

task_5efsj705cf97jxga_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

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lorentz force, magnetic field, exam ee2 SS2024

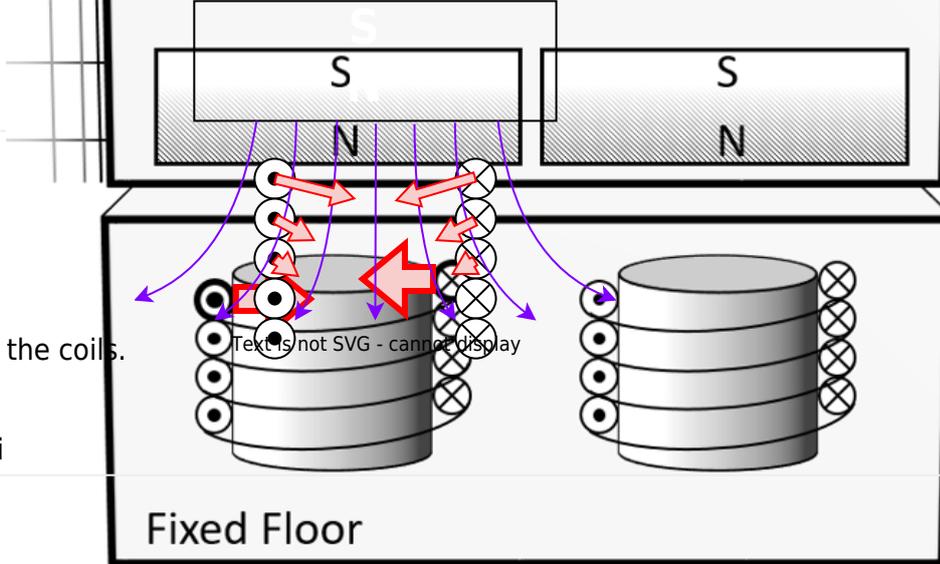
Exercise E7 Lorentz Force
(written test, approx. 8 % of a 120-minute written test, SS2024)

2. Describe the resulting force on the left and right coils of the mobile shuttle in a homogeneous magnetic field of the fixed floor. Do this, by using the vector product in the image for all sides of the shuttle (see image).

Result

Path

Since the mobile shuttle has to be perpendicular to B -field and conductor, the force has to point to the left or the right.
 The force on a homogeneous B -field ("constant magnetic field of the shuttle"), the Lorentz forces cancel each other out.
 The Lorentz force can only have a lifting effect in an inhomogeneous field.
 In this case, the sum of the forces results in a repulsing force, see image.
 Beside boundary effects, The field gets also inhomogeneous, by the additional field of



- current $I = 1.6 \text{ A}$
- magnetic field of the shuttle is homogeneous with $B = 0.5 \text{ T}$

1. Calculate the magnitude of the resulting force on one coil!

Path

The Lorentz force on a conductor the length l and the current I in a B -field is

$$|\vec{F}_L| = I \cdot l \cdot B \cdot \cos(\angle \vec{B}, \vec{l})$$

$$= I \cdot (N \cdot 2\pi r) \cdot B \cdot \cos(\angle \vec{B}, \vec{l})$$

$$= 1.6 \text{ A} \cdot (500 \cdot 2\pi \cdot 40 \cdot 10^{-3} \text{ m}) \cdot 0.5 \text{ T} \cdot \cos 90^\circ$$

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