, which active length $l=60$ mm.

MAGNETIC FIELD

Example 2

Solution

Fleming's Law (Left-hand rule)

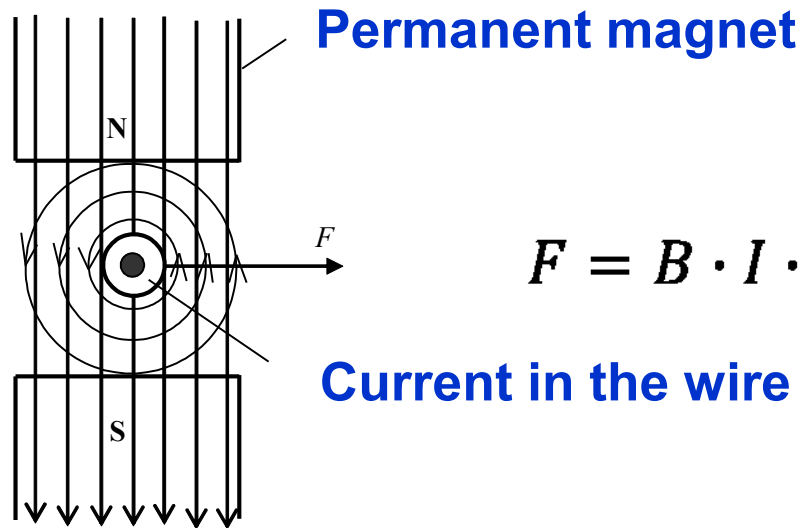


$$F = B \cdot I \cdot l$$

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Example 2

Solution



$$F = B \cdot I \cdot l = 10,8 \cdot 125 \cdot 0,06 = 6 \text{ N}$$

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Example 3

Assignment

Calculate the level of the force between two parallel wires of the length of 1,5 m with axial distance 50 mm. The current of the both wires is equal to 100 A. How large will be the force between them if the wires are short-circuited. The short-circuit current is 25 times higher than the operating one.

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Example 3

Solution

- **Common operation:**

$$F = \frac{2 \cdot I_1 \cdot I_2 \cdot l}{a} \cdot 10^{-7} = \frac{2 \cdot 100 \cdot 100 \cdot 1,5}{0,05} \cdot 10^{-7} = 0,06 \text{ N}$$

- **Short-circuit:**

$$F = \frac{2 \cdot I_1 \cdot I_2 \cdot l}{a} \cdot 10^{-7} = \frac{2 \cdot 2500 \cdot 2500 \cdot 1,5}{0,05} \cdot 10^{-7} = 37,5 \text{ N}$$